

M E E T I N G
SOSORT
20th

**CONFERENCE
PROGRAM AND
ABSTRACT
BOOK**

DUBROVNIK
CROATIA

APRIL 23-26, 2025

WELCOME LETTER BY SOSORT PRESIDENT

Two decades of learning, innovation, and shared knowledge — this is SOSORT!

Can you imagine how much scoliosis rehabilitation has evolved over the years? It all began with advocating for the role of conservative care, which was once disregarded by many. Since then, SOSORT has witnessed and contributed to groundbreaking advancements: the recognition of the **sagittal plane** as the most functional aspect of the spine. The **BRAIST study**—a game-changing RCT that reshaped our understanding. The **standardization of objective measures of compliance**, was first reported at SOSORT. Innovations in **diagnostic tools** like surface topography and raster stereography, ultrasound, and low-dose radiation imaging.

And the future holds even more! With **3D printing and AI**, we are on the brink of new possibilities. SOSORT continues to play a crucial role in guiding these technologies to benefit both clinicians and patients as they navigate the challenges of scoliosis treatment.

A heartfelt thanks to those who envisioned and founded SOSORT as a hub for advancing scoliosis rehabilitation. For me, and many of you, this journey has been incredible—and for those joining SOSORT for the first time, it will be even more exciting!

I am honored to welcome you to the **2025 Annual Meeting**. The entire SOSORT team has worked tirelessly to bring this event to life. I am deeply grateful to all the members who volunteered their time to support the organization of our **20th annual meeting** and contribute to SOSORT's committees.

SOSORT is all of us. This meeting has been designed for the growth of our society and to fulfill our shared vision.

Let us always remember: at the core of everything we do is the well-being of scoliosis patients. Our mission is to provide better treatment to patients around the world.

Welcome, everyone! Enjoy the experience, embrace the opportunity to learn, and be ready to share your insights—for the benefit of scoliosis patients everywhere!

Sabrina Donzelli, MD Msc, SOSORT President

A handwritten signature in black ink, appearing to read 'S. Donzelli', with a long, sweeping horizontal line extending to the right.

SOSORT 2025 SCIENTIFIC COMMITTEE

The Scientific Committee is dedicated to ensuring the quality of the research communicated in SOSORT. The Scientific Committee also periodically conducts consensus exercises and guidelines update initiatives.

EMAIL: scientific.committee@sosort.org

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Tomasz Kotwicki

SCIENTIFIC PROGRAM

Wednesday, 23rd April 2025

Breakfast & Registration

07:00 - 08:30 Wednesday, 23rd April, 2025

Welcome and SOSORT 20 years and Pre Conference Aim and Evolution

08:30 - 08:38 Wednesday, 23rd April, 2025

Presentation type Pre-course Lectures

Sabrina Donzelli

Pre-course Session 1: Adult scoliosis

08:38 - 10:30 Wednesday, 23rd April, 2025

Presentation type Pre-course Lectures

Amy Sbihli, Aynur Metin Terzibasoglu

Manuel Rigo, MD. *Adult Scoliosis and Assessment*

Jean Claude de Mauroy, MD. *Adult Scoliosis and Bracing*

Alessandra Negrini, PT. *Adult Scoliosis and PSSE*

Coffee Break

10:30 - 11:00 Wednesday, 23rd April, 2025

Presentation type Coffee Break

Pre-Course Session 2: Time in brace

11:00 - 13:00 Wednesday, 23rd April, 2025

Presentation type Pre-course Lectures

Tony Betts, Corinne Reynolds

Jan Matussek, MD. *Time in brace; Best Candidate*

Luke Stikeleather, CPO. *Time in brace; Which Brace*

Amy Sbihli, MPT, DPT. *Time in brace; Family and Patient Education*

Lunch

13:00 - 14:00 Wednesday, 23rd April, 2025

Presentation type Lunch

Pre-Course Session 3 : Breakout sessions

14:00 - 17:15 Wednesday, 23rd April, 2025

Presentation type Pre-course Lectures

Room 1 Bracing- Principles of Correction: (Moderating; Martin Matthews, CPO (EC), Sebastian Hoebink, CPI, Silke Auler, M.Sc.)

Room 2 - PSSE Principles of Correction (Moderating; Tony Betts, PT(EC), Amy Sbihli, MPT, DPT (EC), Alessandra Negrini, PT)

Room 3 - Scientific Research Principles (Moderators; Lori Dolan, PhD, Eric Parent, PT, PhD)

Closing Remarks

17:15 - 17:30 Wednesday, 23rd April, 2025

Presentation type Pre-course Lectures

Welcome Reception

18:30 - 20:00 Wednesday, 23rd April, 2025

Pool terrace at Hotel Palace

Thursday, 24th April 2025

Breakfast & Registration

07:00 - 08:00 Thursday, 24th April, 2025

Welcome to SOSORT 2025

08:00 - 08:03 Thursday, 24th April, 2025

Sunciça Bulat Wursching

Session 1: Bracing

08:03 - 10:00 Thursday, 24th April, 2025

Presentation type Oral presentations

Fabio Zaina, Angelo Gabriele Aulisa

Coffee Break and Exhibitor Viewing/ Poster Session

10:00 - 10:30 Thursday, 24th April, 2025

Presentation type Coffee Break & Posters / Exhibitors viewing

Oxford Abstract System and Information

10:30 - 10:36 Thursday, 24th April, 2025

Elias Diarbakerli

Scientific Committee Chair shares information and tips about the Oxford Abstract System

Session 2: Etiology and Pathogenesis

10:36 - 11:30 Thursday, 24th April, 2025

Presentation type Oral presentations

Elias Diarbakerli, Tomasz Kotwicki

SCOLIOSIS RESEARCH SOCIETY Presidential Lecture: Dr Laurel Blakemore M.D., Ph.D.

11:30 - 12:00 Thursday, 24th April, 2025

Presentation type Guest lecture

Sabrina Donzelli

Group Photo

12:00 - 12:05 Thursday, 24th April, 2025

SPONSORED EVENT "Lunch & Learn" 3D printing in scoliosis treatment - the future is here.

12:05 - 13:00 Thursday, 24th April, 2025

Presentation type Lunch & Posters / Exhibitors viewing

Sponsored by 3DScolio. Moderated by Andreas Würsching.

Session 3: Exercise

13:00 - 15:00 Thursday, 24th April, 2025

Presentation type Oral presentations

Larry Cohen, Garikoitz Aristegui

Coffee Break and Exhibitor Viewing/ Poster Session

15:00 - 15:30 Thursday, 24th April, 2025

Presentation type Coffee Break & Posters / Exhibitors viewing

Session 4: Imaging and Assessment

15:30 - 17:00 Thursday, 24th April, 2025

Presentation type Oral presentations

Patrick Knott, Dariusz Czaprowski

Breakfast & Registration

07:00 - 08:00 Friday, 25th April, 2025

Introduction Award Session

08:00 - 08:03 Friday, 25th April, 2025

Elias Diarbakerli

Session 5: SOSORT Award Nominees

08:03 - 10:00 Friday, 25th April, 2025

Presentation type Oral presentations

Sanja Schreiber, Isis Navarro

Coffee Break and Exhibitor Viewing / Poster Session

10:00 - 10:30 Friday, 25th April, 2025

Presentation type Coffee Break & Posters / Exhibitors viewing

Guest Lecture: Dr Kariman Abelin-Genevois M.D., Ph.D.

10:30 - 10:55 Friday, 25th April, 2025

Presentation type Guest lecture

Olavo Biraghi Letaif

Invitation to SOSORT 2026: Sabrina Donzelli M.D.

10:55 - 11:05 Friday, 25th April, 2025

Sabrina Donzelli

SOSORT PRESIDENTIAL LECTURE: Sabrina Donzelli, M.D.

11:05 - 11:35 Friday, 25th April, 2025

Presentation type Guest lecture

Sunciça Bulat Wursching

Celebrating 20 years of SOSORT

11:35 - 12:00 Friday, 25th April, 2025

Presentation type Guest lecture

Prachi Bakarania

How it all began - Manuel Rigo

SOSORT's pillars of progress - Stefano Negrini

The evolution of research - Eric Parent

Where is SOSORT today - Sabrina Donzelli

Where should SOSORT go from here? - Suncica Bulat Wursching

SPONSORED EVENT "Lunch & Learn" PSSE-Schroth method: Recent Advancements in Scoliosis Treatment.

12:00 - 13:00 Friday, 25th April, 2025

Presentation type Lunch & Posters / Exhibitors viewing

Lunch and learn sponsored by Schroth Scoliosis & Spine Clinic. Moderated by Nikos Karavidas.

Session 6: Quality of Life, Patient-Reported Outcome and Telehealth / Technology/ Digital health/ Apps

13:00 - 14:30 Friday, 25th April, 2025

Presentation type Oral presentations

Merve Damla Korkmaz, Arnold Wong

SOSORT Business Meeting: Members only

14:30 - 15:30 Friday, 25th April, 2025

Presentation type General Assembly Meeting

Opening Remarks – Sabrina Donzelli, President

Recognitions – 2025

Treasurer Report – Larry Cohen, Treasurer

Scientific Committee – Elias Diarbakerli, Chair

Communication Committee

Education Committee – Amy Sbihli, Chair

Future Annual Meetings:

- Turin 2026
- SpineWeek 2027
- Proposals for 2028?

Election of New Board Members at Large – Prachi Bakarania, Secretary of the Board

Membership Committee – Isis Navarro, Chair

Vote on New Members

Comments / Questions

Closing Remarks

Gala Dinner & Cruise (*TICKET REQUIRED*)

16:00 - 23:00 Friday, 25th April, 2025

This event requires a special pre-paid ticket. We will be departing on buses from outside of the hotel at 4:30 PM. We will be cruising from 5:00 PM.

Saturday, 26th April, 2025

Breakfast

07:00 - 08:30 Saturday, 26th April, 2025

Session 7: Healthcare systems/ Policies /Screening and Imaging and Assessment

08:30 - 10:00 Saturday, 26th April, 2025

Presentation type Oral presentations

Eric Parent, Stefano Negrini

Coffee Break and Exhibitor Viewing

10:00 - 10:30 Saturday, 26th April, 2025

Presentation type Coffee Break & Posters / Exhibitors viewing

Session 8: Bracing, Quality of Life and Patient-Reported Outcome and Exercise

10:30 - 12:00 Saturday, 26th April, 2025

Presentation type Oral presentations

Pavel Cerny, Nikos Karavidas

Concluding Remarks and Award Announcements

12:00 - 12:10 Saturday, 26th April, 2025

Presentation type General Assembly Meeting

Sunciça Bulat Wursching, Sabrina Donzelli

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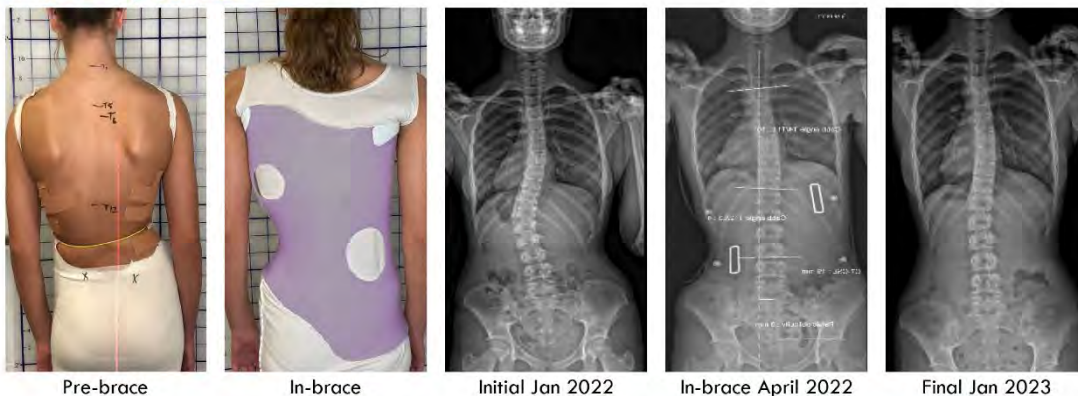
PSSE - Schroth method
by Nikos Karavidas

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Pre-brace

In-brace

Initial Jan 2022

In-brace April 2022

Final Jan 2023



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Colorado Aurora Boulder	New Mexico Albuquerque	San Antonio
Connecticut Ridgefield	New Jersey Lakewood Teaneck Totowa	The Woodlands
Florida West Palm Beach	New York New York City (5)	Washington Seattle Bellevue Gig Harbor
Hawaii Honolulu	North Carolina Apex Raleigh (2)	Wisconsin Green Bay
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*if no program code was given for a submission then this will show the submission serial number

Final category: 1 Etiology and Pathogenesis

6

VITAMIN D DEFICIENCY AS A RISK FACTOR FOR THE PROGRESSION OF IDIOPATHIC SCOLIOSIS IN CHILDREN AGED 10-16 YEARS

TATJANA RAKLINSKA

Rīga, Rīga, Latvia

Background

Several studies have been carried out on vitamin D blood concentrations, Cobb angle correlation after surgery, but no studies have been carried out on vitamin D blood concentrations with Cobb angle correlation.

Objective (s)

A lower concentration of vitamin D in the blood increases the risk of scoliosis progression

Study Design

The study design is a quantitative cross-sectional study, designed to analyse data on blood vitamin D concentrations and their association with scoliosis progression. Population exclusion criteria: congenital scoliosis, congenital spinal anomalies, spinal trauma, endocrine and digestive diseases, tumours. The study was carried out in accordance with the University of Latvia, Faculty of Medicine, Research Ethics Committee REPORT No 19-25/72.

Methods

The data were analysed using different statistical methods. The data were collected and processed using Microsoft Excel spreadsheets and IBM SPSS Statistics 27 software. The conformity of the data with a normal distribution was determined by means of an appropriate correlation analysis, by determining the correlation coefficients and p values for the resulting coefficients.

Results

27 patients participated in the study. 18 of them were female and 9 were male. The mean blood vitamin D concentration was $M = 21.44$ with standard deviation $SD = 9.41$. The mean Cobb angle was $M = 18.8$ degrees, corresponding to the diagnosis of idiopathic scoliosis. There was a statistically significant positive linear relationship between age and total Cobb angle ($r(27) = 0.475$, $p = 0.012$). The higher the age, the higher the Cobb angle. There is no statistically

significant linear relationship between age and change in Cobb angle ($r(27) = 0.000$, $p = 1.000$). There is no statistically significant linear relationship between 25-OH-Vit.D and Cobb angle in patients over 13 years of age ($r(11) = 0.303$, $p = 0.365$). However, there is a statistically significant positive linear relationship between 25-OH-Vit.D and Cobb angle in patients aged up to and including 13 years ($r(16) = 0.593$, $p = 0.015$). There is a statistically significant strong negative linear relationship between 25-OH-Vit.D and change in Cobb angle in patients aged up to and including 13 years ($r(16) = 0.855$, $p < 0.001$), and also in those aged 13 years and above ($r(11) = -0.787$, $p = 0.004$).

Conclusion(s)

Low blood levels of vitamin D could be considered as a risk factor for the progression of idiopathic scoliosis and vitamin D should be introduced in scoliosis treatment guidelines as a minimum to prevent the risk of progression of idiopathic scoliosis as much as possible.

Clinical significance

I consistently monitor my patients' vitamin D levels because it's crucial for both growth and the proper functioning of the endocrine system. This study was conducted to encourage patients to track their vitamin D levels, promoting improved treatment outcomes and overall health.

7

RETROSPECTIVE ANALYSIS OF PATIENT CHARACTERISTICS IN CO-OCCURENCE OF INFANTILE CHEST WALL SURGERIES AND SCOLIOSIS

Michael Ginzburg, Rachel White

UC Davis Health, Sacramento, USA

Background

The relationship between early childhood chest wall surgeries and scoliosis risk in later life is poorly understood and controversial. It has been previously investigated by White, Ginzburg & Taylor in a structured literature review and Ginzburg & White retrospective analysis with a positive correlation seen. To better understand the relationship between the two conditions and the impacted population, this retrospective analysis reviewed the presentation and diagnostic history of the involved population through a manual chart/record analysis.

Objective (s)

What is the relationship between chest wall surgeries in early childhood and risk of scoliosis development?

Is there a causal relationship between chest wall surgeries in early childhood and scoliosis risk?

Study Design

Retrospective analysis of the Electronic Health Record with use of a SlicerDicer tool of Epic EHR

Methods

The Electronic Health Records were manually reviewed/studied, after IRB approval for chart access was granted. The prevalence of scoliosis in the post-surgical population was shown to exceed that of idiopathic scoliosis in the general population. The co-occurring population was shown to also be disproportionately exhibiting a need for higher complexity of care with 24/28 cases needing multicenter multidisciplinary care for co-occurring medical and psychiatric conditions. Unlike in the idiopathic condition, post-surgical scoliosis population was shown to exhibit 1:1 sex ratio and 1:1 Left/Right thoracic curve direction ratio. Further diverging from the idiopathic scoliosis, the curvatures progressed to needing surgical intervention in 22.7% of post surgical cases, outpacing the 0.7-3.8% published prevalence of surgical correction of idiopathic scoliosis. Co-occurring diagnoses that impact scoliosis risk were monitored.

Results

From 338 surgical cases, 28 developed scoliosis.

24/28 cases were multidisciplinary/ multicenter. Two of those cases were multi-state and one was multi-national.

5 individuals have not yet reached skeletal maturity and are still at risk for scoliosis onset

1:1 M:F ratio was seen

1:1 Lt:Rt thoracic curve direction was seen

14 cases, 50%, exhibited a co-occurrence of genetic disorders, chromosomal abnormalities, psychiatric conditions, neurodevelopmental conditions, and learning disabilities that can impact scoliosis risk and treatment compliance.

Conclusion(s)

The post-surgical population is at a disproportionate risk of scoliosis development and may respond to treatment differently as compared to the unaffected idiopathic scoliosis population.

Communication within the treatment team can be made more difficult by multicenter care needs.

Causality could not be established due to small sample size and the breadth of co-occurring conditions that impact scoliosis onset risk seen.

Psychosocial interventions can be very beneficial to scoliosis treatment in the post-surgical population

Clinical significance

The post-surgical population can benefit from increased screening for scoliosis and may respond differently to scoliosis interventions.

Psychosocial interventions can have an outsized benefit for this population.

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THE "IDIOPATHIC SCOLIOSIS GRAPHICAL REPRESENTATION OF WORSENING TREND OF NATURAL HISTORY" (IS-GROWTH) COMMUNICATION TOOL PROVIDES A RELIABLE PREDICTION USEFUL TO MANAGE LONG-TERM TREATMENT DURING GROWTH

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Background

Effective conservative treatment of idiopathic scoliosis (IS) requires understanding its natural history. Di Felice (2018) found information on natural history is unreliable. Subsequently, the BraIST Calc (Dolan 2019) and another study with two models (Parent 2023, Negrini 2024) were developed. Nevertheless, the first focused only 20-40° IS Risser 0-2 adolescents, and the others had a short-term view of 5 or 2-3 years, respectively (Figure). We developed the Idiopathic Scoliosis Graphical Representation Of Worsening Trend of Natural History (IS-GROWTH), a graphical tool showing the natural history of each patient.

Objective (s)

Assess IS-GROWTH's reliability in predicting the natural history of idiopathic scoliosis during growth.

Study Design

A retrospective study for temporal validation.

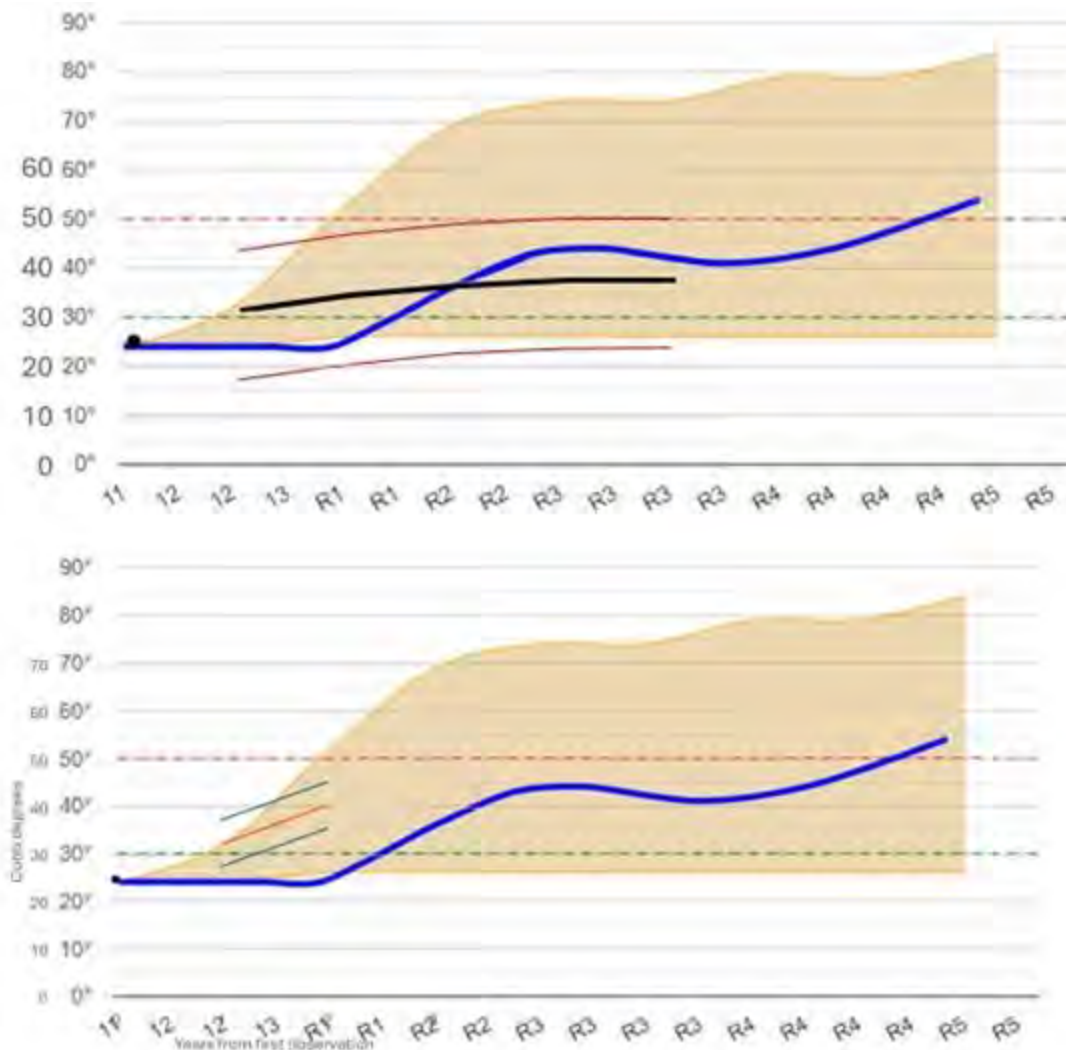
Methods

IS-GROWTH uses the method already described to study natural history from previous radiographies (Parent 2023). It was developed from a population of 1340 adolescents, 450 juveniles, and 10 infantile scoliosis patients. To build the model, we 1) standardised the growth phases among individuals and between sexes, using the age in years until a positive Risser sign and the Risser stage afterwards; 2) calculated the progression between growth phases of each patient using their two consecutive radiographs; 3) grouped patients by 10 °Cobb range and growth phase; 4) calculated the minimum and maximum progression rate per each group. IS-GROWTH is individually developed, adding the minimum and maximum expected progression evolution in each growth phase to the range of Cobb degrees reached in the previous one.

For the validation, we prospectively recruited all never-treated patients who came for consultation after the IS-GROWTH development, having at least 2 radiographs without treatment in between. We compared their personalised IS-GROWTH prediction range to their natural history 1) unadjusted and adjusted for 2) the $\pm 3^\circ$ intra-examiner and 3) the $\pm 5^\circ$ inter-examiner radiographic errors. We calculated the reliability as a percentage of correct prediction with 95% confidence interval and applied chi-square for statistics. We also looked at the distribution of the natural history data within IS-GROWTH.

Results

We included 552 patients (74% females), aged 12.4 ± 2.0 and 14.7 ± 1.7 with a curve of $19 \pm 9^\circ$ and $26 \pm 11^\circ$ at the start and end of observation, respectively. Unadjusted IS-GROWTH correctly predicted the curve progression in 74% (70-78%) of cases. Adjusting predictions for the radiographic measurement errors of $\pm 3^\circ$ and $\pm 5^\circ$, the accuracy improved statistically significantly to 90% (88-92%) and 95% (93-97%), respectively. Patients' evolution concentrated in the lowest level of the prediction, with the 3rd quartile (75% of patients) in the lowest 50%.



Cobb

Cobb

Scolios

Scolios

Example of the evolution of one patient compared to the Idiopathic Scoliosis Worsening Trend of Natural History

On the left, IS-GROWTH is compared to the prediction in the same case study. On the right, correction of the first IS-GROWTH (below) study to include 95% error) and showing in the graph how patients' natural history

Conclusion(s)

IS-GROWTH provides a complete and reliable view of individual IS patients' natural histories. We improved the graphical representation according to these results to further facilitate physicians' understanding and communication with patients.

Clinical significance

Due to its usefulness, we now regularly use IS-GROWTH because it improves our everyday practice.

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AIS RATIO BETWEEN BOYS AND GIRLS BASED ON THE COBB ANGLE SEVERITY IN BALKANS: IS THIS RATIO RELATED TO MENARCHEAL AGE AND GEOGRAPHIC LATITUDE?

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Background

It is well known from the literature that the girls/boys ratio in IS increases in favor of girls as Cobb angle increases. However, it is important to address the possible reasons for variations in published rates. This study will potentially increase our insight into scoligeny and be helpful for tailoring more accurate treatment decisions for our patients.

Objective (s)

The aim of the study is to analyze girls/boys ratio with the increase of Cobb angle and discuss possible factors responsible for this variation.

Study Design

A retrospective cross-sectional study.

Methods

Out of 31793 patients on Pediatric Department from 01.01.2016. to 29.02.2024, data of 4.973 patients aged 10-18 years at first examination was collected from the Institute's Health care system. The focus was on patients with radiologically confirmed AIS.

Statistical analysis was performed using SPSS 29.0 (2023), using mean, SD and percentages. Mann-Whitney test was used to test the difference between groups. $p < 0.05$ was considered statistically significant.

Results

Out of 4.973 patients in total sample, in 24,5% patients radiological diagnostics was performed and AIS was confirmed in 85,4% of the patients.

In Table 1. mean Cobb angle is presented in AIS patients according to gender. There was a significant difference in Cobb angle of the primary curve between girls and boys ($p < 0.001$).

Table 1. Radiological characteristics of AIS patients according to gender.

Age

Primary curve

Secondary curve

Tertiary curve

In the group with Cobb angle $\leq 30^\circ$, girls had statistically significant larger curves compared to boys ($p < 0.001$), unlike in the group with Cobb angle $> 30^\circ$ ($p = 0.485$).

The average menarcheal age was 12.3 ± 1.1 years. A statistically significant weak positive correlation was observed between the menarcheal age and Cobb angle (Spearman's $\rho = 0.183, p < 0.001$).

The difference in menarcheal age was statistically significant in girls with Cobb angle $\geq 30^\circ$ compared to Cobb angle $< 30^\circ$ (12.5 ± 1.1 and 12.2 ± 1.0 years; $p = 0.038$)

The distribution of patients according to gender and Cobb angle showed that ratio girls/boys between increases in favor of girls with the curve size ($< 10^\circ$ - 0,978, $10-20^\circ$ - 1,317, $21-30^\circ$ - 3,314; $31-50^\circ$ - 4,093, $> 50^\circ$ - 6,500).

Conclusion(s)

In this Balkan sample of scoliotics the girls/boys ratio is not that high compared to published ratios. It can be hypothesized that the difference of the geographical latitude, which plays an epigenetic role for the IS prevalence, and the dissimilarity in menarchial age in different geographical zone play a role for this variation.

Clinical significance

The knowledge of AIS girls/boys ratio, as well as menarcheal age in girls, based on the Cobb angle severity in each geographical zone seems to be necessary for a more accurate tailoring of therapeutic decisions and it also can be considered as risk factors for progression of IS in each geographical zone.

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STRESS ASYMMETRY BASED ON THE PRINCIPLE OF CHIRAL SYMMETRY - ETIOLOGICAL ANALYSIS OF ADOLESCENT IDIOPATHIC SCOLIOSIS

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Background

The distribution of human organs presents chiral symmetry or asymmetrical distribution, which can lead to asymmetrical weight distribution, which is believed to lead to asymmetrical force and stress of the trunk. Current research shows that due to the negative pressure in the chest and the muscle support of the trunk, this asymmetrical mechanic is hidden, but when the trunk muscle strength is reduced or the balance is broken, such as single support phase when walking, this asymmetry will appear. At present, the pathogenesis of adolescent idiopathic scoliosis (AIS) remains unclear. However, Stress asymmetry have always been the key to AIS.

Objective (s)

The purpose of this study was to analyze the role of stress asymmetry in scoliosis based on the asymmetric distribution of the human body.

Study Design

Case-control study

Methods

30 AIS patients aged 10-18 years with a single curve of scoliosis in females (n=16) and males (n=14) at an Angle of 10-25°, a control group of 20 healthy adolescents, including 12 females and 8 males, aged 10-19 years old, all participants were collected gait data during natural walking by 3D motion capture system. External moment were analyzed using force plate.

Results

There was no significant difference in age and BMI between the 30 patients and the control group. The moment ratio of left and right joints of lower limbs was compared with the control group, the ratio of hip adduction moment (95%CI: -9.9398-63.9484, p=0.009), the ratio of ankle rotation moment (95%CI: 39.474-189.322, and the ratio of hip adduction moment (95%CI: -9.9398-63.9484, P =0.009), and the ratio of hip joint rotation moment (95%CI: 39.474-189.322, respectively). p=0.004) had a significant difference. In AIS group, there was a significant difference in the adduction moment of both sides of the hip joint (95%CI: -2.8416--0.5488, p=0.005), and there was a significant difference in the flexion moment of both sides of the hip joint (95%CI: -1.6148--0.0988, p=0.027), while the hip rotation moment, (95%CI: -1.1757-0.9245, p=0.812), the knee rotation moment (95%CI: -1.0741-1.0261, p=0.964), Knee adduction moment (95%CI: -1.5635-0.5367, p=0.333), knee flexion moment (95%CI: -1.2631-0.8371, p=0.687), ankle rotation moment (95%CI: -0.9755-1.1247, p=0.888), ankle adduction moment (95%CI: -1.5607-0.5395, p=0.336) and ankle dorsiflexion moment (95%CI: 0.2563-2.3565, p=0.338), were no significant differences.

Conclusion(s)

The results of this study provide evidence for the distribution of lower limb force in AIS at 10-25 degrees. There were significant differences in hip adduction moment and ankle rotation moment between normal control group and adolescent scoliosis, the adduction and flexion moment distribution of the hip joint are the most obvious differences.

Clinical significance

As an important load-bearing joint in standing position of human body, the hip joint also has obvious manifestations of stress asymmetry. Treatment should also focus on adjusting stress distribution, and increase muscle strength of trunk and spinal stability to combat asymmetric stress.

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WHAT IS THE ROLE OF LUMBAR PARASPINAL MUSCLES IN ETIOLOGY OF ADULT DEGENERATIVE SCOLIOSIS?

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Background

Extended human life will bring the problems of aging if preventive measures are missed. Only a few studies analyzed the association of paraspinal muscles in the pathogenesis of ADS.

Objective (s)

In the present study, we aimed to elaborate the recent advances in ADS and paraspinal muscles via a systematic review of the literature. We also aimed to analyze age-, and gender-matched subjects with and without ADS in terms of fatty infiltration of their lumbar paraspinal muscles.

Study Design

Cross-sectional analysis and literature review

Methods

We included 60 patients with ADS and age- and gender-matched 60 healthy control subjects without ADS. All subjects were evaluated in terms fatty infiltration in multifidus, erector spinae, and psoas muscles at all lumbar levels on lumbar spine MRIs. Studies regarding the role of paraspinal muscles in pathophysiology of ADS were retrieved from Pubmed/MEDLINE using PRISMA guideline.

Results

Coronal Cobb angles were significantly greater in ADS patients. Patients with ADS had significantly fattier multifidus, erector spinae, psoas both on the concave and convex sides of the curve compared to the age- and gender-matched control subjects, except for the multifidus muscle on the convex side. Regression analysis revealed that the multifidus and psoas on the concave side were significant predictors for ADS compared to those on the convex side.

Conclusion(s)

Paraspinal muscles were fattier in patients with ADS compared to the controls. Fatty infiltration in the psoas on the concave side could be the starter of ADS development whereas that in the multifidus on concave side could be the pacesetter of this process.

Clinical significance

Patients with ADS had significantly fattier multifidus, erector spinae, psoas both on the concave and convex sides of the curve compared to the age- and gender-matched control subjects, except for the multifidus muscle on the convex side.

CROSS-SECTIONAL STUDY ON THE PATHOGENESIS, PROGNOSIS, AND ASSOCIATED FACTORS OF SCOLIOSIS

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Background

Scoliosis is a complex spinal deformity characterized by lateral curvature and axial rotation of the spine. Understanding the clinical mechanisms and prognosis of scoliosis is crucial for optimizing patient management. This study aims to explore the clinical mechanisms underlying scoliosis development and its impact on long-term prognosis.

Objective (s)

A case-control study was conducted involving 100 patients diagnosed with scoliosis and 100 age- and sex-matched controls without spinal deformities. Clinical data, including demographic information, radiographic parameters, and physical function scores, were collected. Potential etiological factors, including genetic predisposition, biomechanical imbalances, and neuromuscular conditions, were evaluated. Prognosis was assessed through follow-up data over a 5-year period, focusing on curve progression, treatment outcomes, and quality of life. Statistical analysis was performed using logistic regression and survival analysis.

Study Design

This study will employ a case-control design to investigate the clinical mechanisms and prognosis of scoliosis. The study population will consist of patients diagnosed with scoliosis and age- and sex-matched individuals without spinal deformities. Data collection will include demographic information, radiographic measurements, and clinical parameters such as genetic markers, neuromuscular function, and biomechanical assessments. Longitudinal follow-up of the case group will be conducted over 5 years to evaluate curve progression, treatment outcomes, and quality of life using validated scales. Statistical analysis, including logistic regression and survival analysis, will be used to identify risk factors and predictors of prognosis. This design will allow for the identification of underlying mechanisms and provide insights into the long-term impact of scoliosis.

Methods

A case-control study was conducted involving 100 patients diagnosed with scoliosis and 100 age- and sex-matched controls without spinal deformities. Clinical data, including demographic information, radiographic parameters, and physical function scores, were collected. Potential etiological factors, including genetic predisposition, biomechanical imbalances, and neuromuscular conditions, were evaluated. Prognosis was assessed through follow-up data over a 5-year period, focusing on curve progression, treatment outcomes, and quality of life. Statistical analysis was performed using logistic regression and survival analysis.

Results

Significant differences were observed in biomechanical imbalances and neuromuscular abnormalities between cases and controls ($p < 0.01$). Genetic predisposition, particularly variations in GPR126 and SOX9, was strongly associated with scoliosis risk (OR = 2.8, 95% CI: 1.6–4.9). Long-term prognosis was influenced by the severity of initial curvature and compliance with bracing or surgical interventions. Patients with severe scoliosis ($>40^\circ$ Cobb angle) showed a higher risk of curve progression and reduced quality of life scores compared to patients with milder forms ($p < 0.05$).

Conclusion(s)

The clinical mechanisms of scoliosis involve a combination of genetic, biomechanical, and neuromuscular factors. Early diagnosis and appropriate intervention are essential to improve prognosis and mitigate the impact on quality of life. Future research should focus on personalized treatment strategies and the development of predictive models for curve progression.

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HOW OFTEN IS PELVIC OBLIQUITY RELATED TO CONVEXITY OF THE SCOLIOTIC CURVE?

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Background

Leg length discrepancy and the resulting pelvic obliquity may be a possible mechanical cause of the appearance of a scoliotic curve. Pelvic obliquity is defined as a potential cause of the appearance of only functional scoliosis but there is no evidence that this type of scoliosis cannot be structured.

There is no scientifically reliable data to define the minimum measure of leg length discrepancy that can create a scoliotic curve.

Objective (s)

Verify the correlation between pelvic obliquity and the convexity of the scoliotic curve.

Study Design

Descriptive study

Methods

During medical visits at a facility specialized in the treatment of spinal misalignments, patients with idiopathic scoliosis and a lower limb discrepancy of at least 5 mm were identified.

Inclusion criteria:

- Patients with idiopathic scoliosis
- Age 8-15 years
- Single curve
- Both gender
- Leg length discrepancy of at least 5 mm

1791 patients with these characteristics were identified.

1017 with a left shorter leg and 774 with a right shorter leg.

Since it is assumed that leg length discrepancy can influence a scoliotic curve near the oblique pelvis more, this group of patients was divided into two subgroups that differentiated them, considering the segment of the spine affected by scoliosis.

1791 Lower limb discrepancy greater than 5 mm			
1017 left short leg		774 right short leg	
767 L o TL curves	250 T curves	476 L o TL curves	298 T curves

Results

Considering 767 curves with apex between T12 and L5 in patients who showed a left shorter leg, only 99 had convexity on the right (12.9%)

Considering 476 curves with apex between T12 and L5 in patients who showed a right shorter leg, only 145 had convexity on the left (30.5%)

Conclusion(s)

The data of this descriptive study show a clear percentage of coherence between the leg length discrepancy and the convexity of the Lumbar or Thoraco-lumbar curves (87% in case of left shorter leg and 70% in case of right shorter leg)

Clinical significance

In absence of etiological evidence of the scoliosis curve appearance and considering this clear coherence between the convexity of the curve and the obliquity of the pelvis, the realignment of the length of the lower limbs thanks to supports to be placed under the shorter leg should be performed more regularly.

ARE BACK AND HIP PRESSURE VALUES ASSOCIATED WITH SPINOPELVIC ALIGNMENT IN NEUROMUSCULAR SCOLIOSIS?: A RETROSPECTIVE ANALYSIS

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Background

Studies in patients with adolescent idiopathic scoliosis showed a relationship between the extent of scoliosis and plantar pressure distribution. In non-ambulatory patients, body posture is more related to hip and pelvis position, and sagittal and coronal spinal alignment due to functional sitting position.

Objective (s)

To evaluate the relationship between back and hip pressure levels, and sagittal/coronal spinopelvic alignment in patients with non-ambulatory cerebral palsy(CP) and scoliosis.

Study Design

Retrospectively designed cross-sectional study

Methods

Patients under 18 with non-ambulatory CP and scoliosis were assessed for eligibility. Patients with a history of previous spinal surgery, uncontrolled epileptic seizures, who had difficulty in giving a sitting position due to hip contracture and advanced spinal deformity, etc. were excluded from the study. Back and hip pressures in the sitting position were measured using CONFORMat Medical Sensor-5330 (VersaTek System, Tekscan Inc, Boston, USA), and CONFORMat Software. Cobb angle, thoracic kyphosis(TK), lumbar lordosis(LL), pelvic tilt(PT), sacral slope(SS), pelvic incidence(PI), and sagittal vertical axis(SVA) were measured radiologically to evaluate spinopelvic alignment. As secondary outcomes, pelvic obliquity(PO) and Reimers' migration index(RMI) were calculated. Statistical analysis was done by using the Independent sample t-test/Mann Whitney-U test and Pearson/Spearman correlation coefficient. Ethics committee approval was obtained.

Results

24 participants were included in the study (6 female, and 18 male). 14 had major curves on the left side, and 10 had on the right side. The characteristics are seen in Table 1. When the analysis was done according to the major curve side, there were statistically significant differences in terms of the hip at the upper level($p<0.001$), hip ($p=0.005$), and back side with the high pressure($p<0.001$), the pressure of the right back($p=0.005$), LL($p=0.039$), and SVA($p=0.012$) between both groups.

Based on the correlation analyses between the pressures of the back and hips, and the radiological parameters of the participants, a negative correlation was found between the pressure of the left hip and TK($p=0.020, r=-0.470$), and LL($p=0.017, r=-0.483$); and between the pressure of the right back and SS($p=0.018, r=-0.477$); and between the pressure of the left back and SS($p=0.003, r=-0.582$). No relationship was found between the pressure areas and Cobb angle, PO, and RMI(Table 2).

Table 1. Descriptive characteristics and comparison the variables between the both major curve side.

	Major curve side		Total (n=24)	p
	Right (n=10)	Left (n=14)		
Age (years)(Mean (SD))	10.3 (2.3)	10.6 (2.7)	10.5 (2.5)	0.665
Gender (n(%))				
Female	3	3	6 (25%)	0.633
Male	7	11	18 (75%)	
Risser stage (n(%))				
Stage 0	3	9	12 (50%)	0.203
Stage 1	3	1	4 (16.7%)	
Stage 2	4	3	7 (29.2%)	
Stage 3	0	1	4.2 (4.2%)	
Tanner stage (n(%))				
Stage 1	5	7	12 (50%)	0.400
Stage 2	3	2	5 (20.8%)	
Stage 3	2	2	4 (16.7%)	
Stage 4	0	3	3 (12.5%)	
GMFCS (n(%))				
Level 4	2	4	6 (25%)	0.633
Level 5	8	10	18 (75%)	
Hip at the upper level (n(%))				
Right	0	14	14 (58.3%)	<0.001*
Left	10	0	10 (41.7%)	
Hip side with high pressure (n(%))				
Right	8	3	11 (45.8%)	0.005*
Left	2	11	13 (54.2%)	
Back side with high pressure (n(%))				
Right	10	2	12 (50%)	<0.001*
Left	0	12	12 (50%)	
Pressure of the right hip Mean (SD)	109.5 (6.5)	106.1 (13.4)	107.5 (11.0)	0.138
Pressure of the left hip Mean (SD)	105.3 (6.8)	111.5 (16.7)	108.9 (13.6)	0.412
Pressure of the right back Mean (SD)	86.4 (17.4)	58.7 (23.8)	70.2 (25.2)	0.005*
Pressure of the left back Mean (SD)	65.1 (13.4)	70.8 (28.9)	68.4 (23.5)	0.177
Cobb angle (Mean (SD))	25.6 (9.9)	27.9 (14.7)	26.9 (12.8)	0.977
TK (Mean (SD))	38.8 (4.7)	40.3 (10.1)	39.7 (8.2)	0.636
LL (Mean (SD))	25.6 (7.8)	32.8 (9.6)	29.8 (9.4)	0.039*
PO (Mean (SD))	6.3 (3.5)	4.8 (2.9)	5.4 (3.2)	0.205
RMI (right) (Mean (SD))	21.2 (9.0)	24.4 (12.6)	23.1 (11.1)	1.000
RMI (left) (Mean (SD))	32.9 (11.2)	38.6 (18.6)	36.2 (15.9)	0.618
SVA (Mean (SD))	37.1 (18.9)	16.8 (13.2)	25.2 (18.6)	0.012*
PT (Mean (SD))	17.2 (10.3)	17.3 (12.7)	17.2 (11.5)	0.814
SS (Mean (SD))	33.6 (7.4)	36.2 (10.5)	35.1 (9.3)	0.860
PI (Mean (SD))	51.0 (12.8)	53.3 (12.9)	52.3 (12.7)	0.977

GMFCS: Gross motor functioning classification system, TK: Thoracic kyphosis, LL: Lumbar lordosis, PO: Pelvic obliquity, RMI: Reimers migration index, SVA: Sagittal vertical axis, PT: Pelvic tilt, PI: Pelvic incidence, SS: Sacral slope, SD: Standard deviation, n: number, *p<0.05 is accepted significant for Independent samples t test/Mann Whitney U test.

Table 2. Correlation analysis between the pressure of the back and hips and spinal and pelvic variables.

	Pressure of the right hip	Pressure of the left hip	Pressure of the right back	Pressure of the left back
Cobb angle				
<i>r</i>	0.342	-0.027	-0.295	-0.355
<i>p</i>	0.102	0.902	0.161	0.088
TK				
<i>r</i>	-0.015	-0.470	0.072	0.284
<i>p</i>	0.945	0.020*	0.738	0.179
LL				
<i>r</i>	-0.013	-0.483	0.045	0.398
<i>p</i>	0.951	0.017*	0.834	0.054
PO				
<i>r</i>	0.419	-0.346	-0.009	-0.157
<i>p</i>	0.051	0.097	0.966	0.463
RMI (right)				
<i>r</i>	-0.269	0.253	-0.042	-0.192
<i>p</i>	0.205	0.233	0.846	0.369
RMI (left)				
<i>r</i>	0.023	0.110	-0.374	-0.544
<i>p</i>	0.915	0.607	0.072	0.060
SVA				
<i>r</i>	0.406	0.001	0.132	-0.133
<i>p</i>	0.051	0.997	0.540	0.537
PT				
<i>r</i>	-0.033	-0.185	-0.185	0.116
<i>p</i>	0.879	0.386	0.386	0.590
SS				
<i>r</i>	-0.152	-0.409	-0.477	-0.582
<i>p</i>	0.479	0.050	0.018*	0.003*
PI				
<i>r</i>	-0.236	0.024	-0.145	-0.177
<i>p</i>	0.267	0.913	0.499	0.407

TK: Thoracic kyphosis, LL: Lumbar lordosis, PO: Pelvic obliquity, RMI: Reimers migration index, SVA: Sagittal vertical axis, PT: Pelvic tilt, PI: Pelvic incidence, SS: Sacral slope, *p<0.05 is accepted significant for Pearson/Spearman Correlation analysis.

Conclusion(s)

It was observed that high-pressure back and hip sides and upwardly positioned hip sides were associated with major curve direction. The degree of spinal curvature, PO, and hip subluxation were not

related to back and hip pressures. On the other hand, only SS had a negative relationship with back pressures.

Clinical significance

This study is important to determine whether there is a relationship between the side with higher hip and back pressure and scoliosis and/or hip subluxation. This may guide the development of treatment.

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***LBX1*, *ESR1*, AND *ESR2* GENES DNA METHYLATION LEVEL IN IDIOPATHIC SCOLIOSIS**

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Background

Idiopathic scoliosis (IS) is a multifactorial disease with a genetic and environmental background. Recent studies suggest that epigenetic modifications, such as DNA methylation, may contribute to the IS occurrence and course.

Objective (s)

The aim of this study was to evaluate the association of *LBX1*, *ESR1*, and *ESR2* gene methylation levels with susceptibility to and severity of IS.

Study Design

Prospective, case-control study.

Methods

The study group (N=63) consisted of 56 female and 7 male IS patients. The patients were analyzed in two subgroups based on the Cobb angle: $\leq 75^\circ$ (N=36) and $> 75^\circ$ (N= 27). The control group (N=30) consisted of 27 females and 3 males without IS (23 healthy females, 2 spondylolisthesis, 3 scoliosis from prior thoracotomy, and 2 patients with Scheuermann's disease). DNA was isolated from peripheral blood. The

methylation of selected *LBX1*, *ESR1*, and *ESR2* regions was evaluated with a pyrosequencing method. The methylation level was expressed as a percentage of methylated CpG sites. *P*-value <0.05 was considered significant.

Results

The mean methylation of *LBX1* forward strand promoter region differed significantly between controls 25.81% and patients 20.77%, *p* = 0.0013. The methylation was significantly higher in controls in 11 of 15 CpG sites. The mean methylation of the *ESR1* T-DMR2 region was 50.44% in controls and 54.68% in patients, *p* = 0.0003. The methylation was significantly lower in controls in 5 of 8 CpG sites. There was no significant difference in the mean methylation level in *ESR2* exon ON 5.17% vs. 5.58%, *p* = 0.2057. However, the methylation level in 10 of 19 CpG sites was significantly lower in controls and higher in 4 of 19 CpG. We observed no differences in the methylation level within all analyzed regions of *ESR1*, *ESR2*, and *LBX1* genes between IS patients with $\leq 75^\circ$ of the Cobb angle versus $>75^\circ$.

Conclusion(s)

Significant differences in the *LBX1*, *ESR1*, and *ESR2* methylation levels between IS patients and controls were identified. IS patients revealed lower *LBX1* forward strand promoter region methylation levels compared to controls. No association was found between the *LBX1*, *ESR1*, or *ESR2* methylation levels and the severity of IS.

Clinical significance

This study provides new issues concerning the underlying mechanisms of idiopathic scoliosis. It identifies DNA methylation as a significant factor in the predisposition to spinal curvature occurrence. The findings contribute additional information for the development of genetic screening tests in the future.

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A GLIMPSE OF MILAN ROTH'S THEORY ABOUT NEUROVERTEBRAL AND OSTEONEURAL GROWTH RELATIONS FROM THE 1980S AND ITS CONNECTION OF SOME CURRENT RESEARCH THE ETIOLOGY OF IDIOPATHIC SCOLIOSIS.

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Background

The etiology of idiopathic scoliosis is like a mosaic, where we already know some segments based on evidence, some we suspect, some we do not know yet. Milan Roth brought one of the scientific

segments in 1980s. How big it is we don't know but this theory is been constantly confirmed by some newer researches.

Objective (s)

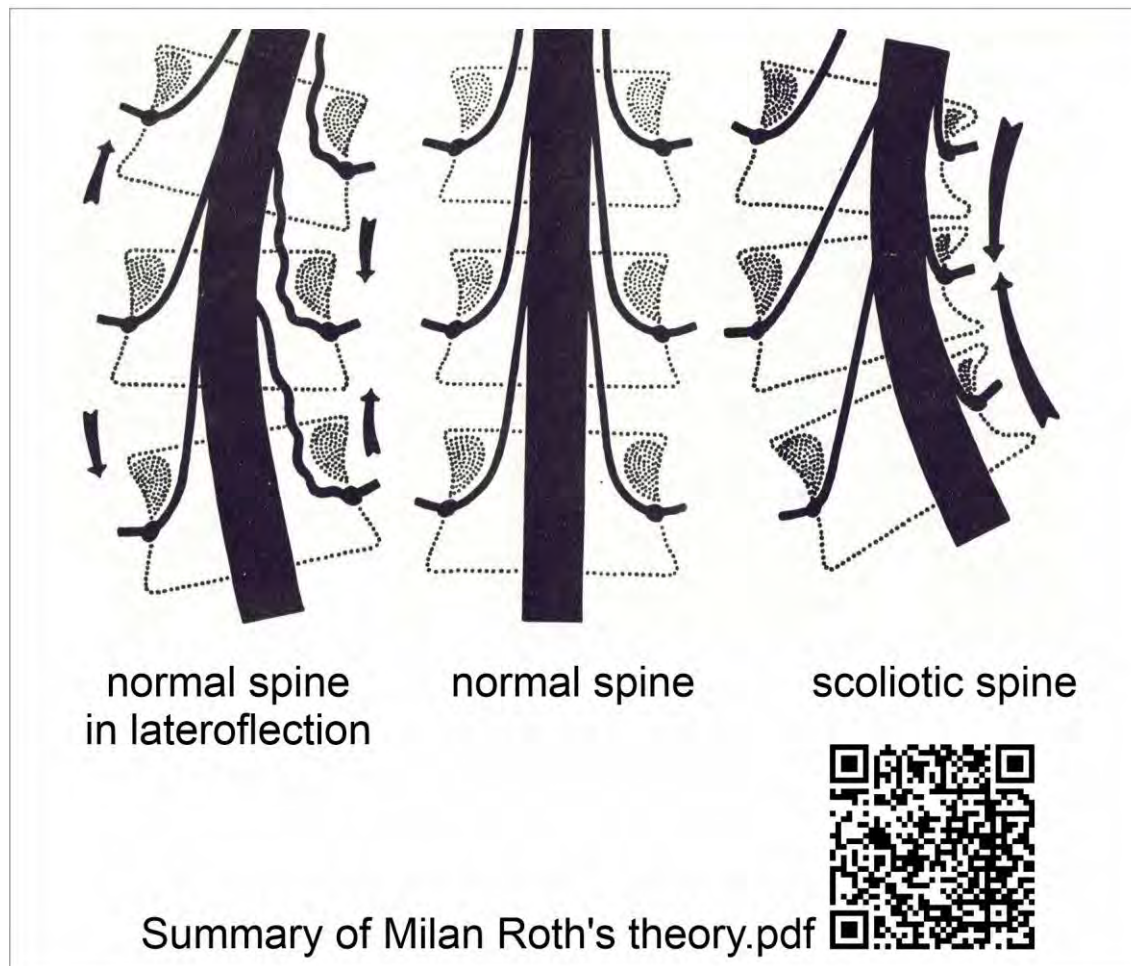
The presentation mentions Milan Roth's theory of 'neurovertebral and osteoneural relations' and some related research.

Study Design

Recent research addressing hormonal balance and biomechanical models correlate with the aforementioned Milan Roth's theory.

Methods

Milan Roth's theory about neurovertebral and osteoneural growth relations was created in a large multidisciplinary platform that includes well-known imaging methods, biology, biochemistry, biomechanics, pathology and other expertise. This created a complex theory that explains the development, growth and genesis of deformities in vertebrates, including humans. The work is published in English as a book in 1985 with the title 'Neurovertebral and osteoneural growth relations'. The main message is that nervous tissue dominates and controls others so that it itself is in a comfortable position.



Mikhail Dudin's research addresses the rate of progression of idiopathic scoliosis due to imbalance of four hormones (GH [STH], Calcitonin, Parathirin, Cortisol) which have an influence on bone growth speed.

Matthew Janzen's biomechanical model of the spine demonstrates the behaviour of the spine with a longer spinal canal in Adams's test, which corresponds to a shorter spinal cord that is in stretching.

Results

It turns out that the Milan Roth's from 1980s theory and subsequent more recent researches are closely correlated and gives an opportunity to look into the etiology of idiopathic scoliosis from another direction.

Conclusion(s)

This contribution does not provide a detailed explanation, but should only be an incentive to become familiar with a different perspective on the etiology of idiopathic scoliosis.

Clinical significance

The aforementioned Milan Roth's Theory shows nervous tissue as the main controlling component in the etiology of idiopathic scoliosis.

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3D RADIOLOGICAL AND CLINICAL PROGNOSTIC FACTORS FOR FAILURES AND IMPROVEMENTS OF BRACING FOR ADOLESCENT IDIOPATHIC SCOLIOSIS: A COMPARATIVE ANALYSIS

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Background

The rate of brace success and failure varies and some factors have been highlighted as positive or negative to the treatment outcome. To date, no study compared the characteristics of failures and improvements from the same initial sample.

Objective (s)

Our objective was to separately analyze radiological and clinical prognostic factors for Cobb angle difference more than 5° in progressive (PROG) and improved (IMPR) groups of patients and detect potential associations.

Study Design

Comparative Experimental Study

Methods

113 patients (73 IMPR and 40 PROG) with progression or improvement from our prospective database, were selected for analysis. All patients that received brace treatment and practiced scoliosis specific exercises (SSE) with the following criteria were included: Cobb angle $>25^{\circ}$, Risser sign 0-2 with at least 12 months of treatment and one follow-up x-ray without brace. We evaluated initial Cobb angles (Cobb-IN), in-brace correction (IBC) and final Cobb angles (Cobb-FI) for thoracic (TH) and lumbar (LU) curves. The factors that we analyzed were Lenke curve type, apex location, type of progressed and improved curve, brace and SSE compliance (self-reported), supervised sessions/year, Pelvic Incidence (PI), Pelvic Tilt (PT), Sacral Slope (SS), Roussouly type, thoracic kyphosis (TK), lumbar lordosis (LL), family history, Risser sign, Triradiate Cartilage (TRC) ossification, Body Mass Index (BMI), Angle Trunk Rotation (ATR) for thoracic and lumbar curves. Chi-square, Fisher's exact and Mann-Whitney U tests were used for statistical analysis.

Results

IBC (41% IMPR – 22.9% PROG, $p<0.001$), Cobb-FI TH (25.7° IMPR – 50.1° PROG, $p<0.001$), Cobb-FI LU (21.9° IMPR – 49.26° PROG, $p<0.001$), Brace compliance (78.1% high, 19.2% moderate, 2.7% poor for IMPR - 32.5% high, 32.5% moderate, 35% poor for PROG, $p<0.001$), SSE compliance (53.4% high, 32.9% moderate, 13.7% poor for IMPR - 15% high, 40% moderate, 45% poor for PROG, $p<0.001$), curve type (single 35.6%, double 64.4% IMPR – single 15%, double 85% PROG, $p=0.028$), Lenke types (1C 4.1%, 3C 2.7%, 5C 20.6% IMPR - 1C 12.5%, 3C 12.5%, 5C 0% PROG, $p=0.008$), Roussouly types ($p=0.038$), Risser ($p=0.035$), TRC (open 46.5% IMPR – open 72.5% PROG, $p=0.01$), menarche (no 56.2% IMPR – 77.5% PROG), BMI (17.7 IMPR – 19.2 PROG, $p=0.043$) and sessions/year (26.1 IMPR – 15.4 PROG) were significantly different between groups.

Cobb-IN TH (35.8° IMPR – 37.3° PROG, $p=0.594$), PI (50.6° IMPR – 47.3° PROG, $p=0.151$), PT (10.6° IMPR – 8.5° PROG, $p=0.088$), SS (40° IMPR – 37.8° PROG, $p=0.274$) and family history (57.5% IMPR – 50% PROG, $p=0.554$) were not significantly different between groups.

						Chi-Square Tests			
LENKE TYPE	IMPR		PROG		Total	Chi-Square	p		BRACE COM
1A	6	8,22%	5	12,50%	11	22,124	0,008		A
1B	8	10,96%	2	5,00%	10				B
1C	3	4,11%	5	12,50%	8				C
2A	0	0,00%	1	2,50%	1				Total
2B	0	0,00%	0	0,00%	0				
2C	0	0,00%	0	0,00%	0				
3A	0	0,00%	2	5,00%	2				EXERC COM
3B	5	6,85%	3	7,50%	8				A
3C	2	2,74%	5	12,50%	7				B
4A	0	0,00%	0	0,00%	0				C
4B	0	0,00%	0	0,00%	0				Total
4C	1	1,37%	1	2,50%	2				
5C	15	20,55%	0	0,00%	15				
6C	33	45,21%	16	40,00%	49				ROUSOULLY
Total	73		40		113				
						Chi-Square Tests			
SINGLE/DOUBLE	IMPR		PROG		Total	Chi-Square	p		1
SINGLE	26	35,62%	6	15,00%	32	5,411	0,028		2
DOUBLE	47	64,38%	34	85,00%	81	(Fisher's Exact Test)			3
Total	73		40		113				3AP
									4
									Total
						Chi-Square Tests			
TH/L/TL	IMPR		PROG		Total	Chi-Square	p		
BOTH	22	30,14%	13	32,50%	35	10,488	0,005		FAMILY HIST
LUMBAR	31	42,47%	6	15,00%	37				NO
THORACIC	20	27,40%	21	52,50%	41				YES
Total	73		40		113				Total

Conclusion(s)

Higher IBC and compliance with brace and SSE (also more supervised sessions), later growth stage, single curve types and lower BMI were associated with better outcomes. Initial Cobb angles, pelvic parameters and family history did not significantly affect the result.

Clinical significance

Our study showed that many prognostic factors are associated with treatment outcome and should be carefully monitored for improving prognosis.

Final category: 2 Healthcare Systems / Policies / Screening

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SCOLIOSIS AMONG CHILDREN IN QINGHAI- TIBETAN PLATEAU OF CHINA

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Background

The average altitude of Qinghai-Tibetan Plateau is 4,500 m and most of the residents are Tibetan ethnicity.

Objective (s)

The purpose of this study was to investigate the prevalence of scoliosis and associated factors among children in this region through a scoliosis screening program.

Study Design

A cross-sectional study

Methods

A cross-sectional study was preformed between May 2020 and December 2020 in Qinghai-Tibetan Plateau. A total of 9,856 children aged 6–17 years from schools and nearby villages were screened using visual inspection, the Adams forward-bending test, the angle of trunk rotation, and radiography. A self-designed questionnaire was used to collect demographic data. The prevalence of scoliosis and associated factors were analyzed.

Results

The overall prevalence of scoliosis among children in QinghaiTibetan Plateau was 3.69%, with 5.38% for females and 2.11% for males. The prevalence of scoliosis was 3.50% in children resided below 4,500 m while 5.63% in those resided above 4,500 m ($P = 0.001$). The prevalence of congenital scoliosis (2.14 vs. 0.42%, $P < 0.001$) and neuromuscular scoliosis (0.34 vs. 0.07%, $P = 0.041$) were significantly higher in the altitude above 4,500 m. 50.00% of patients resided above 4,500 m were recommended for surgery while 16.24% in those resided below 4,500 m ($P < 0.001$). Independent associated factors were detected as

female (OR = 2.217, 95 CI% 1.746–2.814, $P < 0.001$), BMI < 18.5 (OR = 1.767, 95 CI% 1.441–2.430, $P = 0.005$), altitude of residence $\geq 4,500$ m (OR = 1.808, 95 CI% 1.325–2.483, $P = 0.002$), and sleep time < 8 h (OR = 2.264, 95 CI% 1.723–2.846, $P = 0.001$).

Conclusion(s)

The prevalence of scoliosis among children in Qinghai-Tibetan Plateau was 3.69%. With increasing altitudes, the prevalence of scoliosis and its major type were different from that at lower altitudes. Female, BMI < 18.5, altitude of residence $\geq 4,500$ m, and sleep time < 8 h were independently associated with the prevalence of this disease. Early screening should be carried out before the age of 7 years, especially in the high-altitude, underdeveloped, and rural areas.

Clinical significance

This study highlights the elevated prevalence of scoliosis among children living in the Qinghai-Tibetan Plateau, particularly at altitudes above 4,500 m, where significant rates of congenital and neuromuscular scoliosis were observed. Recognizing the independent risk factors—female gender, low BMI, high altitude, and insufficient sleep—can help healthcare providers identify at-risk populations for early intervention. The findings emphasize the need for targeted screening programs in high-altitude, rural areas, ideally before the age of 7, to ensure timely diagnosis and treatment. Additionally, community-based initiatives can enhance awareness and access to care, ultimately improving health outcomes for children affected by scoliosis in these underdeveloped regions.

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SPORTS MEDICINE SPECIALISTS' KNOWLEDGE OF ADOLESCENT IDIOPATHIC SCOLIOSIS AND ASSESSMENT PRACTICES DURING PRE-PARTICIPATION EXAMINATIONS IN TURKEY: INSIGHTS FROM AN ONLINE SURVEY

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Background

Sports medicine specialists, like pediatricians and family physicians, are among the professionals who have the opportunity to assess healthy adolescents and conduct pre-participation evaluations. They can play a critical role in the early diagnosis of scoliosis and in ensuring that patients remain physically active and participate in sports activities.

Objective (s)

This study aims to evaluate the frequency of scoliosis assessment and the knowledge of adolescent idiopathic scoliosis (AIS) among sports medicine specialists in Turkey.

Study Design

Cross-sectional study

Methods

A 24-question online survey was prepared, combining a previously tested 10-question survey about the 2011 SOSORT guidelines with 14 additional questions designed by the researchers. These additional questions evaluated the demographic characteristics of sports medicine physicians and their scoliosis assessment practices in daily clinical settings. Sports medicine specialists and residents in Turkey were invited to participate in the study through the Turkish Sports Medicine Association. A total of 195 individuals (135 specialists and 60 residents) were invited to participate. The survey link remained active for four weeks.

Results

A total of 110 participants (70 specialists and 40 residents) completed the survey. Of the respondents, 79.1% reported assessing scoliosis during pre-participation examinations. Analysis revealed that 73.6% could define idiopathic scoliosis (IS), 94.5% identified when AIS is most likely to develop, and 70.9% correctly stated that the etiology of IS is unknown. Additionally, 58.2% of participants were aware of the diagnostic criteria, and 83.6% correctly identified bracing indications for IS. However, only 32.7% could determine the appropriate treatment approach using therapeutic exercise. Notably, only 13.8% of sports medicine specialists reported using a scoliometer during scoliosis screening.

Conclusion(s)

Sports medicine specialists demonstrate sufficient knowledge regarding the definition, etiology, and diagnostic criteria of scoliosis; however, their understanding of scoliosis screening methods and therapeutic exercises appears to be inadequate.

Clinical significance

Sports medicine specialists, when trained in scoliosis screening methods, can play a vital role in the early detection of AIS. Enhancing their understanding of exercise and sports participation planning for individuals with AIS is essential to promote better patient engagement in sports and improve overall health outcomes.

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Background

The scoliometer is an effective tool for AIS screening; however, the optimal threshold for screening remains controversial. Identifying patients with actionable scoliosis during screening is critical to timely intervention and improving outcomes.

Objective (s)

To evaluate an adolescent idiopathic scoliosis (AIS) screening method combining a scoliometer with a physical examination and establish optimal screening thresholds.

Study Design

A single-center prospective observational study.

Methods

This study included 595 participants (458 with AIS and 137 without scoliosis). Screening involved visual inspection, Adam's Forward Bending Test (FBT), and Angle of Trunk Rotation (ATR) measurement. Diagnostic confirmation was performed using standing whole spine X-ray or spine ultrasound. Receiver operating characteristic (ROC) analysis and logistic regression were employed to identify the best predictive combination of ATR thresholds and clinical signs.

Results

Among the 595 participants, there were 137 without scoliosis and 458 with scoliosis. The main Cobb angle mean was $21.0^\circ \pm 8.1^\circ$ for AIS patients and $4.0^\circ \pm 4.0^\circ$ for non-AIS individuals. The optimal ATR cutoff was determined to be 5.5° , with an AUC of 0.72, sensitivity of 73.1%, and specificity of 70.8%. Further analysis revealed that 10.3% of patients with Cobb angles $\geq 20^\circ$ had an ATR $< 6^\circ$, underscoring the critical role of clinical signs in identifying severe cases. Combining an ATR of 5.5° with three clinical signs (head tilt, waistline asymmetry, and pelvic prominence) significantly improved screening accuracy. For practical application, a simplified threshold of 6° combined with these clinical signs is recommended.

Conclusion(s)

The combined use of FBT, scoliometer measurements, and clinical signs is effective for AIS detection in Chinese adolescents. Incorporating clinical signs is particularly valuable for identifying patients with severe scoliosis (Cobb angle $\geq 20^\circ$) who may otherwise be missed by ATR measurements alone. For screening programs, an ATR of 6° or combined with three specific clinical signs provides a practical and efficient protocol, balancing sensitivity, specificity, and ease of implementation.

Clinical significance

it is helpful for a best practice for scoliosis screening project.

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SCHOOL SCREENING FOR ADOLESCENT IDIOPATHIC SCOLIOSIS IN CHINA: EVALUATING THE EFFECTIVENESS OF A SCHOOL-BASED ASSESSMENT PROTOCOL FOR EARLY DETECTION

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Background

School screening of scoliosis is an important way for early detection and treatment of scoliosis. There is no continuous screening report in Chinese mainland.

Objective (s)

This study evaluates the effectiveness and accuracy of a school-based screening program for Adolescent Idiopathic Scoliosis (AIS) in Zhongshan, China, from 2017 to 2021. It also evaluates trends in case severity and provides recommendations for enhancing future screening initiatives.

Study Design

A single-center prospective observational study.

Methods

A longitudinal survey study was conducted annually from 2017 to 2021 on middle school students across three grades. The screening process adhered to standardized protocols, including visual inspections, clinical assessments, and confirmatory X-rays for suspected cases. Key metrics were calculated, including the Positive Test Rate (PTR), Further Testing Rate (FTR), Diagnosis Rate (DR), and severity proportions. AIS prevalence was estimated using a range of assumptions, and trends by gender and grade level were analyzed. Sensitivity, number needed to screen (NNS), and positive predictive value (PPV) were used to assess screening effectiveness.

Results

Over 10,000 students were identified as suspected AIS cases during initial screening. Approximately 51.6% underwent further diagnostic evaluation, with 85.5% being confirmed as having AIS. The

screening program effectively enabled early detection, resulting in a significant decrease in severe cases over time. Girls demonstrated higher positivity and confirmation rates compared to boys, along with a greater proportion of severe cases. An upward trend in AIS prevalence across grade levels indicates a possible connection between age and disease progression. This underscores the importance of early intervention.

Conclusion(s)

This study demonstrates the effectiveness of school-based AIS screening programs in reducing the number of severe cases detected. Gender and age-specific patterns point to areas for further refinement in screening strategies to optimize early detection and intervention.

Clinical significance

It supports the screening experience of China mainland for the worldwide.

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POINT CLOUD AND DEEP LEARNING-BASED FOR SCOLIOSIS SCREENING

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Background

With advancements in 3D imaging technology, point cloud data has become increasingly prevalent in the screening and diagnosis of scoliosis. Unlike X-rays, point cloud imaging is radiation-free and cost-effective, making it suitable for large-scale population screening.

Objective (s)

To propose an efficient method for scoliosis segmentation and grading using point cloud data and deep learning.

Study Design

A two-stage approach was developed to enhance scoliosis diagnosis accuracy.

Methods

The first stage involved a point cloud segmentation model using a deep residual multilayer perceptron to accurately extract regions of interest (ROI) from the human body. The second stage classified the

degree of spinal curvature using the SpConv network, categorizing patients into high-risk and low-risk groups based on a principal curve threshold. The study analyzed 677 point cloud data cases from Hospital A, with scoliosis angles measured via X-ray. The dataset was divided into a development cohort (507 cases) and an internal test cohort (170 cases), with the development cohort split into a training set (405 cases) and a validation set (102 cases). Additionally, 169 cases from Hospital B served as an independent external test set. Manual ROI annotations were performed for segmentation model training and testing, with predictions used as inputs for the classification model.

Results

The segmentation model achieved a 93.2% (95% CI 91.1%-95.4%) accuracy in back ROI segmentation on the validation set. The classification model's AUC on the validation set was 100.00%. Internal and external test sets showed AUCs of 100.00% and 99.50% (95% CI 99.00%-100.00%), respectively. Sensitivities were 100.00%, 100.00%, and 98.58% (95% CI 96.41%-99.45%) across the datasets.

Conclusion(s)

The AI-based model demonstrated high accuracy in detecting and screening spinal curvature, highlighting its potential in clinical applications for improving scoliosis screening.

Clinical significance

This model offers a promising tool for enhancing the efficiency and accuracy of scoliosis screening.

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A REAL-WORLD STUDY ON THE EFFECTS OF CONSERVATIVE TREATMENT FOR HIGH-RISK ADOLESCENT IDIOPATHIC SCOLIOSIS IN MAINLAND CHINA

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Background

School screenings for scoliosis aim to detect and treat the condition early. However, the treatment outcomes for immature Adolescent Idiopathic Scoliosis (AIS), particularly for curves above 20°, which are at a high risk of requiring surgery, remain unclear based on data from large populations in real-world settings.

Objective (s)

This study aims to analyze the long-term clinical effects of the Xinmiao scoliosis treatment system (XTS) in patients diagnosed with progressive scoliosis, based on data from a 10-year scoliosis school screening project in Guangzhou city.

Study Design

A study conducted in a real-world setting.

Methods

This study analyzed AIS treatment data from 2 million participants in the scoliosis school screening program at the Guangdong Xinmiao Scoliosis Prevention Center over the past decade. Patients with moderate AIS met the following criteria are included: 1) AIS confirmed by a whole spine X-ray; 2) main curve between 20° and 40° (Risser ≤ 3) ; 3) Received the treatment of Xinmiao Scoliosis Treatment System (XTS) ; 4) followed up until they reached bone age maturity (Risser ≥ 4). Patients with mature bone age at diagnosis, non-AIS conditions, or immature bone age at final follow-up were excluded from the study. Treatment effectiveness is evaluated based on the correction of the main curve and is categorized into three groups: improvement (≤ -6°), stability (±5°), and progression (≥ 6°).The control rate is calculated as the ratio of patients showing improvement and stability. The success rate is defined as the proportion of patients whose main curve is below 50° at bone maturity compared to all patients.

Results

This study involved 382 AIS patients, aged 12.9 ± 1.0 years at diagnosis, with a Risser sign average of 2.1 ± 1.2 and a main Cobb angle of $26.4 \pm 5.1^\circ$ before treatment. Of these patients, 6 received PSSE, 2 received brace treatment, and 374 received both brace treatment and PSSE.The average follow-up time was 2.3 ± 1.4 years. At the final follow-up, the average main Cobb angle was $23.7 \pm 8.4^\circ$, with 141 patients (36.9%) showing improvement, 191 patients (50%) maintaining stability, and 50 patients (13.1%) experiencing deterioration,The control rate was 86.9%. After bone maturity, 17 patients' scoliosis progressed beyond 40°, with 2 cases exceeding 50° (one at 50° and the other at 53°), achieving a treatment success rate of 99.5%. All patients ultimately did not undergo surgical treatment.

Conclusion(s)

The school scoliosis screening program is an effective way for early detection and treatment of AIS patients. Combined with the early conservative treatment of XTS, it can effectively control the progression in high-risk AIS patients. The treatment success rate for immature AIS at 20-40° is 99.5%.

Clinical significance

School scoliosis screening program combined with the early conservative treatment can effectively control the progression in high-risk AIS patients.

THE PERCENTAGES AND SEVERITY OF THE MOST COMMON SPINAL DEFORMITIES IN CHILDREN IN A BALKAN SPINAL CENTER: THERAPEUTIC AND CONSEQUENT ECONOMIC IMPLICATIONS USEFUL FOR A HEALTH CARE SYSTEM

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Background

Institute for physical medicine, rehabilitation and orthopedic surgery "Dr Miroslav Zotović" in Banja Luka represents a referral center for all children with suspected spinal deformities for one part of B&H (49%). These referrals represent a trove of information related to various spinal deformities in the area and reflect preventional, diagnostic and therapeutic potential of different centers in the country.

Objective (s)

The aim was to analyze the percentages and severity of the most common spinal deformities in children, as well as the ratio between suspected and confirmed diagnosis with economical implications on health care system in this part of Balkan.

Study Design

Retrospective cross sectional study

Methods

Out of 31.793 examined patients on Pediatric Department between 01.01.2016. and 29.02.2024, the data of 8.406 patients at first examination was collected from the Institute's Health care system, including demographic, anamnestic, clinical and radiological data. Statistical analysis was performed using SPSS 29.0 (2023). The quantitative variables were presented as mean and standard deviation and qualitative data as percentages.

Results

Out of 8.406 patients, 49,4% were referred as M41.1, 41,7 % as M40.0 and 8,9% as other diagnosis according to ICD-10. The average age was 10,8±3,6 (4–18yrs). Spine X-ray was performed in 17,4% patients. Scoliosis was confirmed only in 1,8% patients referred as M40.0 and in 27% patients referred as M41.1 with the ratio in favor of girls (2,3:1 and 1,9:1). Out of 1.401 patients with radiograph, scoliosis was

verified in 84,6% with the higher prevalence in girls (66,2%) vs boys (33,8%). The average age was $12,9 \pm 2,7$ years with girls being and slightly younger ($12,8 \pm 2,7$) than boys ($13,3 \pm 2,7$). In scoliotic patients, the mean Cobb angle was $21,0 \pm 11,6^\circ$ (10-87). The girls had more severe curves ($22,8 \pm 12,4^\circ$) compared to boys ($17,6 \pm 9,1^\circ$). Brace treatment was recommended in 46,8% patients. The subanalysis according to different areas showed that referred children who live further from the center were older ($14,2 \pm 2,3$ yrs) with more severe scoliosis ($20,5 \pm 15,5^\circ$) compared to patients ($12,4 \pm 3,0$ yrs) located near the referral center ($18,8 \pm 8,5^\circ$). The financial burden for the healthcare system for all referred patients who needed treatment (PSSE or/and bracing) was 621.249,00€.

Conclusion(s)

The results reflect adverse conditions of public health care organization in our country regarding children with spinal deviations. High percentage of brace prescription indicates delayed referral to our center. In contrast, inappropriate referrals of children with no scoliosis indicate the need for additional training of doctors in peripheral areas.

Clinical significance

This is the first study in this part of Balkan analyzing the percentages and severity of spinal deformities in children and economical implications for the local health care system. This analysis is the first step for optimal planning and the improvement of the provided health services in the region.

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CORRELATION BETWEEN SCOLIOMETRY AND COBB ANGLE IN CHILDREN WITH NO SPINAL DEFORMITY: CAN ASYMMETRICAL CHILDREN HAVE STRAIGHT SPINE?

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Background

Previous studies stated that hump size was found to be the most powerful predictor of scoliosis. Large humps were more prevalent among non-scoliotic children that subsequently developed IS. It was also

confirmed that asymmetric children with a hump deformity, but without radiographically diagnosed scoliosis, can develop IS with an odds ratio 1.72 in boys and 1.55 in girls.

Objective (s)

The aim of the study was to determine if there is a correlation between scoliometry and Cobb angle in non-scoliotic children according to age and gender and to compare the scoliometry readings with patients with confirmed IS.

Study Design

A retrospective cross sectional study.

Methods

Out of 31,793 examined patients on Pediatric Department between 01.01.2016. and 29.02.2024, the data of 8406 patients at first examination was collected from the Institute's Health care system, including demographic, anamnestic, clinical and radiological data.

Patients were divided into groups according to Cobb angle, gender and age.

Statistical analysis was performed using SPSS 29.0 (2023), using mean, SD and percentages, Mann-Whitney test for the difference between groups and Pearson's correlation coefficient for [association](#) between two variables. $p < 0.05$ was considered statistically significant.

Results

A total of 7494 patients was examined, with 3344 patients being referred as M40.0 and 4150 patients as M41.1 according to ICD-10. The mean age was $12,5 \pm 2,9$ years (4-18).

Spine radiograph was performed in 1401 patients, in 16% no scoliosis was found, while in 84% scoliosis was confirmed. The mean scoliometer measurements in non-scoliotics were $5,1 \pm 2,0^\circ$ with mean Cobb angle $6,8 \pm 1,7^\circ$ and in scoliotics $7,1 \pm 3,7^\circ$ (1-26) with mean Cobb angle $21,0 \pm 11,6^\circ$ (10-87).

No statistically significant correlation was found between scoliometry and Cobb angle in group of non-scoliotics in total sample and according to age (<14 and ≥ 14 years) and gender, while in scoliotics it was statistically significant in all groups ($p < 0.001$).

A statistically significant difference was found in scoliometric measurements in non-scoliotic boys according to age (<14 and ≥ 14 years; $p = 0.019$), while in girls that wasn't the case ($p = 0.968$). In scoliotics, there was a statistically significant difference in scoliometry in both girls and boys according to age ($p = 0.023$ and $p = 0.024$).

Conclusion(s)

The results confirm previous findings that asymmetrical children can have straight spine and that scoliometer readings don't differ significantly between scoliotics and non-scoliotics. However, these children should not be discharged from the clinics due to the possibility of developing IS. With planned longitudinal analysis of these patients, our results can provide further evidence of these findings in the future.

Clinical significance

False positive cases like asymmetrical non-scoliotics were probably the reason of discontinuation of school screening programs in some countries. Based on previous research, it seems to be an inappropriate decision, because those children lose the opportunity to be followed up and their scoliosis to be detected and treated on time.

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THE APPLICATION OF THE PORTABLE 3D ULTRASOUND IMAGE SYSTEM IN THE SCHOOL SCREENING OF SCOLIOSIS.

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Background

X-ray is the standard method to diagnose scoliosis, but radiation is always a concern about its application in scoliosis screening. A portable 3D ultrasound imaging system can provide a radiation-free method in diagnosing scoliosis, but there is no study about its application in scoliosis screening.

Objective (s)

To determine the validity of portable 3D ultrasound imaging system in diagnosing scoliosis in suspected scoliosis screening students compared with X-ray.

Study Design

Cross-sectional Study

Methods

Students are screened using the forward bending test and by measuring the angle of trunk rotation (ATR) using a scoliometer. Those with an ATR more than 5 degree was applied both 3D ultrasound and

X-ray examination. The spinal process angle measured by ultrasound more than 5 degree and Cobb angle measured by X-ray more than 10 degree were diagnosed Scoliosis.

Results

There are total of 367 (Male 159, Female 208) suspected students who were then examined by both 3D ultrasound and X-ray, average age was 11 ± 5.3 year. There were 139 students' Cobb angle more than 10 degree in which 35 students' spinal process angle more than 5 degree. There were 75 students' spinal process angle more than 5 degree in which 35 students' Cobb angle were more than 10 degree. Therefore, the 3D ultrasound is with a sensitivity of 25.18%, specificity of 84.50%, and false positive rate of 15.5%. When the scoliosis patients classified into three types according to the major curve: upper thoracic(UT), thoracic(T) and Thoracolumbar(TL), the sensitivity of 3D ultrasound is 7.69%, 33.33% and 24.44%, respectively.

Conclusion(s)

The sensitivity of 3D ultrasound imaging system was relatively low, especially in the students with upper thoracic curves. In the setting of school screening, the portable 3D ultrasound imaging system should improve to increase its sensitivity.

Clinical significance

X-ray is the standard method to diagnose scoliosis, but radiation is always a concern about its application in scoliosis screening. A portable 3D ultrasound imaging system can provide a radiation-free method in diagnosing scoliosis. This is the first study about its application in scoliosis screening. It found the sensitivity of 3D ultrasound imaging system was relatively low, especially in the students with upper thoracic curves. The portable 3D ultrasound imaging system should improve to increase its sensitivity.

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EXPLORING THE NECESSITY OF INCORPORATING FOOT ARCH SCREENING IN SCOLIOSIS SCREENING: AN ANALYSIS OF DATA FROM 7786 STUDENTS

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Background

Given the subtle onset of scoliosis, early detection through screening is of paramount importance. In China, to enhance prevention and control measures, the screening for spinal deformities has been integrated into the national surveillance program for common student health issues since 2019, and has become a part of the annual or freshman physical examination since 2021. However, current global screening protocols often focus on methods such as the forward bend test and scoliometer measurements, overlooking the significance of foot arch screening.

Objective (s)

The primary purpose of this study was to analyze the necessity of incorporating foot arch screening in scoliosis screening. By examining a large sample of students, we aimed to determine whether there is a significant association between foot arch characteristics and scoliosis, and to evaluate whether adding foot arch screening could improve the efficiency and accuracy of scoliosis screening.

Study Design

A cross-sectional study design was implemented, enrolling a total of 7786 students aged 9-14 from multiple schools in Taishan and Daiyue districts of Tai'an City, China. Participants were required to undergo both foot arch and scoliosis screenings. The aim of the study is to conduct a comprehensive assessment of the relationship between these two health indicators within the context of a real-world school population setting.

Methods

Within the school setting, a multifaceted approach is taken to assess students' foot arch status, encompassing physical examinations that evaluate the foot's contour visually, palpate the arch, and assess its flexibility. The risk of scoliosis is identified through routine inspections and the Adam Forward Bend Test and scoliometer measurements to quantify Angle of Trunk Rotation(ATR). The data gathered from these screenings are meticulously collected and organized.

Results

Out of 7786 students, 574 were identified as possibly having scoliosis, which is 7.37% of the total number. Flatfoot was identified in 705 students, constituting 33.5% of the total. Among students with flatfoot, 33.5% were considered potentially susceptible to scoliosis, and 4.68% had an ATR angle of 7° or greater. The detection rate for scoliosis in students without flatfoot was 1.06%.

Conclusion(s)

It has been observed that among students with abnormal foot arches, those with flat feet, particularly those with bilateral imbalance in foot arches, have a higher prevalence of scoliosis compared to students with normal foot arches.

Clinical significance

In clinical practice, this discovery highlights the significance of taking foot arch status into account during scoliosis screenings, particularly for children and adolescents. By incorporating observations of foot arches and posture, along with the forward bend test, parents and healthcare providers can more promptly identify individuals at high risk for scoliosis.

EXTENDING CONVOLUTIONAL NEURAL NETWORKS TO DETECT SYMMETRICAL DIFFERENCES IN VIDEORASTERSTEROGRAPHIC BACK SCANS WITH THE AIM TO IMPROVE SCREENING OF ADOLESCENT IDIOPATHIC SCOLIOSIS

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Background

Adolescent idiopathic scoliosis (AIS) treatment has an improved prognosis when discovered early. However, current screening methods show high referral rates (positive predictive values range 0.17-0.50 for Cobb angles >10°), making them cost-intensive.

While artificial intelligence, especially convolutional neural networks (CNN), are popular and strong approaches to combat these problems, they lack the ability to identify and compare symmetries. This could, however, be key to improving and objectifying screening predictions. Recent developments in other medical specialties show promising to be adapted for more effective AIS screening.

Objective (s)

This study aims to create a CNN that identifies asymmetries of the human back and determines whether they are scoliotic or not. To achieve this, a “DeepSymNet” approach was implemented to analyze symmetry-sensitive videorasterstereographic (VRS) images of AIS patients.

Study Design

For this study, subjects underwent standard posture assessments (according to 2016 SOSORT guidelines) and they classified into having AIS, having other postural deficiencies (e.g., hyperkyphosis, hyperlordosis) or healthy. Then, standing in habitual posture, a VRS measurement was taken. From each VRS measurement, Gauss and mean curvature images were prepared for further analysis.

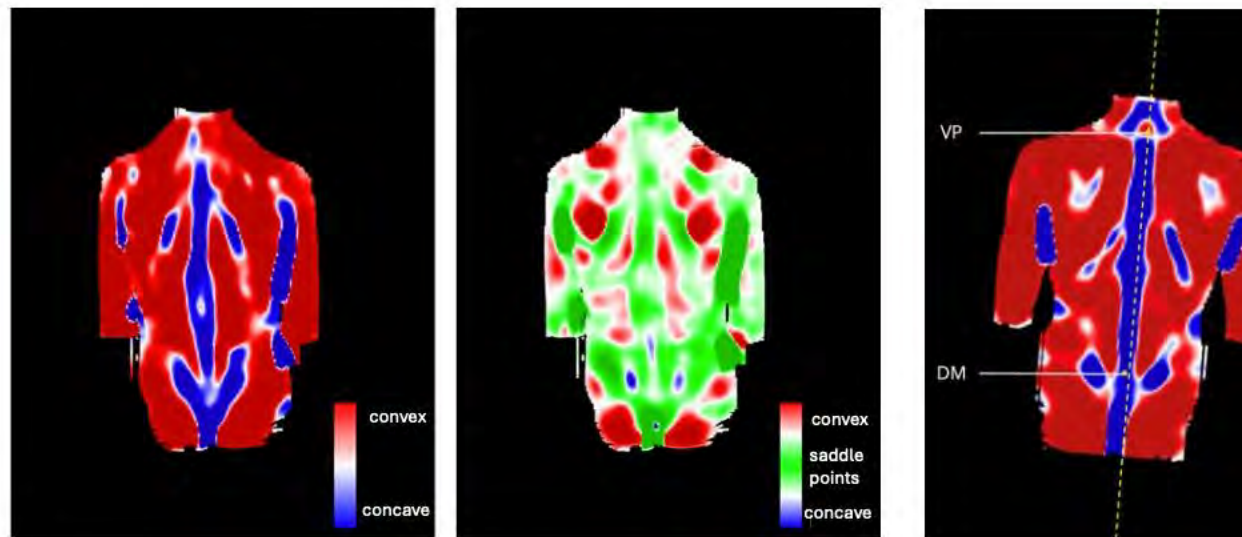
Methods

A total of 1486 rasterstereographic measurements were collected from individuals aged 6 to 19 years (11±2.4 years), 360 with AIS, 313 with other postural deficiencies and 813 with no postural deficiency. Mean and Gauss images were pre-processed such that the symmetry line was centered in the image. Finally, a 2-channel CNN based on DeepSymNet was trained with a 65-20-15 train-validation-test-split, a method that analyzes left and right side of the image along the symmetry line separately and then identifies the differences. The results were compared to a regular CNN model.

Results

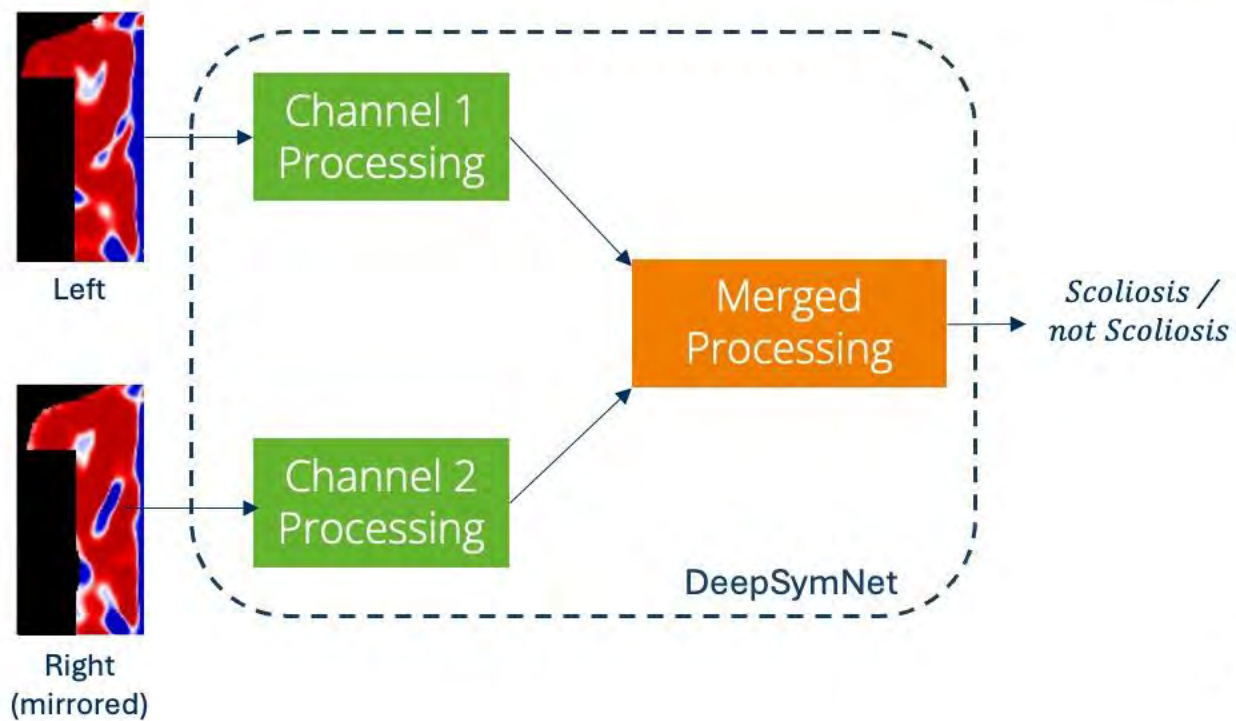
For the task of classifying subjects with AIS or without AIS a regular CNN achieved an accuracy (acc) of acc=0.72. DeepSymNet achieved acc=0.82 and acc=0.84 for mean and Gauss images, respectively, while Gauss images scored a higher specificity (0.71 mean vs. 0.86 Gauss). The positive predictive value was

0.68 for Cobb angles $>10^\circ$. The number of false negatives remains high (sensitivity=50%).



a) Left: mean image, right: Gauss image

b) Image



c) Overview of 2-channel processing with DeepSymNet

Conclusion(s)

DeepSymNet performed better than a regular CNN in differentiating between AIS and not AIS. In fact, this new approach increased the accuracy by 0.1. Moreover, the model improved the positive predictive rate by at least 0.18 compared to previous literature results. Differentiating between AIS and other postural deficiencies that also induce asymmetrical torso shapes remains a challenge, which is why numerous AIS cases were not detected. Further research on approaches that specifically identify the differences between these two groups is needed to combat this challenge.

Clinical significance

Expanding CNNs to incorporate symmetry learning based on non-ionizing measuring systems seems a promising approach for improving screening results. There is potential to make screening tests quicker and more objective to detect AIS earlier for better treatment.

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PREVALENCE FOR POSTURAL DISORDERS AND MUSCLE DYSFUNCTIONS IN THE EXAMINATIONS OF 800 CHILDREN AND ADOLESCENTS ANALYSED FOR CORRESPONDING ANTHROPOMETRIC RISK FACTORS

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Background

Postural disorders are prevalent in children and can lead to various chronic conditions in adulthood. Environmental, socioeconomic, and intrinsic factors influence postural development during puberty. Despite the potential benefits, school-based postural screenings are controversial due to concerns about costs, overreferrals, and unnecessary diagnostic procedures.

Objective (s)

This study aims to evaluate the prevalence of postural deviations among schoolchildren aged 7-13 in the german-polish border region and to assess the influence of demographic and anthropometric factors on these deviations to optimize future screening programs.

Study Design

A retrospective analysis of anonymised data from the screening program conducted between 2018 and 2019. The study is based on the results a comprehensive clinical examination of postural features conducted by a team of seven experienced physiotherapists.

Methods

The study sampled the examination data of 800 children (male: 367, female: 433) ages between 7 and 13, assessing 14 postural features including spinal alignment in various planes, pelvic static, body alignment, foot anatomy, and muscle functionality. Statistical analyses were conducted to identify significant correlations between postural deviations and factors such as sex, age, Body Mass Index (BMI), and Body Fat Percentage (BFP). The subjects were categorized into quartiles based on these anthropometric measurements to explore significant trends.

Results

The data shows that 80.6 % of all participants had at least one postural deviation. Overall 23.8 % of children were referred to a specialist for further consultation. The five most common postural deviations resulting in a referral are in body alignment (56.8 %), foot anatomy (53.1 %), spinal transverse plane (48.4 %) followed by muscle weakness (44.7 %) and spinal sagittal plane (42.6 %). Among all children complex spinal deformities like scoliosis (7.1 %) are less prevalent. The obesity rate is 24.6 %. Significant findings include an increase in muscle shortening with age and a higher prevalence of pelvic static issues and hyperkyphosis with lower BMI. High BFP was correlated with foot anomalies. No significant sex-based differences were noted after adjustments for multiple comparisons. Scoliosis, flat back and hyperlordosis showed no significant change in prevalence with age, sex, BMI or BFP.

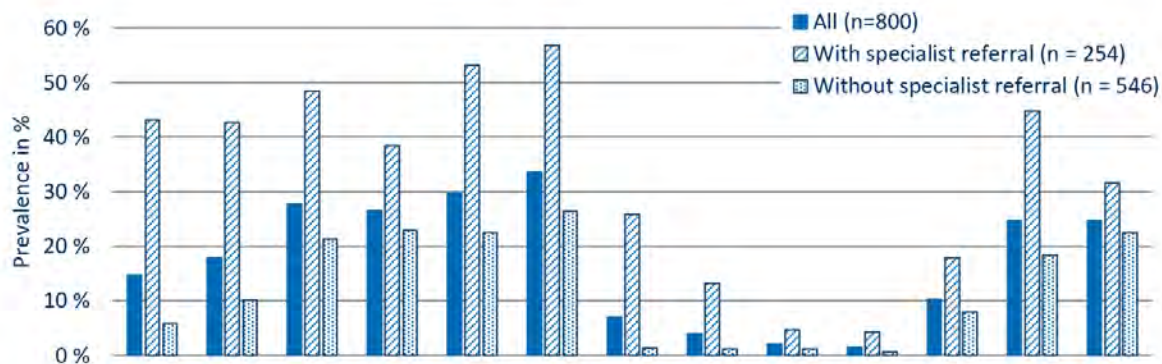


Figure 1 Prevalence of the individual posture deviations in subjects with and without a specialist referral. Each posture deviation showed significant differences in prevalence between these two groups.

Conclusion(s)

The study provides clinical evidence for targeted postural screening programs that focus on children at high risk due to specific anthropometric profiles, potentially reducing the financial burden and incidence of overreferrals in school-based screenings. The results highlighted that the substantial referral rate was primarily influenced by BMI and BFP deviations from the normative values of the World Health Organization. However, for scoliosis no simple anthropometric risk factor screening was identified that justifies a more targeted screening approach.

Clinical significance

Early detection and intervention for postural deviations during critical growth periods in children can prevent the progression of postural disorders and associated secondary diseases, promoting better health outcomes.

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THE GUIDELINE FOR INTERVENTION DESCRIPTION IN REHABILITATION (GUIDE-REHAB): A TOOL TO OPEN THE “BLACK BOX” OF REHABILITATION COMPLEX INTERVENTIONS

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Background

The World Health Assembly adopted a resolution to strengthen rehabilitation in health systems and improve the quality of rehabilitation research globally. Reporting guidelines can enhance the report but also the conduct of research. Rehabilitation is a complex and, at times, poorly described intervention. Similarly to what happens for other complex interventions, it has been characterised as a “black box” intervention. The existing reporting guidelines have not resolved the problems. We developed the Guideline for Intervention Description in Rehabilitation (GUIDE-Rehab) to address this issue and contribute to solving the problem of describing complex interventions.

Objective (s)

To develop a reporting guideline for the description of rehabilitation interventions for research purposes.

Study Design

Mixed-methods study, including research preparatory papers, Delphi rounds, consensus meetings and piloting.

Methods

We followed the EQUATOR Network’s guidance and reported on the consensus procedure using the ACCORD reporting guideline. The background preparation work included 21 papers identifying the needs

and defining the baseline knowledge. The GUIDE-Rehab contents development started from the TIDieR reporting guideline, the Rehabilitation Treatment Specification System, and the definition of rehabilitation for research purposes. The Executive Committee participated in the consensus meeting and the Delphi process, which also included the Advisory Committee. We performed a three-phases piloting: editorial, clinical research and general rehabilitation.

Results

The Executive and Advisory Committees included 16 and 29 experts, respectively, and the piloting involved 17 chief editors, seven research groups and the participants in 10 scientific rehabilitation and evidence meetings. In total, we involved 68 experts from 26 countries of all continents, including the Global South. The guideline includes four versions: complete (16 items), short (10 items), uncontrolled studies (13 items), and graphical intervention description (9 items), each designed to cater to different research needs. It also consists of a glossary of terms and explanations for implementation, with twelve items of the complete version referring to the methods, two to the discussion, and one to the abstract/introduction and the results sections.

Conclusion(s)

GUIDE-Rehab will support reporting standardised descriptions of complex rehabilitation interventions to improve clinical research and may support the implementation of rehabilitation interventions in clinical practice. GUIDE-Rehab is specific to rehabilitation, but the theory approach used to open the “black box” could inform the development of reporting guidelines for other complex interventions. The concept and reporting of background treatment could be relevant beyond rehabilitation.

Clinical significance

GUIDE-Rehab could help solve some of the issues in understanding treatments for spinal deformities in children and adults. This poster provides additional information on the background of two other abstracts presented for the Conference implementing GUIDE-Rehab to describe brace and exercise treatments.

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ULTRASOUND CURVE ANGLE (UCA) DEMONSTRATE GREATER ACCURACY THAN EXISTING METHOD TO REDUCE UNNECESSARY RADIATION IN SCOLIOSIS SCREENING – A PROSPECTIVE DIAGNOSTIC ACCURACY STUDY IN A PRIMARY COHORT OF 414 PATIENTS VALIDATED BY A SEPARATE COHORT OF 95 PATIENTS

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Background

Adolescent idiopathic scoliosis (AIS) is a complex three-dimensional spinal deformity. Hong Kong has a well-established scoliosis screening program since 1995, referring more than 3000 cases for radiographical confirmation of scoliosis every year.

Ultrasonography emerged as a possible radiation free alternative for scoliosis screening. A previous study showed that adding spinous process angle (SPA) measurement with ultrasonography to the current screening workflow could reduce the number of unnecessary referrals for radiography by more than 50%. The Ultrasound Curve Angle (UCA) was developed as a novel algorithm to measure ultrasound-based Cobb angle, designed to be more robust in cases with spinal rotation compared with SPA.

Objective (s)

(a) Evaluate the accuracy of US (SPA vs UCA) in determining Referral Status for orthopaedic consultation in a primary cohort of skeletally immature AIS girls; and (b) to validate the findings in a consecutive separate cohort of skeletally immature AIS girls. Referral for orthopaedic consultation was indicated and hence Referral Status was considered positive when EOS-Cobb angle $\geq 20^\circ$.

Study Design

Prospective diagnostic accuracy study

Methods

Girls aged 10-14 years old recommended for x-ray in the scoliosis-screening program were recruited from 2018 to 2020. Another consecutive cohort of AIS girls were recruited for validation between 2020 to 2023. Ultrasound scanning using a validated system was done according to a standardized validated procedure. All EOS x-rays were taken within 4 weeks of ultrasound measurements with a similar standing position as that for US measurement. Investigators for US measurement were blinded of EOS Cobb angle measurement and vice versa for the EOS Cobb angle investigator.

Results

In the primary cohort of 413 girls (aged 11.8 ± 1.1 , Cobb $14.1 \pm 6.7^\circ$), the ROC-AUC for using US to predict positive Referral Status defined as EOS-Cobb $\geq 20^\circ$ was 0.70 for SPA, and 0.88 for UCA. In the validation cohort of 94 girls (aged 12.2 ± 1.0 , Cobb $14.7 \pm 7.0^\circ$), the ROC-AUC for using US to predict EOS-Cobb $\geq 20^\circ$ was 0.78 for SPA, and 0.89 for UCA. The results indicated that UCA had better performance in predicting EOS-Cobb $\geq 20^\circ$ than SPA, with a sensitivity of 0.94 and specificity of 0.59 in the primary cohort, and sensitivity of 0.96, and specificity of 0.56 in the validation cohort. Combining both cohorts, 6 cases with a mean cobb angle of 28.1° were screened false negative (Table 1).

Conclusion(s)

Incorporation of ultrasonography into the scoliosis screening program could potentially reduce unnecessary radiography by 56-59% in skeletally immature female AIS patients. The strengths of the study are the direct comparison of the UCA and SPA methods, a large sample size of early mild AIS patients, and inclusion of a validation cohort to verify the logistic regression models developed.

Clinical significance

Ultrasonography shows promising potential in scoliosis screening. implementation studies could be considered for incorporation of USG into the scoliosis screening workflow.

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MALNUTRITION AND BODY COMPOSITION ASSESSMENT USING BIOELECTRICAL IMPEDANCE ANALYSIS IN ADOLESCENTS WITH ADOLESCENT IDIOPATHIC SCOLIOSIS TREATED IN ORTHOPEDIC HOSPITAL VALDOLTRA, PILOT STUDY

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Background

There is very little known about the prevalence of malnutrition and changes of body composition in adolescents with Adolescent Idiopathic Scoliosis (AIS). Limited research has explored body composition in this population, with findings suggesting lower lean and fat mass compared to healthy peers.

Objective (s)

To investigate the prevalence of malnutrition and body composition changes in patients with AIS undergoing conservative treatment at Orthopaedic Hospital Valdoltra.

Study Design

Case Series.

Methods

We conducted a pilot study on five female patients aged 12–16 years who were treated in December 2024. The Cobb angle was measured from the latest radiographs. Malnutrition screening was performed via Pediatric Yorkhill Malnutrition Score (PYMS) questionnaire evaluating factors such as body mass index (BMI), weight loss, appetite, clinical condition. The PYMS ranges from 0 to 7, with scores above 2 indicating the need for dietitian referral. Body composition was evaluated using bioelectrical impedance analysis (BIA). Using Microsoft Excel, we performed descriptive statistical analyses of body composition variables and compared the results with data from the existing literature. To account for age-related variability, we calculated Z-scores for height, weight, and BMI based on standardized growth curves.

Given the small sample size, statistical hypothesis testing was not performed. We also estimated the sample size required for the continuation of the study (significance level 0.05, power 70%, correlation - 0.30, based on previous studies), which is between 65 and 70 female patients.

Results

The BMI Z-scores ranged from 0.08 to -1.38, while the proportion of lean body mass (LBM) ranged from 70% to 86%, with the highest proportion observed in the patient with the lowest BMI Z-score. The patient, with a BMI Z-score of -1.38 indicating mild malnutrition, had an elevated total body (TBW) water to extracellular water (ECW) ratio of 0.48 and was the only one yet to undergo menarche. Three patients scored 1 point on PYMS, while two scored 0. The patient with the highest Cobb angle had the lowest LBM percentage (70%), the lowest absolute LBM (36 kg, at a body weight of 52 kg and age of 14 years), lowest fat-free mass index (FFMI) of 13.2 kg/m², increased TBW/ECW ratio (0.48) and PYMS score of 1.

Conclusion(s)

Based on the results, we proposed an initial working hypothesis that a greater Cobb angle is associated with a lower proportion of LBM relative to FM. Mild malnutrition was observed in this cohort, indicating that malnutrition may not be uncommon among adolescents with AIS. A follow-up study with more participants will hopefully provide further evidence about the link between the severity of AIS and LBM to FM ratio and prevalence of malnutrition.

Clinical significance

Our findings highlight the importance of assessing body composition and diagnosing malnutrition to enable early intervention and treatment for malnourished AIS patients.

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IDIOPATHIC SCOLIOSIS PATIENT EXECUTIVE CONTROL (PEC) IN THE PRIMARY HEALTH CARE SYSTEM

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Background

Screening studies reveal the IS pathology in 4–9% of school-age children, among them active progression observed in 15–25%. However, there is lack of monitoring, control and timely prescription of corrective treatment (incl. brace and exercises in children with IS) in Russian Federation and other countries.

Objective (s)

The objectives of the study were to study global experience, prepare information resources and optimize the methodology for screening progressive spinal deformities due to IS, which can subsequently be used in the domestic healthcare system. The main possible directions for introducing PEC for IS in pediatric and adolescent orthopedics are highlighted.

Study Design

Systematic review and PEC development

Methods

17 regulatory documents regulating the provision of orthopedic care to children in the Russian Federation and the CIS countries were studied. The reporting on the identified incidence of IS and the results of conservative treatment in regions were included.

Results

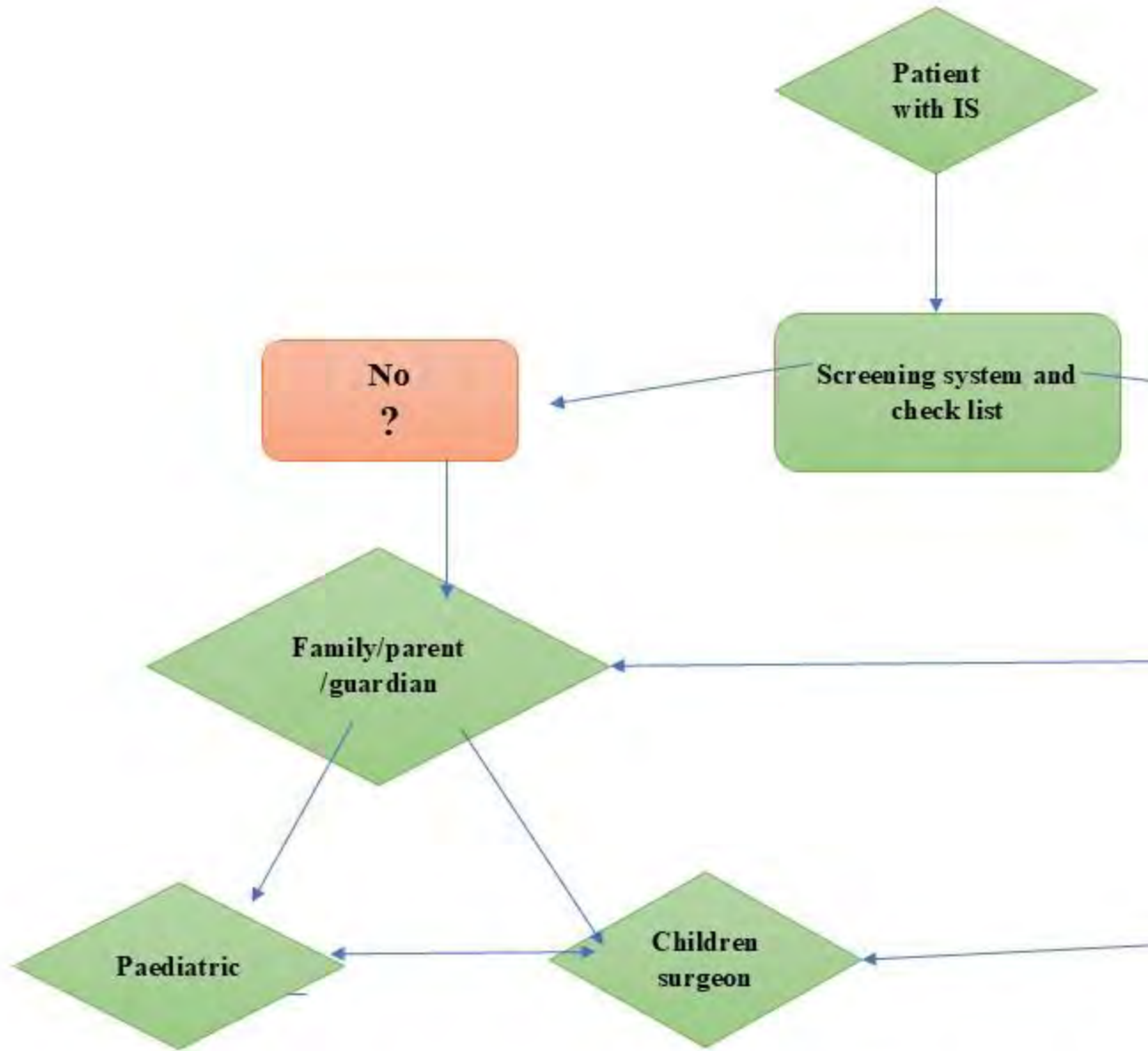


Figure . PEC levels interaction algorithm in patients with IS in the pr

The following directions for the primary level in providing orthopedic and trauma care to children and adolescents with IS are proposed:

- development and testing of checklists and scales for assessing the orthopedic status for primary care specialists;

- planning and implementation of the regions pilot projects on early detection of pathology;
- prescribing and conducting brace treatment in growing patients with IS;
- clinical justification for the inclusion of compensation for the costs of implementing this treatment in the compulsory health insurance system (CHI).

Conclusion(s)

The proposed PEC system must include the patient's family/parent or guardian, who perform this function in the options of keeping observation diaries, video reporting on the implementation of specialized therapeutic physical training, using the connection of various monitoring sensors (detectors) wearing the brace when it is prescribed.

The considered directions for the primary level in providing orthopedic and trauma care to children and adolescents with IS are proposed for use in the domestic as well as international health care system.

Clinical significance

Systematic review and observational study

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SCOLIOSIS PREVALENCE IN SCHOOL SCREENING IS DEPENDENT ON SCREENING TECHNIQUE: COMPARISON OF SCOLIOMETER VERSUS NON-SCOLIOMETER EXAMINATION

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Background

Idiopathic scoliosis is considered the most frequent musculoskeletal disorder in children. The prevalence is reported to be about 2-3% of the growing population. Bunnell scoliometer is used for scoliosis screening. However, for some professionals, the clinical examination without scoliometer is claimed to be of the same or superior value for scoliosis school screening.

Objective (s)

To compare the positive screening rates revealed by scoliometer screening versus physiotherapeutic clinical examination without scoliometer.

Study Design

Cross-sectional study

Methods

In the frame of a school screening program endorsed by the municipality of the 500-thousand-habitants city, 9282 pupils aged 7-10 years old were examined. The screening was performed twice at the same day by the same group of physiotherapists trained in scoliosis detection. The first examination did not involve the Bunnell scoliometer and consisted of observing and/or palpating trunk asymmetries in standing or in bending position. At the end of examination, the diagnosis of scoliosis suspicion (positive screening) versus the normal trunk was put.

Then, the same day, the same physiotherapists performed the examination of the same children using the Bunnell scoliometer. The cut-off values of the Angle of Trunk Rotation (ATR) were: 7 degrees or more = suspicion of scoliosis (positive screening), 4-6 degrees = grey zone comprising children to be re-examined in 6-12 months, and 0-3 degrees = normal spine.

Results

Positive scoliosis screening outcome concerned 432 children (4.7%) for the non-scoliometer screening versus 81 children (0.87%) for scoliometer screening. The number of positively screened females to males (F/M) was 210/222 children in non-scoliometer screening versus 47/34 children in scoliometer screening, Table1, 2.

In scoliometer group, the normal spine was diagnosed in 8128 (87.6%) children while the grey zone of 4-6 ATR in 1073 children (11.6%).

In scoliometer group, the number of right-sided trunk asymmetry versus the left-sided trunk asymmetry (R/L) presented as follows ATR=0: 3477; ATR=1-3 degrees: R/L = 2835/1816; ATR=4-6: R/L = 713/360; ATR= 7 or more: R/L = 63/18.

Table 1. Scoliosis screening of 7-10 years children in scoliometer group

Positive screening	M	F	M+F
Yes	34	47	81
No	4580	4621	9201

Table 2. Scoliosis screening of 7-10 years children in non-scoliometer group

Positive screening	M	F	M+F
Yes	222	210	432
No	4392	4458	8850

Conclusion(s)

Scoliosis screening based on clinical examination revealed to be not enough specific, resulting in a high rate of positively screened children. Scoliosis screening with the use of scoliometer allowed for a more specific outcome and revealed important data about the male to female and right to left proportion of scoliotic asymmetry in children.

Clinical significance

The study supports performing scoliosis screening with the use of scoliometer and can be helpful in endorsing scoliosis screening programs.

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COMPARISON OF POSTURAL CONTROL AND BALANCE METRICS IN CHILDREN AND WITHOUT SCOLIOSIS

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Background

Postural control and strength are critical for maintaining balance and performing dynamic movements, especially in individuals with postural deviations or spinal deformities. Thoracic and lumbar scoliosis, as well as poor posture, can alter biomechanical and neuromuscular mechanisms because they disrupt spinal alignment and muscle activation patterns, leading to compensatory movements, uneven force distribution, and reduced stability.

Objective (s)

To assess differences in postural control and strength among children with and without scoliosis by analysing static and dynamic balance metrics, with a particular emphasis on concentric and eccentric forces during squats and postural sway during balance tasks.

Study Design

Cross-sectional study

Methods

The study was approved by the local Ethical Committee (49-02-04/2023-1). Parents or legal guardians signed informed consent forms for their children's participation in the study. Thirty-five girls were divided into three groups: Lumbar scoliosis (N = 12; age: 12.8 ± 1.1 years; height: 163.1 ± 10.5 cm; weight: 49.7 ± 11.9 kg), Thoracic scoliosis (N = 13; age: 12.6 ± 1.8 years; height: 166.0 ± 9.2 cm; weight: 57.4 ± 12.0 kg), and Non-scoliotic (control) group (N = 10; age: 12.5 ± 1.4 years; height: 158.0 ± 18.6 cm; weight: 42.1 ± 17.6 kg). Participants were instructed to performed a 10-second quiet stand, single-leg stands (10 seconds per leg), and 10 squats, all on force plates. General Linear Model and post-hoc tests were performed using Jamovi software to detect differences among the groups.

Results

One-Way ANOVA (Fisher's)	F	df1	df2	p
Body Height [cm]	3.1244	2	29	0.059
Body Weight [kg]	2.7667	2	26	0.081
SLS Area of CoP Ellipse [mm ²]	1.0203	2	25	0.375
SLS CoP Range - Anterior-Posterior [mm]	1.1013	2	25	0.348
SLS CoP Range - Anterior-Posterior [mm] (L)	0.2183	2	25	0.805
SLS CoP Range - Anterior-Posterior [mm] (R)	0.6923	2	24	0.51
SLS CoP Range - Medial-Lateral [mm]	1.8783	2	25	0.174
SLS CoP Range - Medial-Lateral [mm] (L)	0.464	2	25	0.634
SLS CoP Range - Medial-Lateral [mm] (R)	2.7531	2	24	0.084
SLS Area of CoP Ellipse [mm ²] (L)	0.1518	2	25	0.86
SLS Area of CoP Ellipse [mm ²] (R)	0.8439	2	24	0.442
SLS Mean Velocity [mm/s]	2.3645	2	25	0.115
SLS Mean Velocity [mm/s] (L)	1.5402	2	25	0.234
SLS Mean Velocity [mm/s] (R)	1.6836	2	24	0.207
SLS Total Excursion [mm]	2.3645	2	25	0.115
SLS Total Excursion [mm] (L)	1.5402	2	25	0.234
SLS Total Excursion [mm] (R)	1.6836	2	24	0.207
QSB Area of CoP Ellipse [mm ²]	0.6665	2	25	0.522
QSB CoP Range - Anterior-Posterior [mm]	0.6247	2	25	0.544
QSB CoP Range - Medial-Lateral [mm]	2.2945	2	25	0.122
QSB Mean Velocity [mm/s]	0.1057	2	25	0.9
SQ Concentric Mean Power [W]	1.8536	2	25	0.178
SQ Concentric Mean Power / BM [W/kg]	0.0487	2	25	0.953
SQ Concentric Peak Power / BM [W/kg]	0.1214	2	25	0.886
SQ Eccentric Mean Force [N]	4.5039	2	25	0.021
SQ Eccentric Mean Power / BM [W/kg]	0.6445	2	25	0.533
SQ Eccentric Peak Power / BM [W/kg]	0.658	2	25	0.527
SQ Concentric Mean Force [N]	5.0022	2	25	0.015
SQ Maximum Negative Displacement [cm]	0.3945	2	25	0.678

No significant differences were found in static balance measures among the groups ($p > 0.05$). The area of CoP ellipse during single-leg stance was similar between groups (Control: 143.2 ± 28.5 mm²; Lumbar: 152.4 ± 31.7 mm²; Thoracic: 157.8 ± 29.1 mm²; $p = 0.375$). In contrast, the thoracic scoliosis group showed

reduced concentric (275.3 ± 45.8 N) and eccentric forces (245.6 ± 38.7 N) during squats compared to the control group (310.2 ± 41.2 N and 283.5 ± 42.1 N, respectively; $p = 0.015$ and $p = 0.021$).

Conclusion(s)

The findings suggest that thoracic scoliosis uniquely impacts dynamic force production, as evidenced by reduced concentric and eccentric forces during squats. This is likely due to increased postural sway, center of mass instability, and compensatory neuromuscular adaptations. These factors distinguish individuals with thoracic scoliosis from the control group during tasks requiring controlled force production. Future research should explore the relationship between sway, stability, and dynamic performance to inform targeted interventions and expand the studied age range.

Clinical significance

These findings emphasize the need to account for thoracic scoliosis when assessing dynamic performance, as this condition specifically affects force production during movements like squats. Rehabilitation programs should prioritize exercises that target concentric and eccentric strength to address these deficits, improving functional performance and reducing injury risk. A focused approach tailored to the unique biomechanical challenges of thoracic scoliosis can enhance the effectiveness of therapeutic interventions.

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UTILIZATION OF THE COMMUNITY ENGAGEMENT STUDIO MODEL TO FACILITATE PARTICIPATORY DESIGN OF A MULTICENTER RANDOMIZED CONTROLLED TRIAL ON THE EFFICACY OF SCOLIOSIS SPECIFIC EXERCISE REHABILITATION

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Background

Meaningful engagement involving those with lived experience in research design ensures that interventions are both scientifically sound and relevant. In adolescent idiopathic scoliosis (AIS), where exercise rehabilitation options are limited, including the voices of both patients and caregivers in all steps of the research process is crucial.

Objective (s)

Supported by an NIH clinical trial planning grant, we explored barriers, facilitators, and strategies for recruitment, retention, outcome selection, and defining success in a multicenter randomized controlled trial (RCT) on scoliosis exercise rehabilitation for children with AIS.

Study Design

We utilized Community Engagement (CE) Studio model.

Methods

The CE Studio model, which offers a structured framework to support participatory design, was conducted with children living with AIS and their caregivers. The CE Studio was implemented with trained facilitators, following the NIH-approved model.

Children, ages 10-16 years, living with AIS, no prior spinal surgery, with/without brace, and/or their caregivers were eligible as Community Experts. Participants were recruited through past engagement databases, community organizations, and social media groups, ensuring a diverse eligible group of experts.

During the 1.5-hour interactive session, researchers provided a project overview. The facilitator posed key questions and guided the discussion. Feedback was documented, capturing major themes and individual suggestions. Experts were compensated for consulting. One week after the CE studio, a survey with follow-up questions was distributed to the participants using Qualtrics.

CE Studio is an advisory, non-research consultative session and is institutional review board (IRB) exempt.

Results

Eighty-one individuals responded to our invitation, with 31 eligible participants across 16 US states and one Canadian province. Eighteen experts participated, including nine girls aged 12-16 years and their caregivers, from seven race/ethnic groups (by self-report) and representing nine states.

All participants deemed the study important, saw benefits, and would be willing to enroll. Of those not currently in physical therapy/rehabilitation, 43% cited limited access, 57% reported doctor skepticism, and 43% reported their doctors' preference for bracing only. 78% of this group would be willing to be randomized (to either the active intervention or the 6-month waitlist control arm).

The most bothersome issue reported by the children with AIS was pain (50%), while 17% mentioned brace discomfort. All participants prioritized preventing progression, surgery, and improving pain and appearance as main goals, while parents highlighted quality of life concerns.

Conclusion(s)

Overall, there was a strong willingness to participate, regardless of the treatment group assignment. Pain and progression were the greatest concerns. Common themes included limited access to therapy and a desire for improved communication with healthcare providers about non-operative management options to support shared decision-making.

Clinical significance

CE Studios bridge the gap between researchers and the community, leading to more patient-centered, effective, and impactful clinical research.

Final category: 3 Exercise Treatment

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THE EFFECT OF SPECIFIC FEED-FORWARD TRAINING TO ADOLESCENT IDIOPATHIC SCOLIOSIS: A RANDOMIZED CONTROLLED CLINICAL TRIAL

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Background

The abnormal feed-forward patterns in the shoulder stabilizing muscles of individuals with adolescent idiopathic scoliosis (AIS) has been found. While the Schroth exercise is the most widely used exercise approach for scoliosis, research on its effects on feed-forward adjustment remains limited.

Objective (s)

The purpose of this study is to explore the effects of a combined Schroth exercise with specific feed-forward training for shoulder stabilizing muscles, compared to Schroth exercise alone.

Study Design

Randomized controlled trial.

Methods

The study recruited participants diagnosed with AIS from outpatient of rehabilitation. All participants must exhibit right thoracic and left lumbar curves characteristic of S-shaped scoliosis. Participants were randomly assigned to the experimental group (Schroth combined with feed-forward training) or the control group (Schroth). The approximately 30-min feed-forward training focused on the shoulder stabilizers and consisted

of four movements, Y pull-down, seated rowing maintenance, shoulder external rotation training and ball rolling with upper extremity in prone. Participants received three times outpatient treatment and 3 to 4 home-based training sessions per week, each lasting 1.5 hours, for three weeks. Pre- and post-intervention assessments included measurement of anticipatory muscle activation (AMA) using surface electromyography (upper trapezius, lower trapezius, infraspinatus, serratus anterior), angle of trunk rotation (ATR) with scoliometer, postural symmetry through the Global Postural Scale, and scoliosis-related quality of life via the Scoliosis Research Society 22-item questionnaire (SRS-22). The primary outcome is activation time of the scapular stabilizers, others are secondary outcomes.

Results

The study involved 20 participants, where 90% (n = 18) were female and 10% (n = 2) were male. The mean age and Rissre sign of all individuals were 14.45 ± 2.36 years and 3.5 ± 0.87 . The mean Cobb angle of the thoracic and lumbar were 27.6 ± 9.10 and 27.95 ± 10.53 . After 3-week treatment, the experimental group demonstrated a significantly decrease in the incidence of effective AMA on the ipsilateral upper trapezius (69.81% vs. 83.30%, $F = 7.425$, $P = 0.015$, $\eta^2_p = 0.317$) compared to the control group. For activation latency, ipsilateral lower trapezius in the experimental group activated significantly earlier than in the control group (-16.83 vs. -0.90 , ms, $F = 6.195$, $P < 0.023$, $\eta^2_p = 0.256$). Additionally, the experimental group showed a significant improvement in scapular alignment compared to pre-treatment (4.17 vs. 2.06 , degree, $P < 0.05$), and the control group showed a significant improvement in lumbar angle difference (14.09 vs. 11.05 , degree, $P < 0.05$). Furthermore, ATR in lumbar segment and SRS-22 scores improved compared to pre-treatment in both groups ($P < 0.01$).

Conclusion(s)

The findings suggest that incorporating feed-forward training into Schroth exercise can enhance muscle activation patterns and postural control in AIS subjects.

Clinical significance

These initial findings need further investigation in larger, multi-center trials to establish long-term benefits and broader applications for AIS management in the future.

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COMPARATIVE MUSCLE ACTIVATION PATTERNS OF THE SHOULDER JOINT IN ADOLESCENT IDIOPATHIC SCOLIOSIS : AN EMG STUDY OF DIFFERENT CURVE TYPES

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Background

Previous studies have demonstrated that patients with main thoracic curves in Adolescent Idiopathic Scoliosis(AIS)exhibit differences in muscle activation patterns around the shoulder compared to healthy controls.

Objective (s)

This study compares muscle activation patterns in AIS patients with different curve types to healthy controls, aiming for a comprehensive understanding to guide physical therapy.

Study Design

A cross-sectional study

Methods

The study included 3 groups of AIS patients(main thoracic curve,double curves, single thoracolumbar/lumbar curve AIS),each group containing 12 subjects, and 12 healthy controls.EMG sensors were placed on the bilateral Anterior Deltoid, Upper Trapezius(UT), Middle Trapezius (MT),Lower Trapezius(LT),Infraspinatu and Serratus anterior.Subjects performed shoulder flexion movements, and EMG features were analyzed for temporal and spectral changes, including onset duration, root mean square, integrated EMG, and power density across frequency bands. Muscle synergy was assessed using coherence analysis.

Results

<i>feature/class</i>	significant difference data	
	Healthy controls	thoracic
<i>Right_trapezius_onset_duration</i>	1928.92 ± 656.49	1685.12 ± 456.78
<i>Left_serratus_anterior_normalization_EMG</i>	0.26 ± 0.18	0.30 ± 0.15
<i>Trapezius_coherence_delta_to_delta</i>	0.76 ± 0.19	0.51 ± 0.12
<i>Middle_and_lower_trapezius_coherence_delta_to_delta</i>	0.40 ± 0.38	0.65 ± 0.25
<i>Lower_trapezius_coherence_delta_to_alpha</i>	5.72e-03 ± 1.01e-02	-2.8e-03 ± 1.2e-02
<i>Lower_trapezius_coherence_delta_to_beta</i>	-1.69e-04 ± 1.94e-04	-1.9e-04 ± 1.5e-04
<i>Trapezius_coherence_alpha_to_alpha</i>	0.15 ± 0.05	0.15 ± 0.04
<i>Lower_trapezius_coherence_beta_to_delta</i>	-4.64e-05 ± 5.71e-04	-1.0e-05 ± 1.2e-04
<i>Infraspinatus_coherence_beta_to_alpha</i>	1.31e-03 ± 2.38e-03	5.72e-04 ± 1.5e-03
<i>Trapezius_coherence_beta_to_beta</i>	0.03 ± 0.04	0.07 ± 0.03
<i>Right_anterior_deltoid_delta_frequency_band_energy</i>	3.02e-08 ± 2.85e-08	8.14e-09 ± 1.2e-08
<i>Right_anterior_deltoid_alpha_frequency_band_energy</i>	1.57e-09 ± 1.28e-09	1.20e-09 ± 8.5e-10
<i>Right_trapezius_alpha_frequency_band_energy</i>	5.47e-10 ± 4.33e-10	2.67e-10 ± 1.5e-10
<i>Right_anterior_deltoid_beta_frequency_band_energy</i>	2.66e-09 ± 2.69e-09	7.24e-10 ± 1.1e-09
<i>Right_trapezius_beta_frequency_band_energy</i>	8.14e-10 ± 6.45e-10	2.13e-10 ± 3.5e-10
<i>synergy_sparseness</i>	0.59 ± 0.06	0.67 ± 0.05

When comparing subjects with main thoracic curve to healthy controls, significant differences were observed in the onset duration of the right MT, coherence of the MT in the Delta to Delta and Alpha to Alpha bands, coherence of the LT in the Beta to Alpha band, and sparseness of muscle synergies ($P < 0.05$).

When comparing subjects with double curves to healthy controls, significant differences were noted in the IEMG of the left serratus anterior, coherence of the MT in the Delta to Delta and Alpha to Alpha bands, and coherence of the LT in the Delta to Delta band ($P < 0.05$).

When comparing subjects with single thoracolumbar/lumbar curve to healthy controls, significant differences were found in the coherence of the MT in the Delta to Delta and Beta to Beta bands, and coherence of the UT in the Delta to Alpha, Delta to Beta, and Beta to Delta bands ($P < 0.05$).

Upon muscle synergy analysis, the synergy similarities between healthy controls and AIS patients did not show any significant difference among the three groups of patients ($P > 0.05$).

Significant differences were observed in muscle activation patterns between AIS patients and controls. Main thoracic curve patients showed right MT insufficiency, poor MT-LT synergy, and sparse muscle synergies. Double curve patients had prolonged left serratus anterior activation and poor MT synergy but better LT synergy. Single thoracolumbar/lumbar curve patients

exhibited poorer inter-muscle coherence despite no significant activation differences. Muscle synergy analysis revealed no significant differences among patient groups, indicating similar changes compared to controls.

Conclusion(s)

AIS patients displayed distinct muscle activation patterns during shoulder flexion, with controls showing better synergy and neuromuscular synchronization. Even patients with single thoracolumbar/lumbar curves, without obvious shoulder abnormalities, differed significantly from controls.

Clinical significance

It is recommended to include shoulder muscle training in exercise interventions for AIS patients, as muscle activation patterns vary across different curve types.

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THE MUSCLE ACTIVATION PATTERN OF MILD ADOLESCENT SCOLIOSIS IS MORE SIMILAR TO THAT OF MODERATE SCOLIOSIS THAN HEALTHY CONTROLS

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Background

According to the SOSORT guidelines, observation is the main intervention when Cobb angle falls within 10° and 20°. However, whether exercise therapy is necessary for mild scoliosis is still debatable.

Objective (s)

This study aimed to compare the kinematics and muscle activation patterns between mild scoliosis patients (Cobb 10°-20°), moderate scoliosis patients (Cobb >20°), and healthy controls during functional movements, to inform physical therapy for mild scoliosis.

Study Design

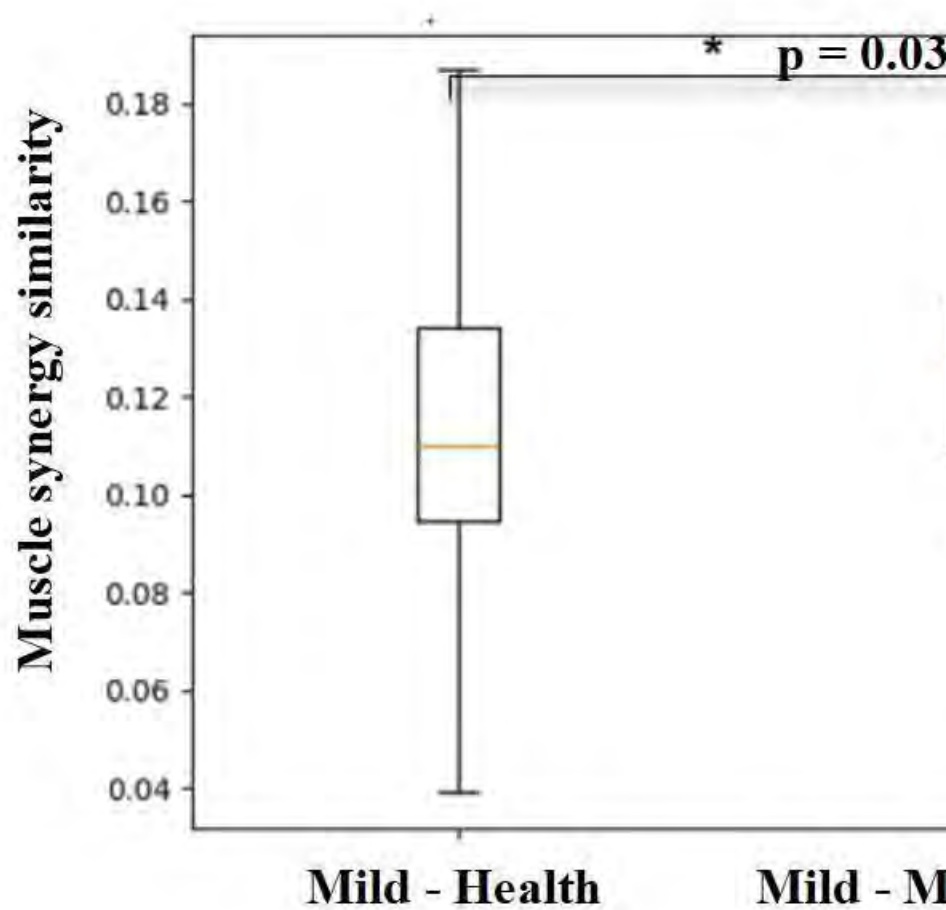
A cross-sectional study.

Methods

The study we enrolled 60 subjects (20 per group): healthy controls aged 10-13, mild scoliosis aged 10-13 with Cobb 10°-15°, and moderate scoliosis aged 10-16 with Cobb 20°-35°. They performed a 200-meter walk at normal pace, plank support, and shoulder exercise tests. Inertial measurement unit (IMU), electromyography (EMG) and plantar pressure signals were simultaneously collected during walking. IMUs were placed on both wrists, shoulders, and feet, EMG sensors on multifidus muscles (T2, T8, L1), quadriceps, gastrocnemius, tibialis anterior, and gluteus medius. Pressure sensors on anterior, middle, and posterior foot regions. During plank support (EMG placed on both sides of the erector spinae muscles at T2, T8, and L1 levels, upper and lower abdominal muscles) and shoulder joint (EMG placed on bilateral upper, middle, and lower trapezius, infraspinatus, serratus anterior, and deltoid anterior) movements, only EMG signals were collected. We extracted muscle synergies and spatio-temporal features from IMU and EMG signals for each step of walking or for each round of shoulder movements, then compared the features among the three groups and evaluated the similarities between the mild scoliosis and healthy control groups and between the mild and the moderate scoliosis groups through regression. Linear decoder was also used to classify subgroups within the mild scoliosis group.

Results

EMG signal analysis during walking, our findings from multiple perspectives (confusion matrix by linear decoder, muscle synergy similarity, muscle synergy sparsity, and regression on spectra-temporal features of EMG) provided consistent evidence that the muscle activation pattern of mild scoliosis were more similar to those of moderate scoliosis patients, compared with the similarity between mild scoliosis and healthy controls. Notably, in the confusion matrix analysis, we found that some subjects with mild scoliosis presented characteristics more similar to healthy controls, while the rest was more similar to those with moderate scoliosis. In other movements, muscle synergy similarity in shoulder flexion was more similar between mild and moderate scoliosis.



Interpretation: the muscle pattern of mild scoliosis is more similar to moderate patients compared with controls, suggesting a pa

Conclusion(s)

In terms of muscle activation patterns, mild scoliosis presented to be more similar to moderate scoliosis. Through confusion matrix analysis, it was suggested that there would be a subtype of mild scoliosis that is more similar to moderate scoliosis.

Clinical significance

Timely exercise therapy and neuromuscular control training are suggested for mild scoliosis patients to correct muscle activation patterns and prevent progression.

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CHANGES IN ODI SCORES FOLLOWING COMPLETION OF PSSE IN ADULTS WITH SCOLIOSIS MULTIPLE YEARS POST SPINAL FUSION

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Background

Disability due to low back pain is a potential long-term risk for patients multiple years post spinal fusion surgery for scoliosis. The ODI (Oswestry Disability Index) measures disability related to low back pain. Further research into the conservative management of long-term disability levels post spinal fusion for scoliosis is needed.

Objective (s)

The objective of this study is to report ODI outcomes of adults who completed Physiotherapeutic Scoliosis Specific Exercise (PSSE) for the first time multiple years post spinal fusion for scoliosis.

Study Design

Retrospective Case Series

Methods

Seven subjects with scoliosis and spinal fusion, aged 28-71 years (mean 56 years), were selected consecutively. None had participated in PSSE before. Six out of seven subjects (86%) were female. All

had successful post-operative recoveries from spinal fusion at least 4 years prior to treatment at an outpatient clinic specialized in scoliosis. Six out of seven subjects (86%) were fused into the lumbar spine. The population had a mean of 25 years post-surgery (range 4 years- 49 years) before initiating PSSE. Each subject sought out PSSE due to subjective reports of increased pain or decreased function. Each completed a long-term (minimum 1 year) follow-up ODI that was compared to the ODI completed upon their initial evaluation. PSSE sessions were 1 hour weekly for a minimum of 1 month, continuing as needed over an average of 2.7 years. Each subject was given a home program to complete self-practice between sessions and after discharge. Changes in ODI scores were retrospectively analyzed using the original and follow-up ODIs.

Results

On average, subjects demonstrated improvement in the ODI scores over the course of treatment. Six out of seven (86%) demonstrated positive improvement, with an overall average improvement of 13% on the ODI. Four out of seven (57%) demonstrated an improvement significant enough to move them into a category of lesser disability according to ODI interpreted levels of disability. No subjects progressed to a greater level of disability.

Conclusion(s)

The results of this retrospective case series indicate that there may be an association between PSSE and improvements in disability and function for adults with scoliosis who have undergone spinal fusion surgery multiple years prior to initiating PSSE.

Clinical significance

The results of this case series suggest that PSSE may be helpful in decreasing the level of disability in a subject with scoliosis multiple years post spinal fusion. Further research with a larger sample size and a valid control group is recommended to validate these results and enhance generalizability.

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REHABILITATION EFFECT OF CHRONIC CONTINUOUS STRETCHING TECHNIQUE FOR CHRONIC LOW BACK PAIN IN ADULTS WITH IDIOPATHIC SCOLIOSIS

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Background

Adult scoliosis refers to spinal deformity that manifests itself after skeletal maturation, generally defined as a Cobb angle greater than 10° in the coronal position. Adult scoliosis can be further divided into two categories: one is a deformity

that occurs before skeletal maturity and is presented at a later date, usually idiopathic scoliosis, but may also be congenital or paralytic scoliosis; The other type is deformity, which occurs after the bones have matured. It is often secondary to degenerative changes. The main symptoms of idiopathic scoliosis in adults include lower back pain and decreased ability to perform daily living. This study conducted a preliminary observation on the rehabilitation effect of suspension exercise training in adults with idiopathic scoliosis pain.

Objective (s)

To observe the effects of the chronic continuous stretching technique in the treatment of chronic low back pain in adults with idiopathic scoliosis

Study Design

Randomized controlled trials

Methods

Thirty-six adult patients with idiopathic scoliosis were divided into treatment group and control group by age- and sex-matched methods, and the pain numeric score (NRS) and Oswestry low back pain questionnaire were used to evaluate before the start of treatment and after 4 weeks of treatment, respectively.

Results

The treatment group could significantly reduce low back pain, and the effect was significantly better than that of the control group ($P < 0.01$).

Conclusion(s)

The chronic continuous stretching technique is effective in reducing chronic low back pain in adults with idiopathic scoliosis

Clinical significance

The chronic continuous stretching technique is effective in reducing chronic low back pain in adults with idiopathic scoliosis

REHABILITATION EFFECT OF ORTHOPEDIC BRACE COMBINED WITH CORE MUSCLE TRAINING FOR PEDIATRIC IDIOPATHIC SCOLIOSIS

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Background

Adolescent idiopathic scoliosis (AIS) is characterized by high and low shoulder and back pain, which may affect lung function, and in severe cases, sensory ataxia is detrimental to physical and mental health. At present, the pathogenesis of AIS is not well understood, and specific interventions are lacking. Some studies have confirmed that orthopedic braces can better correct AIS than Western medical rehabilitation training alone, which provides theoretical support for the development of this study. Both core muscle strength training and orthopedic bracing can achieve good efficacy in the treatment of AIS, but there is still a lack of research on whether the combination of the two can further significantly enhance the effect. Therefore, the author conducted a randomized controlled trial to analyze the efficacy of orthopedic brace combined with core muscle training in the treatment of AIS, which is reported as follows

Objective (s)

To observe the efficacy of orthopedic brace combined with core muscle training in the treatment of idiopathic scoliosis (AIS).

Study Design

Randomized controlled trials

Methods

From July 2022 to September 2023, 48 children with AIS were randomly divided into two groups, with 24 cases in each group, and were given orthopedic brace combined with core muscle training (composite group) and pure core training (training group), respectively, for 12 weeks. The clinical and imaging results of the two groups were compared.

Results

At 12 weeks after treatment, VAS score, ODI and trunk rotation angle were significantly decreased in the two groups ($P<0.05$), and SAQ, SRS-22 scores and low back muscle strength were significantly increased ($P<0.05$), and there was no significant difference in the above indexes between the two groups before treatment ($P>0.05$), and at 12 weeks after treatment, VAS score, ODI, SAQ [(66.4±5.7) vs (62.6±5.6), $P=0.002$] and SRS-22 score [(96.2±8.8) vs (87.8±9.6), $P<0.001$], low back muscle strength [(442.6±18.5) N·m vs (414.6±17.7) N·m, $P<0.001$] and trunk rotation angle [(5.3±1.1)° vs (6.4±1.2)°, $P<0.001$] were significantly better than those in the training group. In terms of imaging, 12 weeks after treatment, the Cobb angle and AT of the main bend were significantly reduced in the two groups ($P<0.05$), and there was no statistical difference between the above imaging indexes between the two groups before treatment ($P>0.05$), and 12 weeks after treatment, the Cobb angle and AT of the main bend in the composite group were significantly better than those in the training group.

Conclusion(s)

Compared with single core training, orthopedic brace combined with core muscle training for AIS can enhance the low back muscle strength, improve the lateral process angle and spinal function.

Clinical significance

Enhance the strength of the child's lumbar back muscles, improve the angle of the lateral process and the function of the spine.

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PAIN REDUCTION AND FUNCTIONAL IMPROVEMENT IN PATIENTS WITH DEGENERATIVE SCOLIOSIS AND LOW BACK PAIN THROUGH PATTERN-SPECIFIC SCOLIOSIS REHABILITATION: A PROSPECTIVE COHORT STUDY

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Background

Only a limited number of studies have explored the efficacy of pattern-specific rehabilitation for patients over 50 years of age with scoliosis and associated pain.

		Baseline	After Treatment	P values
ATR		11.8±4.3 (5-21)	9±5.1 (1-21)	0.000
ODI		13.50±5.80 (06-27)	09.10±06.10 (0-26)	0.001
ODI Level of disability	Minimal	19(%82.6)	22(%95.7)	0.896
	Modarete	2(%8.7)	1(%4.3)	
	Severe	2(%8.7)	-	
SRS-Pain		2.90±0.70 (1.2-4)	3.5±0.7 (2.2-4.8)	0.001
SRS-Function		3.4±0.6 (2.4-4.4)	3.7±0.7 (2.2-4.8)	0.123
SRS-Mental		3.8±0.7 (2.4-5)	4.02±0.6 (2.6-5)	0.021
SRS-Self Image		2.9±0.6 (1.6-3.8)	3.3±0.7 (1.8-4.8)	0.027
SRS-Total		3.2±0.5 (2.2-4.1)	3.7±0.5 (2.7-4.9)	0.001
Numeric Pain rest		4.4±3.1 (0-9)	2.1±2.5 (0-9)	0.018
Numeric Pain Activiy		7.2±1.7 (4-10)	5.2±2.5 (0-10)	0.003

Objective (s)

The aim of the study is to evaluate whether patient education combined with pattern-specific scoliosis rehabilitation (PSSR) can alleviate symptoms, enhance functionality, and determine the optimal intervention dosage required

Study Design

A prospective study was conducted in a private clinic with consecutive patients meeting the following inclusion criteria: adults aged 50 years and older with scoliosis and low back pain, no history of back surgery, and no prior exposure to PSSR.

Methods

At baseline and study completion, data were collected on ATR, NAS (rest and activity), ODI, SRS-22r, Formetric scan and posture photographs were taken.

Based on the Schroth Best Practice (SBP) approach, patients were instructed in relaxed corrections for ADLs to develop new daily habits, daily stretching and mobilization exercises, and SBP exercises to be performed 2–3 times per week at home. Follow-ups at 3, 6, 12, and 24 months were analyzed using initial and final evaluations.

Results

Of the patients who completed the 12-month follow-up ($n = 27$), the mean age was 65 years and the average Cobb angle was 40° (Table 1). Following treatment, statistically significant reductions were observed in ATR ($p = 0.00$), ODI ($p = 0.001$), and NAS ($p = 0.003, 0.018$) scores. Additionally, significant improvements were noted in SRS-22r total scores (Table 2).

Conclusion(s)

The results of this study indicate that pain, disability, and quality of life can be improved in patients with degenerative scoliosis, particularly in those with pain and cosmetic concerns, through PSSR and adaptations in activities of daily living.

Clinical significance

Incorporating pattern-specific exercises and adaptations into daily living activities may offer a valuable approach to symptom management in this patient group.

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ENHANCING TREATMENT COMPLIANCE AND OUTCOMES IN ADOLESCENT IDIOPATHIC SCOLIOSIS: A COMPARATIVE STUDY OF GROUP VERSUS INDIVIDUAL EXERCISE PROGRAMMES

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Background

Adolescent idiopathic scoliosis (AIS) is a complex spinal deformity that can deteriorate during growth, affecting physical and psychological well-being. Traditional management includes orthotic treatment and physiotherapy exercises but maintaining patient's compliance to both interventions is often challenging. Individual exercise programs often face low compliance due to lack of motivation and support. In contrast, group exercise may enhance motivation and compliance through social support and peer interaction. This study evaluates the effectiveness of group versus individual exercise in the patients with AIS undergoing same orthotic treatment protocol.

Objective (s)

To compare the effectiveness of combined orthotic treatment with group exercise versus individual exercise via the assessment of treatment compliance, spinal deformity, and quality of life (QoL) of the patients with AIS.

Study Design

A prospective randomized controlled trial.

Methods

Patients meeting the SOSORT and SRS criteria for orthotic intervention were randomly assigned to the group exercise (GE) or individual exercise (IE) cohort. Each participant received a rigid thoracolumbosacral orthosis, prescribed for 23 hours of daily wear, allowing 1 hour for personal hygiene and exercises. Monthly supervised exercise sessions were conducted for both cohorts, with 3 to 4 patients per group in the GE cohort or one-on-one sessions in the IE cohort. Home exercises were prescribed via a mobile exercise app for 25 minutes daily. Orthosis compliance was monitored using built-in sensors, while exercise compliance was tracked via the app. QoL was assessed using the Trunk Appearance Perception Scale (TAPS), Scoliosis Research Society-22r questionnaire (SRS-22r), and Brace Questionnaire (BrQ). Cobb angle and QoL were evaluated at baseline, 1-month, and 7-month follow-ups. Intergroup comparisons used independent *t*-tests or Mann-Whitney U tests, while intragroup comparisons used paired sample *t*-tests or Wilcoxon matched-pairs signed-rank tests.

Results

Thirty-eight patients were involved in the study. No significant differences were observed in age, gender, Risser sign, BMI, or Cobb angle at baseline between cohorts. By the 7th month, participants in the GE cohort exhibited higher exercise and orthosis compliance, as well as improved scores in TAPS, SRS-22r, and BrQ compared to the IE cohort. While the IE cohort experienced a decrease in daily exercise time by 2.4 minutes after 7 months ($p < 0.001$), the GE cohort significantly improved TAPS ($p = 0.023$) and SRS-22r ($p = 0.001$) scores compared to the 1st month. Although not statistically significant, the Cobb angle

decreased in the GE cohort after 7 months, while it remained stable in the IE cohort.

Table 1 Baseline characteristics and assessment results at the 1st and the 7th month

Parameter	Time	IE cohort (n=19) Mean $\pm$ SD	GE cohort (n=19) Mean $\pm$ SD
Gender (F/M)	Baseline	14/5	14/5
Age (years)	Baseline	12.2 $\pm$ 1.3	12.2 $\pm$ 1.3
BMI (kg/m ²)	Baseline	17.9 $\pm$ 3.3	17.9 $\pm$ 3.3
Risser sign	Baseline	0.8 $\pm$ 0.9	0.8 $\pm$ 0.9
Cobb angle (°)	Baseline	27.8 $\pm$ 4.7	27.8 $\pm$ 4.7
	1 st month (in-brace)	14.8 $\pm$ 10.2	13.5 $\pm$ 10.2
	7 th month (out-brace)	26.5 $\pm$ 10.8	24.5 $\pm$ 10.8
Exercise compliance (mins/day)	1 st month	10.5 $\pm$ 5.5	10.5 $\pm$ 5.5
	7 th month	8.1 $\pm$ 4.8	11.5 $\pm$ 4.8
Orthosis compliance (hrs/day)	1 st month	12.4 $\pm$ 7.4	7.5 $\pm$ 7.4
	7 th month	9.9 $\pm$ 4.4	12.5 $\pm$ 4.4
TAPS total score	Baseline	3.9 $\pm$ 0.6	3.9 $\pm$ 0.6
	1 st month	4 $\pm$ 0.5	3.9 $\pm$ 0.5
	7 th month	3.8 $\pm$ 0.8	4.1 $\pm$ 0.8
SRS-22r total score	1 st month	4.2 $\pm$ 0.4	4.2 $\pm$ 0.4
	7 th month	4.2 $\pm$ 0.6	4.2 $\pm$ 0.6
BrQ total score	1 st month	75.3 $\pm$ 7.8	79.3 $\pm$ 7.8
	7 th month	76.7 $\pm$ 9.6	82.3 $\pm$ 9.6

Conclusion(s)

Group exercise enhances compliance with both orthotic and exercise interventions in the patients with AIS. The GE cohort demonstrated improved outcomes, including a reduction in Cobb angle and improved QoL scores compared to the IE cohort.

Clinical significance

Group exercise settings enhance treatment compliance and improve outcomes.

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EFFECTS OF LEAFLET AND VIDEO-BASED CORE STABILIZATION EXERCISES ON JUVENILE IDIOPATHIC SCOLIOSIS

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Background

Juvenile idiopathic scoliosis (JIS) carries a higher risk of developing several deformities compared to AIS, necessitating proactive and early management.

Objective (s)

To evaluate the effectiveness of leaflet- or video-based instruction for home core stabilization exercises in JIS.

Study Design

Retrospective study

Methods

This study included children with JIS and a Cobb angle of 10–20° who visited a rehabilitation clinic. They performed core stabilization exercises at home for 6 months, guided either by a leaflet or a video. Whole spine X-rays were taken before and after the 6-month intervention to measure the Cobb angle and spinal rotation. Endurance was assessed by measuring the duration participants could maintain the bird-dog and Superman positions in the clinic.

Results

Comparisons of the leaflet-based and video-based groups

		Bird dog (sec)	Superman (sec)	Cobb's angle	Rotation Degree
Leaflet-based group	Pre	3.18±4.77	9.55±2.13	12.19±1.74	0.18±0.39
	Post	5.91±5.03	10.00±0.00	7.10±4.59	0.09±0.29
	Diff	2.73±5.50	0.45±2.13	-5.18±3.76	-0.09±0.29
Video-based group	Pre	5.71±5.14	9.29±2.67	12.84±1.81	0.07±0.27
	Post	9.29±2.67	8.64±3.46	9.36±5.34	0.07±0.27
	Diff	3.57±4.97	-0.64±2.41	-3.48±5.26	0.00±0.00

Thirty-six children with JIS participated in this study: 22 in the leaflet-based group and 14 in the video-based group. Before and after the 6-month intervention period, the leaflet-based and video-based groups showed no significant differences in Cobb angle, degree of rotation, or endurance in the bird-dog and Superman positions. However, within-group analysis before and after the 6-month exercise period showed significant improvement in both groups in Cobb angle and endurance in the bird-dog posture.

Conclusion(s)

Both leaflet-based and video-based core stabilization exercises improve Cobb angle and enhance endurance in maintaining the bird-dog position in patients with JIS. Since no significant differences were observed between the two groups, offering either option may support proper home exercise performance.

Clinical significance

Preventing the progression of JIS is crucial, and it is necessary to develop and improve methods that are easy for juvenile children to understand and follow while also enhancing adherence and motivation.

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Background

Adolescent idiopathic scoliosis (AIS) is a common adolescent spinal deformity with an incidence of 1%-3% in the general population. At present, there are many schools of rehabilitation treatment for AIS, and the lack of a unified treatment plan has an adverse impact on clinical decision-making. In the clinical rehabilitation work of AIS for many years, we have explored and proposed the theory of "vertebral stress asymmetry", which may be a new etiological theory of idiopathic scoliosis. It is pointed out that vertebral stress asymmetry is an important factor in the occurrence and development of idiopathic scoliosis.

Objective (s)

we used chronic continuous traction for more than 1.5 hours, to be applied to the conservative treatment of AIS, and to observe the effect to control the progress of AIS deformity.

Study Design

Randomized controlled trial

Methods

A total of 43 AIS patients admitted to the Rehabilitation Department of Tai 'an Central Hospital from December 2021 to January 2023 were collected, and a total of 65 patients completed the treatment and evaluation according to the standard. The dropped cases were treated as excluded cases and were not included in the final results. A total of 65 patients with AIS were randomly divided into observation group and control group by digital table method. Thirty-three patients in the control group were treated with bracing and PSSE. 32 cases in the observation group were treated with chronic continuous traction, brace and PSSE. On the basis of the control group, the observation group received chronic continuous traction treatment for 6 weeks before wearing the brace. The traction strength was 30% of body weight, 90min/ time, 1 time/day. Before treatment and at 24 weeks after treatment, Cobb Angle, thoracic kyphosis (TK), lumbar lordosis (LL), trunk rotation (ATR), surface electromyography (AEMG ratio, MPF ratio), static balance index (COP-trajectory area, Romberg ratio), and SRS-22 scale were evaluated and recorded. SPSS statistical software was used to analyze the data.

Results

After treatment, the Cobb Angle and ATR of the two groups decreased ($P < 0.01$). The AEMG ratio and MPF ratio in the observation group decreased ($P < 0.05$). The COP-trajectory area (eyes closed) and Romberg rate of the two groups decreased ($P < 0.05$), and the COP-trajectory area (eyes open) of the observation group decreased ($P < 0.05$). the scores of self-image perception and pain dimension in the observation group were significantly higher ($P < 0.05$).

Conclusion(s)

Chronic continuous traction improve the efficacy of brace and PSSE in AIS, reduce Cobb Angle and ATR, and no effects on sagittal physiological curvature.

Clinical significance

Chronic continuous traction effectively improve the static balance ability of both feet, adjust the asymmetric stress on both sides of the spine. In particular, it can improve self-image satisfaction and relieve pain.

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ROTARY BREATHING TRAINING FOR ADOLESCENT IDIOPATHIC SCOLIOSIS WITH THORACIC CURVES

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Background

Currently, the clinical treatment of AIS includes exercise therapy, brace therapy and surgical therapy, among which there are 7 international systems of exercise therapy, and schroth therapy has an ideal effect and is widely recognized and promoted . Rotational breathing training is an important action to correct lateral curvature deformity in the Schroth training system. Although there are many studies on AIS treatment combined with Schroth system, there are few studies on the treatment of main thoracic curvature AIS with rotational breathing training, so we apply this method in clinical treatment. In this study, the therapeutic effects of rotating breathing training on posture, Cobb Angle and vital capacity of patients with thoracic curved AIS were observed.

Objective (s)

To explore the therapeutic effect of rotational breathing training on posture, Cobb's angle, ATR and lung capacity in adolescent idiopathic scoliosis (AIS) patients with main thoracic curvature.

Study Design

An assessor-blinded randomized control trial.

Methods

Thirty-two patients with thoracic scoliosis (20 females and 12 males) aged 11-17years, were randomly assigned to a conventional rehabilitation training (CRT) group and a combined rotational breathing training (CRBT) group. Both groups underwent an intervention program consisting of 12 weeks, with five

sessions per week. Measurements were taken before and after the intervention to assess changes in body posture (bilateral shoulder height, subscapularis height, and iliac crest height), ATR, Cobb angle, and lung capacity indicators. Independent sample t test or one-way ANOVA combined with LSD pairwise comparison test were used for inter-group comparison, and paired sample t test was used for intra-group comparison before and after treatment.

Results

There were no significant differences in age, height, weight and Cobb's angle between the two groups ($P > 0.05$). The posture (bilateral shoulder height ($t_{\text{CRT}}=11.202$, $t_{\text{CRBT}}=13.545$, $P < 0.01$), subscapularis height ($t_{\text{CRT}}=7.006$, $t_{\text{CRBT}}=8.289$, $P < 0.01$), and iliac crest height ($t_{\text{CRT}}=4.443$, $t_{\text{CRBT}}=5.194$, $P < 0.01$)), ATR ($t_{\text{CRT}}=9.789$, $t_{\text{CRBT}}=11.341$, $P < 0.01$) and Cobb's angle ($t_{\text{CRT}}=6.412$, $t_{\text{CRBT}}=18.579$, $P < 0.01$) improved in both groups compared with those before treatment, and the lung capacity ($t_{\text{CRT}}=-4.601$, $t_{\text{CRBT}}=-17.118$, $P < 0.01$) increased compared with those before treatment. The CRBT group had better posture (bilateral shoulder height ($t_{\text{CRT, CRBT}}=0.434$, $P=0.027$), bilateral subscapularis height ($t_{\text{CRT, CRBT}}=1.818$, $P=0.019$), Cobb angle ($t_{\text{CRT, CRBT}}=2.248$, $P=0.032$) and lung capacity ($t_{\text{CRT, CRBT}}=-2.093$, $P=0.045$) than the CRT group.

Conclusion(s)

In adolescent idiopathic scoliosis (AIS) with thoracic curvature, combining rotational breathing training into conventional rehabilitation demonstrates superior efficacy in enhancing posture, reducing Cobb's angle, and improving lung capacity compared to conventional rehabilitation alone.

Clinical significance

Therefore, this combined approach warrants clinical promotion.

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EFFECT OF SCOLIOSIS-SPECIFIC EXERCISES ON TRUNK ASYMMETRY IN CHILDREN WITH ADOLESCENT IDIOPATHIC SCOLIOSIS – PRELIMINARY RESULTS

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Background

Physiotherapeutic scoliosis-specific exercises (PSSE) have demonstrated promising results in patients with adolescent idiopathic scoliosis (AIS). The focus in these studies is often on radiological outcomes, e.g. changes in the degrees of curvature of the spine. Asymmetry in AIS involves, besides the spine,

other structures of the trunk so changes in trunk symmetry and patient's perceptions of them are important for evaluating the effects of treatment.

Objective (s)

To investigate the effect of PSSE on trunk asymmetry and to determine relationship between objective and subjective measures in children with AIS.

Study Design

Pre-post intervention study.

Methods

Twenty-four participants with AIS (19 female, convenience sample) between 10-18 years (13.6 ± 2.2 years) underwent outpatient PSSE treatment according to Barcelona Scoliosis Physical Therapy School (BSPTS) method. The intervention consisted of 15 individual treatments, 5 times a week, 60 minutes per day. Angle of trunk inclination (ATI) was assessed with scoliometer, and the sum of thoracic and lumbar ATI was on average $9.6 \pm 2.8^\circ$. Eight participants had N3N4 type of scoliosis. Furthermore, 8 participants had lumbar/thoracolumbar scoliosis, 7 participants had 4C, and 1 participants had 3C type of scoliosis. Twenty-five percent of participants received concomitant brace treatment. Trunk photographs in standing position were taken and analyzed to calculate Posterior Trunk Symmetry Index (POTSI) and Anterior Trunk Symmetry Index (ATSI). All subjects completed Trunk Appearance Perception Scale (TAPS). T-test for paired samples or Wilcoxon signed-rank test were used to determine differences before and after the intervention. Appropriate correlation coefficients were calculated to determine relationship between objective and subjective measures.

Results

Objective measures of symmetry, ATSI and POTSI values, showed statistically significant improvement ($p < 0.001$) and large effect size after the intervention (Table 1). Cohen's d was 0.766 for ATSI, and 1.784 for POTSI. No statistically significant differences were found in TAPS values. No significant correlations were found between subjective and objective indicators of trunk symmetry.

Table 1. Trunk asymmetry measures before and after the intervention (N=24)

	Before intervention	After intervention	p
	mean $\pm$ SD	mean $\pm$ SD	
TAPS SET 1	3.3 $\pm$ 0.6	0.8 $\pm$ 3.5	0,244 ^b
TAPS SET 2	3.8 $\pm$ 0.5	0.7 $\pm$ 4	0.285 ^b
TAPS SET 3	3.5 $\pm$ 0.8	0.9 $\pm$ 4	0.381 ^b
TAPS mean	3.6 $\pm$ 0.5	0.7 $\pm$ 3.7	0.777 ^a
ATSI	32.9 $\pm$ 8.2	6 $\pm$ 26.3	<0.001 ^{a*}
POTSI	35.8 $\pm$ 10.3	8.5 $\pm$ 23.4	<0.001 ^{a*}

N - sample; SD – standard deviation; TAPS SET 1 – Trunk Appearance Perception Scale posterior; TAPS SET 2 – Trunk Appearance Perception Scale forward bending position, TAPS SET 3 – Trunk Appearance Perception Scale anterior; ATSI – Anterior Trunk Symmetry Index; POTSI - Posterior Trunk Symmetry Index.

^aT-test for paired samples; ^bWilcoxon signed-rank test; *statistically significant.

Conclusion(s)

Exercises according to the BSPTS method have significant effect on reducing trunk asymmetry, however the correlation between objective and subjective measures in children with AIS is poor.

Clinical significance

PSSE have beneficial effects on trunk asymmetry.

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PARASPINAL MUSCLES ACTIVITIES IN S-SHAPED ADOLESCENT IDIOPATHIC SCOLIOSIS DURING PHYSIOTHERAPEUTIC SCOLIOSIS SPECIFIC EXERCISE: A CASE-CONTROL STUDY

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Background

Physiotherapeutic scoliosis-specific exercises (PSSE) have gained recognition as a crucial component in the rehabilitation of adolescents with idiopathic scoliosis (AIS). Despite their importance, there remains a notable scarcity of research specifically addressing the effects of PSSE on the paraspinal muscles, which play a vital role in spinal stability and posture. Understanding how PSSE influences these muscles could provide valuable insights into optimizing treatment protocols for AIS patients. This relationship highlights the potential for PSSE to not only address existing imbalances but also to prevent further deterioration of spinal health in adolescents with scoliosis.

Objective (s)

The purpose of this study was to: (1) use surface electromyography to compare paraspinal muscle activities during PSSE between AIS patients and healthy individuals; and (2) provide clinical and daily living guidance for individuals with AIS.

Study Design

Case-Control Study

Methods

Twelve S-shaped AIS and ten age-matched healthy controls participated. Five paired target paraspinal muscle groups (upper end vertebra, apex vertebra, lower end vertebra of the thoracic and apex vertebra, lower end vertebra of the lumbar) were assessed during relaxed sitting, erect sitting, and symmetrical and asymmetrical exercises.

Results

The results revealed that exercises effectively activated paraspinal muscles in AIS subjects, with a stronger activation observed during asymmetrical exercises ($P < 0.05$). Compared to the healthy group, AIS subjects exhibited inhibited paraspinal muscle activity during relaxed sitting at the apex vertebra of the thoracic spine (left: 13.81 ± 0.71 vs. 19.67 ± 0.81 , $P < 0.001$; right: 14.17 ± 1.12 vs. 20.16 ± 1.64 , $P < 0.01$) and lumbar spine (left: 10.88 ± 1.17 vs. 17.05 ± 1.81 , $P < 0.05$; right: 10.10 ± 1.21 vs. 15.71 ± 2.24 , $P < 0.01$). Additionally, in erect sitting, AIS subjects also showed inhibition of the paraspinal muscles at the apex of the thoracic spine (left: 17.16 ± 2.30 vs. 23.93 ± 2.52 , $P < 0.001$, right: 18.53 ± 1.16 vs. 23.93 ± 2.52 , $P < 0.05$). Furthermore, erect sitting failed to enhance symmetric muscle activation in S-shaped AIS.

Conclusion(s)

These findings emphasize the importance of PSSE regimens for AIS rehabilitation and education. Understanding the dynamics of the paraspinal muscles could optimize scoliosis management strategies and provide more targeted interventions for improving muscle function in AIS individuals.

Clinical significance

The clinical significance of this study lies in its demonstration that physiotherapeutic scoliosis-specific exercises (PSSE) can effectively activate paraspinal muscles in AIS subjects, particularly during asymmetrical exercises. This finding underscores the importance of incorporating PSSE into the rehabilitation regimen for AIS patients. The study also highlights that AIS subjects exhibit inhibited paraspinal muscle activity during relaxed and erect sitting compared to healthy individuals, suggesting that specific exercises are necessary to counteract this inhibition.

THE PROGRESSIVE MODULAR REBALANCING (RMP) SYSTEM: A NOVEL APPROACH IN SCOLIOSIS REABILITATION – A RETROSPECTIVE STUDY

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Background

The Progressive Modular Rebalancing (RMP) system builds upon Proprioceptive Neuromuscular Facilitation (PNF) principles (1), offering a versatile approach applicable across rehabilitation domains, including neurology and orthopedics. The RMP system integrates seamlessly with the principles of corrective exercises that form the foundation of conservative scoliosis treatment (2). These exercises aim to enhance postural control, optimize spinal alignment, and promote neuromuscular re-education, making the RMP system a theoretically consistent tool within the broader framework of non-surgical scoliosis management.

Objective (s)

This retrospective study evaluated the effectiveness of the RMP system in scoliosis rehabilitation, focusing on its role in improving spinal deformities and supporting conservative management strategies.

Study Design

Retrospective longitudinal observational study.

Methods

Sixteen patients with scoliosis participated in the study, 10 with thoracic scoliosis and 6 with lumbar scoliosis. All patients underwent treatment using the RMP approach, tailored to address their specific spinal deformities, for a duration of 5 years (thoracic scoliosis) or 4 years (lumbar scoliosis). The Cobb angle, a widely accepted measure of spinal curvature, was assessed at baseline (T0) and after treatment (T1). Data normality was evaluated using the Shapiro-Wilk test, and paired t-tests were employed to analyze the differences between T0 and T1.

Results

The mean age of patients with thoracic scoliosis was $11,80 \pm 1,03$ years, and the mean age of patients with lumbar scoliosis was $11,83 \pm 0,75$ years. In thoracic scoliosis, the mean Cobb angle decreased significantly from $34,2 \pm 8,9^\circ$ at baseline to $23,6 \pm 8,4^\circ$ after 5 years of treatment ($p < 0,01$). In lumbar scoliosis, the mean Cobb angle decreased significantly from $31,8 \pm 9,8^\circ$ to $17,8 \pm 13,2^\circ$ after 4 years of treatment ($p < 0,01$). These results highlight the potential effectiveness of the RMP approach in reducing spinal curvature over an extended treatment period.

Conclusion(s)

The RMP system demonstrated significant improvements in Cobb angle in both thoracic and lumbar scoliosis cases. By aligning with the foundational principles of conservative scoliosis treatment, the RMP system may serve as a valuable adjunct to standard rehabilitation practices, offering a structured method to support long-term spinal correction and functional improvement.

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Clinical significance

Further investigations into this approach could pave the way for considering a novel treatment modality in the management of patients with scoliosis.

EFFECTIVENESS OF PHYSIOTHERAPEUTIC SCOLIOSIS - SPECIFIC EXERCISES VERSUS GENERAL EXERCISES IN ADOLESCENT IDIOPATHIC SCOLIOSIS: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Background

The effectiveness of physiotherapeutic scoliosis-specific exercises (PSSE) compared to general exercises (GE) in managing adolescent idiopathic scoliosis (AIS) is under debate.

Objective (s)

This systematic review and meta-analysis aims to analyze the comparative efficacy of PSSE versus GE, focusing on key clinical outcomes, including Cobb angle (CA) reduction, Anterior Trunk Rotation (ATR), and Quality of Life (QoL). Understanding these metrics is essential for establishing PSSE as a potentially superior intervention and clarifying its role in clinical practice for AIS management.

Study Design

Systematic review and meta-analysis of studies directly comparing PSSE versus GE in patients with AIS.

Methods

We conducted a systematic search across multiple databases, including PubMed, Scopus, Cochrane, Embase, and PEDro, to identify studies comparing PSSE with GE in patients with AIS. The analysis included randomized controlled trials (RCTs) and observational studies reporting outcomes such as CA, ATR, and QoL, measured using standardized tools. A random-effects model was employed to pool mean differences (MD) and 95% confidence intervals (CI) across studies, with heterogeneity assessed via I^2 statistics.

Results

Our meta-analysis included 6 RCTs and 3 observational studies, comprising a total of 749 patients with AIS. Among these, 442 (59.1%) patients underwent PSSE, while 307 (40.9%) were assigned to GE. The mean age of participants was 13.57 years, and follow-up durations ranged from 2 to 54 months. Pooled analysis demonstrated a statistically significant reduction in the Cobb angle for PSSE as compared with

GE (MD -3.10; 95%CI [-5.55,-0.66]; $I^2=91\%$; $p=0.01$), indicating PSSE's potential for addressing curvature more effectively than GE.

The analysis also revealed significant improvements in ATR (MD -2.13; 95%CI [-3.05, -1.22]; $I^2=89\%$; $p<0.001$) in the PSSE group compared with GE. Quality of Life, as measured by the Scoliosis Research Society Questionnaire (SRS-22), showed no statistically significant difference between groups (MD 0.06; 95% CI [-0.21, 0.34]; $I^2 = 88\%$; $p = 0.64$).

Conclusion(s)

These findings suggest that PSSE promoted a higher reduction in Cobb angle, and ATR than GE in patients with AIS, without a significant impact in QoL

Clinical significance

Due to the study-level meta-analysis approach and the lack of detailed data in most studies, we were unable to assess the impact of key factors, such as treatment adherence, the proportion of patients using braces, and the percentage of clinically significant angle changes (e.g., changes exceeding 5°). This study highlights the need for adequately powered randomized studies to analyze the efficacy of PSSE therapies for both physical and psychological outcomes in AIS in a longer follow-up period.

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TO EXPLORE THE EFFECT OF SCHROTH THERAPY COMBINED WITH TRACTION THERAPY ON IMPROVING SPINAL DEFORMITIES IN ADOLESCENT PATIENTS WITH SCOLIOSIS.&NBSP;

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Background

To explore the effect of Schroth therapy combined with traction therapy on improving spinal deformities in adolescent patients with scoliosis.

Objective (s)

To explore the effect of Schroth therapy combined with traction therapy on improving spinal deformities in adolescent patients with scoliosis.

Study Design

Patients were randomly assigned into observation group(n=20) and control group(n=20).Patients in the control group were treated with Schroth therapy, while those in the observation group were treated with Schroth therapy combined with traction therapy. All treatments lasted for 6 months.

Methods

Forty cases of adolescent patients with scoliosis admitted to the Department of Rehabilitation Medicine of The Affiliated Taian City Central Hospital of Qiongdao University From January 2022 to January 2024 were selected as the research objects.They were randomly assigned into observation group(n=20) and control group(n=20).Patients in the control group were treated with Schroth therapy, while those in the observation group were treated with Schroth therapy combined with traction therapy. All treatments lasted for 6 months.The Cobb angle,angle of trunk rotation(ATR),and apical vertebral translation(AVT) between two groups were compared. Using the Footscan plantar pressure testing system, gait and plantar pressure during natural walking were measured.Using the NeuroCom balance training system,changing speed of the center of gravity displacement of the bipedal support body in the unsteady state of open/closed eyes was measured. The Scoliosis Research Society-22 questionnaire(SRS-22) was used to evaluate the quality of life.

Results

Compared with those before treatment, Cobb angle, ATR, and AVT significantly decreased in both groups after 6 months of treatment,which were significantly smaller in the observation group than the control group($P<0.05$). Compared with those before treatment,the center of pressure excursion index(CPEI) of the two groups significantly decreased after 6 months of treatment, which was significantly lower in the observation group than the control group($P<0.05$). Compared with before those treatment,the unsteady support speed at the state of eyes open or closed significantly decreased in both groups after 6 months of treatment, which was significantly lower in the observation group than the control group($P<0.05$). Compared with those before treatment, the SRS-22 scores and total scores after 6 months of treatment significantly increased in both groups,which were significantly higher in the observation group than the control group($P<0.05$).

Conclusion(s)

Schroth 疗法联合牵引疗法可显著降低青少年脊柱侧凸患者的 Cobb 角、ATR 和 AVT, 改善脊柱畸形、足底压力分布、身体平衡和生活质量, 具有临床应用价值。

Clinical significance

Schroth therapy combined with traction therapy can significantly reduce the Cobb Angle,ATR and AVT, and improve spinal deformity, plantar-pressure distribution, body balance and quality of life in adolescent patients with scoliosis,with a clinical application value.

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IMPACT OF PHYSICAL ACTIVITY ON SCOLIOSIS OUTCOMES IN ADOLESCENTS WITH AIS: THE ROLE OF EXERCISE DURATION AND SPORT TYPE

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Background

Negrini et al. demonstrated that regular sports activities increase the likelihood of improvement in adolescents with idiopathic scoliosis (AIS). However, their study did not differentiate between specific sports that might positively impact scoliosis. While swimming is considered health-promoting, it is linked to a higher risk of trunk asymmetries (Zaina et al.). In contrast, sports like dancing, gymnastics, karate, and horseback riding have been associated with a reduced risk of developing AIS (McMaster).

Objective (s)

Increased physical activity is associated with significant improvement in the Cobb angle in AIS patients. Additionally, factors such as weekly physical activity duration and trunk stability may influence this improvement.

Study Design

Cross-sectional observational study with consecutive sampling.

Methods

Patients were recruited from the outpatient scoliosis clinic at the University of Regensburg. Eligible participants were adolescents aged 10–17 years with AIS and a Cobb angle $>10^\circ$. They underwent clinical examinations, motor skill, and trunk stability assessments and completed questionnaires on medical history, sports activities, physiotherapy, brace-wearing, and family history.

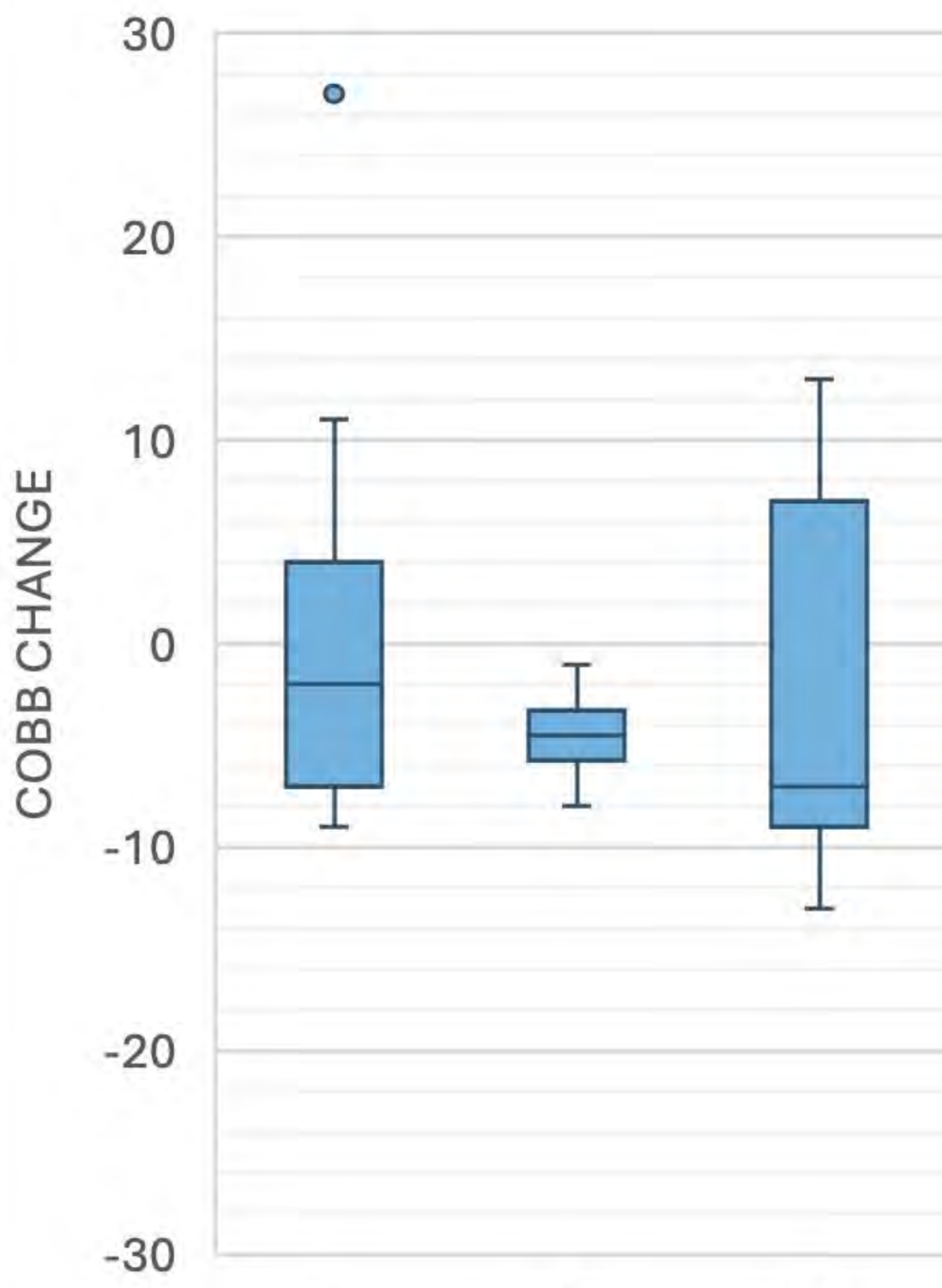
Primary outcomes included pain, trunk strength, and physical activity engagement. The secondary outcome was the Cobb angle, evaluated via initial and follow-up radiographs. Mean analysis assessed group differences, lambda directional tests evaluated categorical associations, and Pearson correlation analyzed linear relationships using SPSS.

Results

A total of 105 patients (mean age 15.01 years, ± 1.69 ; 82 females, 23 males), with an initial average Cobb angle of 25.7° (SD = 8.99), were included. Participants engaged in an average of 3.28 hours of sports weekly, with 75.2% participating in extracurricular sports. Ninety patients underwent PSSE.

Pain on the VAS and PSSE engagement showed no correlation with the Cobb angle or clinical parameters. Brace-wear duration did not significantly affect sports activity levels or trunk stability outcomes.

In a subgroup of 75 patients (mean age 14.7 years, ± 1.78 ; 57 females, 18 males), retrospective comparison of Cobb angles (mean change -2.65° , SD 8.91) over time showed significant improvements in gymnastics/dance participants (Pearson 0.228, 95% CI) and those engaging in >2.5 hours of physical activity weekly (Pearson 0.233, 95% CI). Hurdle jumps (Pearson 0.267, 95% CI) and single-leg squats (Pearson 0.291, 95% CI) were associated with better outcomes, while trunk strength showed no correlation.



Conclusion(s)

Regular physical activity exceeding 2.5 hours per week positively influences scoliosis outcomes, with gymnastics and dance showing significant benefits for AIS patients. While no correlation was found between trunk strength and radiological improvement, exercises like hurdle jumps may enhance results. A multidimensional training regimen focusing on coordination, endurance, and strength is recommended. Further research is needed to confirm these findings.

Clinical significance

Targeted physical activity, especially gymnastics and dance, may improve scoliosis outcomes in AIS patients. Sports exceeding 2.5 hours weekly should be encouraged as part of non-surgical scoliosis management, supported by individualized training programs.

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IMMEDIATE EFFECTS OF SCHROTH EXERCISES ON THREE-DIMENSIONAL PARAMETERS OF THE VERTEBRAE AND PARAVERTEBRAL MUSCLES IN ADOLESCENT IDIOPATHIC SCOLIOSIS

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Background

Asynchronous growth of muscle and skeleton is widely recognized as one of the risk factors for the curve progression of Adolescent Idiopathic Scoliosis (AIS), which can lead to a vicious cycle. Studies have shown that the main risk factor for the difference in growth rates between the two is a reduction in paraspinal muscle mass. Therefore, improving muscle mass under spinal-pelvic alignment becomes the key for treatment. Although studies showed that Schroth Method could control the curves' severity, the lack of quantification of changes in the skeleton and muscles during exercise limits its reproducibility, as the specificity of the deformity often relies on the subjective experience of the therapist.

Objective (s)

We aimed to quantify the changes in skeletal and paravertebral muscles of AIS during Schroth exercise by using three-dimensional ultrasound reconstruction.

Study Design

Methods

This study was performed at the Guangzhou Sport University Scoliosis Clinic from September 2024 to December 2024. Patients with a single type of Cobb angle in the thoracic curvature of 20°-45° were included in the study. According to Schroth's method we used Muscle cylinder, The door handle exercise, self-corrected standing and self-corrected sitting postures to compare with habitual standing and habitual sitting postures to observe changes in spinal alignment and muscle volume parameters. Paravertebral muscle reconstruction was performed in each posture on the customized software, and metrics including paravertebral muscle length (cm), mean cross-sectional area (cm²) and volume (cm³), and cross-sectional area (cm²) of the upper and lower end vertebrae and the parietal vertebrae were captured, with simultaneous recordings of lumbar lordosis (LL) and thoracic kyphosis (TK). Statistical analyses were performed using the IBM SPSS27, $p < 0.05$ considered statistically significant.

Results

A total of 20 participants were included. The results showed that all four corrective postures decreased the Cobb angle ($p < 0.05$). The change of lumbar lordosis angle (LL) in the muscle cylinder posture was $11.18 \pm 5.91^\circ$ ($p = 0.01$), and there was no significant change in thoracic kyphosis angle (TK). In the self-corrected sitting posture, the change in the cross-sectional area of the left paraspinal muscle of the parietal spine was $0.35 \pm 0.21 \text{ cm}^2$ ($p = 0.02$). In the door handle posture, the change in the cross-sectional area of the right paraspinal muscle of the parietal spine was $1.94 \pm 0.04 \text{ cm}^2$ ($p = 0.04$).

Conclusion(s)

The door handle position specifically targets the paraspinal muscles of the parietal spine, while the self-correcting sitting position improves the paraspinal muscles on the left side of the parietal spine. These two positions may help to improve the strength and endurance of the muscles in AIS with main thoracic curvature, thereby supporting spinal alignment and stabilization more effectively.

Clinical significance

To verify the accuracy and validity of the Schroth method when practicing and to provide a basis for corrective posture selection.

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EFFECTS OF THE SCHROTH METHOD ON SPINAL CURVATURE AND PARAVERTEBRAL MUSCLE ACTIVATION IN ADOLESCENT IDIOPATHIC SCOLIOSIS

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Background

Adolescent idiopathic scoliosis (AIS) is a complex three-dimensional morphologic spinal deformity with a prevalence of approximately 1-3% in adolescents (10-16 years of age) as reported in epidemiologic studies. The International Association for Scoliosis Orthopaedics and Rehabilitation (IASOR) stated in 2011 that exercise interventions are appropriate for scoliosis between 10° and 20°. The Schroth method is considered potentially valuable as an alternative intervention to control curve progression in mild to moderate adolescent idiopathic scoliosis. However, patients are often dependent on the subjective experience of the physiotherapist when practicing, when changes in spinal alignment and muscle activation are unknown.

Objective (s)

The aim of this study was to evaluate the effectiveness of the Schroth Method for spinal alignment and muscle activation in AIS.

Study Design

A cross-sectional study.

Methods

This study recruited 36 adolescent patients with idiopathic scoliosis with major thoracic curvature. Three-dimensional spinal ultrasound and surface electromyography were used to evaluate changes in the spinal ultrasound angle and activation characteristics of paravertebral muscles using the Schroth method.

Results

The ratio of asymmetric activation of the paravertebral muscles improved when the spinal ultrasound angle of the main thoracic curvature line was reduced and decreased using Schroth method. The number of proximal thoracic curve compensations increased when practicing 50 × Pezziball and sail, with a corresponding imbalance in the paraspinal root mean square ratio at T2. The paraspinal muscle activation at L2 and L5 revealed a reverse imbalance during muscle cylinder exercises.

Conclusion(s)

Schroth method decreased the spinal ultrasound angle of the main thoracic curve and improved the asymmetric activation of paravertebral muscles at T8. Compensation of the proximal thoracic curve and paravertebral imbalance at T2 that occurred during 50 × Pezziball and Sail exercises should be treated with caution.

Clinical significance

The results of this study may contribute to guiding physical therapists to develop specific exercise programs on an individual basis and improve treatment performance.

IMPACT OF CONSERVATIVE TREATMENT ON TRUNK DEFORMITY IN ADOLESCENTS WITH IDIOPATHIC SCOLIOSIS

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Background

Adolescent idiopathic scoliosis (AIS) is a three-dimensional spinal deformity that progresses during growth, leading to postural asymmetries and patient dissatisfaction. The treatment of AIS on factors such as curve location and severity. Conservative treatment, including specific exercises and the use of orthoses, is recommended for curves with a Cobb angle $>25^\circ$ (moderate and severe curves), aiming to stabilize progression and reduce spinal deformity.

Objective (s)

To evaluate assess trunk deformity in patients with AIS with moderate and severe curves before and after conservative treatment (S4D) using Surgimap Spine software.

Study Design

Retrospective study, multicenter, quasi-experimental before-and-after study (single group)

Methods

This study included patients aged 10 to 18 years, diagnosed with AIS with moderate (25° - 45°) or severe (46° - 60°) curves in the growth phase (Risser 0-4). Approved by the Research Ethics Committee of Scoliosis Brazil Institute (n° 52631421.8.0000.0081), all patients underwent standardized treatment, combining scoliosis-specific exercises (S4D method) and a thoracolumbosacral orthosis (TLSO) at Scoliosis Brazil Institute with locations in four Brazilian states. Evaluations were conducted at baseline and after six months. Radiographic assessments included measurements of Cobb angle, kyphosis, lordosis, and Risser sign using X-ray imaging. Photographic evaluations were conducted in the standing position, capturing both anterior and posterior frontal planes. These measurements were analyzed using the Surgimap Spine software to determine the following angles: shoulder height, craniosacral alignment, and the external and internal waist angles. Patients were stratified based on the main curve location (thoracic or lumbar) and severity (moderate or severe). Intragroup comparisons (pre- and post-

intervention) were conducted using paired Student's t-tests for parametric variables and Wilcoxon tests for non-parametric variables.

Results

A total of 210 adolescents (180 females; mean age: 14 years, range: 12.2–15 years) were included. Patients were stratified into four groups: moderate thoracic (MT, N=73), moderate lumbar (ML, N=81), severe thoracic (ST, N=40), and severe lumbar (SL, N=16). Across all groups, significant reductions in Cobb angle were observed, with the largest improvements in the ML and SL groups. Moderate reductions in kyphosis and lordosis were also noted, particularly in the ST and SL groups. Photographic evaluations showed significant improvements in craniosacral alignment and external waist angles, with the SL group demonstrating the most substantial changes. For more detailed results, refer to Table 1.

Table 1. Radiographic and Photographic Outcomes Pre- and Post-Treatment Across Stratified Groups.

1a. Patients with Moderate Severity (MT and ML Groups)						
	MT			ML		
	Pré treatment N=73	Pos treatment N=73	Effect Size (95%CI; p)	Pré treatment N=81	Pos treatment N=81	Effect Size (95%CI; p)
Radiographic Measurements						
Major Curve (°)	37.5±4.9	35.4±7.8	0.3 (0.1 to 0.6; p 0.009*)	35 (30 – 39)	32 (25 – 37)	0.8 (0.7 to 0.9; p < 0.001*)
Kyphosis (°)	20 (13–28)	17 (13–26)	0.1 (-0.2 to 0.3; p 0.722)	25.9±12.1	24.4±10.5	0.3 (0.1 to 0.5; p 0.001*)
Lordosis (°)	54.5 (48–63.2)	49 (42.5 – 56)	0.7 (0.6 to 0.8; p < 0.001*)	53.3±11.6	51.8±10	0.1 (-0.1 to 0.3; p 0.001*)
Surgimap Spine Measurements						
Shoulder (°)	1.8±2.6	1.5±2.1	0 (-0.2 to 0.3; p 0.7)	1.3±2.2	1 ±1.7	0.1 (-0.1 to 0.3; p 0.001*)
CS (°)	1.8±1.2	1.5±1.2	0.2 (0 to 0.5; p 0.04*)	2.2±1.4	1.5±1.1	0.4 (0.2 to 0.7; p < 0.001*)
EW (°)	9.6±7.4	8.5±5.3	0.1 (-0.1 to 0.4; p 0.289)	17.3 (11.4 – 22.3)	7.9 (3.5 – 11.2)	0.9 (0.9 to 1; p < 0.001*)
IW (°)	8.7±6.5	7.7±5.5	0.2 (0 to 0.4; p 0.037*)	8.1±8	7.4±5.9	0.2 (-0 to 0.4; p 0.001*)
1.b Patients with Severe Severity (ST and SL Groups)						
	ST			SL		
	Pré treatment N=40	Pos treatment N=40	Effect Size (95%CI; p)	Pré treatment N=16	Pos treatment N=16	Effect Size (95%CI; p)
Radiographic Measurements						
Major Curve (°)	50.6±3.9	46.1±8.3	0.2 (0.2 to 0.8; p 0.002*)	47.7±1.9	44.9±5.4	0.8 (0.1 to 1.1; p 0.001*)
Kyphosis (°)	24.2±11.9	20.1±8.9	0.6 (0.2 to 0.9; p 0.001*)	26.8±8.9	24.1±9.6	0.6 (0.1 to 1.2; p 0.001*)
Lordosis (°)	54.4±11.4	48.6±11.8	0.6 (0.3 to 0.9; p < 0.001*)	57.2±7.4	54.1±9.1	0.3 (-0.2 to 0.9; p 0.001*)
Surgimap Spine Measurements						
Shoulder (°)	2.4±2.1	1.6±1.5	0.4 (0.1 to 0.7; p 0.017*)	2.5±2.4	1.2±2.6	0.8 (0 to 1.1; p 0.001*)
CS (°)	1.6 (0.9–2.9)	1.4 (0.8–2)	0.4 (0.2 to 0.6; p 0.062)	2.7±1.5	1.5±1	0.7 (0.1 to 1.2; p 0.001*)
EW (°)	10.7±8.7	6.3±4.9	0.5 (0.2 to 0.8; p 0.004*)	22.1±8.3	11.8±8	1.1 (0.5 to 1.8; p < 0.001*)
IW (°)	10.3±6.4	7.4±5	0.4 (0 to 0.7; p 0.029*)	8.8±5.1	5.5±3.6	0.8 (0.1 to 1.1; p 0.001*)

MT: moderate thoracic group; ML: moderate lumbar group; ST: severe thoracic group; SL: severe lumbar group. Craniosacral alignment angle; EW: external angle of the waist; IW: internal waist angle. The values of the variables are pre in two formats: the mean followed by the standard deviation (for variables with normal distribution) and the median follow interquartile ranges (for variables with asymmetric distribution). For the Student t-test, effect size is given By Cohen's d. For Wilcoxon test, effect size is given by the matched rank biserial correlation.

Conclusion(s)

All groups showed significant improvements in trunk deformity after 6 months of conservative treatment, particularly in patients with severe curves.

Clinical significance

Conservative treatment improved spinal deformity, especially in patients with Cobb angles $>45^\circ$, offering a non-surgical option for severe AIS.

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RISK OF PROGRESSION IN SCOLIOSIS: EFFICACY OF SIDE-SHIFT THERAPY IN SLOWING CURVE PROGRESSION

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Background

Scoliosis progression, particularly during growth phases, remains a significant concern in pediatric orthopedics. Identifying children at risk for rapid progression is crucial for developing effective treatment plans. Factors influencing progression risk include Cobb angle, skeletal maturity (Risser stage), and curve pattern. Non-invasive treatments, such as side-shift therapy, have emerged as potential alternatives to bracing and surgery, with the aim of slowing or halting curve progression. This study investigates the effect of side-shift therapy in children with idiopathic scoliosis, specifically analyzing how risk of progression influences treatment outcomes

Objective (s)

The primary objective of this study is to assess the impact of side-shift therapy on scoliosis progression in children at different risk levels, defined by Cobb angle, skeletal maturity, and rate of curve progression. The hypothesis is that side-shift therapy can slow the progression of scoliosis in high-risk patients and may stabilize or improve spinal alignment in lower-risk patients

Study Design

This is a prospective cohort study evaluating the effects of side-shift therapy on scoliosis progression in children classified by risk of progression. Risk categorization was based on clinical factors such as Cobb angle, skeletal maturity (Risser stage), and rate of curve progression

Methods

A total of 35 children with idiopathic scoliosis were included in the study, divided into three groups based on their risk of progression: high-risk (Group 1), moderate-risk (Group 2), and low-risk (Group 3). Side-shift therapy, involving targeted exercises to correct spinal alignment, was administered to all participants for a minimum of 1.5 years. Primary outcomes included changes in Cobb angle, rotation, and lateral vertebral tilt (LVT), measured at the start and end of treatment. Statistical analysis was performed to compare outcomes across groups using paired t-tests and regression models

Results

Group 1 (high-risk, N=10) showed an average increase in Cobb angle of +1.0° per year, with small changes in rotation (+0.35°) and LVT (+0.6°). Group 2 (moderate-risk, N=10) showed a more pronounced progression with Cobb angle increasing by +1.4° per year, rotation (+1.0°), and LVT (+0.8°). In contrast, Group 3 (low-risk, N=15) showed slight improvements in all parameters, with Cobb angle decreasing by -0.5°, rotation (-0.5°), and LVT (-0.5°).

Conclusion(s)

Side-shift therapy was effective in slowing scoliosis progression in high-risk children, as evidenced by a reduced rate of Cobb angle increase and stabilization of rotation and LVT. The therapy also showed potential for slight improvement in lower-risk patients, suggesting its role in both stabilizing and potentially correcting spinal deformities.

Clinical significance

This study provides evidence supporting the use of side-shift therapy as a non-invasive treatment for scoliosis, particularly for children at risk of rapid progression. Its potential to stabilize or improve spinal curvature offers an alternative to more invasive interventions like bracing or surgery, emphasizing the importance of early intervention and personalized treatment plans.

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ANALYSIS OF MUSCLE ACTIVITY VARIABILITY AND BALANCE DURING SIDE-SHIFT OVERCORRECTION EXERCISES IN ADOLESCENT IDIOPATHIC SCOLIOSIS PATIENTS

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Background

Adolescent idiopathic scoliosis (AIS) is characterized by three-dimensional spinal deformities often accompanied by muscular imbalances. Muscle activity balance, quantified using the root mean square (RMS) value, is crucial in assessing recruitment symmetry. An ideal RMS value of 1 indicates balanced muscle activation. Prior studies suggest that side-specific imbalances are associated with curve severity and flexibility. Surface electromyography (sEMG) is a valuable tool for quantifying these discrepancies and guiding rehabilitation strategies

Objective (s)

The study aimed to:

1. Investigate muscle activity symmetry between the convexity and concavity sides during side-shift overcorrection exercises in AIS patients.

2. Analyze variability patterns across different curve flexibility types.

Study Design

A cross-sectional observational study

Methods

Seventeen AIS patients aged 13–20 years (mean height: 167.5 cm; Cobb angle: 27°–55°) were included. Surface electromyography (sEMG) biofeedback was utilized to record muscle activity during 10 repetitions of 10-second side-shift overcorrection exercises. Patients were classified into three flexibility types: Type 1 (flexible), Type 2 (stiff), and Type 3 (rigid).

Convexity and concavity muscle RMS values were recorded. Variability metrics, including standard deviation (SD) and coefficient of variation (CV), were calculated. Maximum output differences between sides were assessed. Statistical analysis included paired t-tests and ANOVA for group comparisons.

Results

Convexity muscles exhibited higher average RMS values (mean 1.8) than concavity muscles (mean 1.2, $p=0.001$). Balanced RMS values of 1 were observed in only 18% of cases, predominantly in Type 1 curves. Variability was greater in convexity muscles (SD: 0.65, CV: 36.1%) than concavity muscles (SD: 0.45, CV: 29.7%). Maximum output differences averaged 0.6 RMS, with Type 2 and Type 3 curves showing more pronounced imbalances.

Conclusion(s)

Muscle recruitment patterns in AIS patients reveal significant asymmetry, with convexity muscles displaying higher activation and variability. Side-shift overcorrection exercises demonstrate limited muscle balance restoration, particularly in patients with stiff or rigid curves (Type 2 and 3).

Clinical significance

This study highlights the utility of sEMG biofeedback in identifying recruitment asymmetries, informing targeted interventions to improve muscle balance. Such approaches may enhance functional outcomes in AIS rehabilitation, particularly in patients with severe curve rigidity.

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OXYGENATION AND FATIGUABILITY STATUS OF THE TRUNCAL MUSCLES DURING ENDURANCE TASK EXECUTION: A COMPARATIVE STUDY BETWEEN YOUNG INDIVIDUALS WITH AND WITHOUT IDIOPATHIC SCOLIOSIS

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Background

Impaired spinal kinematics during the execution of daily functional movements has been shown in adolescents with idiopathic scoliosis (AIS). While compositional differences between concave- and convex-side paraspinal muscles have been reviewed in AIS, comprehensive studying of muscle endurance and its impacts on movement quality remains limited.

Objective (s)

This study aimed to investigate the endurance performance of the truncal muscles in adolescents with AIS and if changes in the movement kinematics during walking occur after fatiguing of the truncal muscles.

Study Design

Cross-Sectional Study

Methods

Real-time muscle oxygenation and muscle activity during truncal endurance tasks (modified Sorensen test for thoracic extensors, bilateral side plank for truncal side flexors, and abdominal curl up for truncal flexors) were acquired by Near-Infrared Spectroscopy (NIRS) and electromyography (EMG) respectively in 27 individuals with AIS and 32 healthy controls (HC). The fatigability during the endurance tests was verified by self-perceived exertion and spectrum analysis of EMG. The endurance times, muscle oxygenation and EMG activity during the endurance tests, were compared between two groups of participants. For Endurance time, normality and heterogeneity tests determined whether t-test or Mann-Whitney U tests were used for endurance times and demographic data. For EMG data, median frequency slopes were analyzed using Mann-Whitney U tests for between-group comparisons (HC vs. AIS) and paired t-tests (or Wilcoxon Signed Ranks) for within-group comparisons. Root-mean-square (RMS) amplitudes were analysed by two-way mixed ANOVA for group x side effect. Significance was set at 0.05. For NIRS data, between-group and side comparisons were compared by Aligned Rank Transform (ART) ANOVA.

Results

Participants in AIS group showed a significantly lower endurance time in bilateral side plank tasks when compared to the HC group ($p < 0.05$). Meanwhile, a comparable level of endurance of the truncal flexors and extensors were revealed between two groups ($p > 0.05$). The slope of the median frequency of the EMG activity showed a steeper decline in the quadratus lumborum over the concave-side of AIS as compared to HC ($p = 0.003$). There was no significant between-group and between-side difference in oxyhemoglobin (O_2Hb) levels of corresponding prime movers during all muscle endurance tasks ($p > 0.05$).

Conclusion(s)

The muscle endurance of the concave-sided quadratus lumborum (QL) of AIS participants was found to be reduced when compared to those without scoliotic curve. While there is emerging evidence indicating the immediate impaired coronal movement control in AIS following the trunk muscle endurance tasks. Long-term impacts associated with deficiency of truncal muscle endurance and muscle fatigue on postural control or curve progression in AIS group are yet to be investigated.

Clinical significance

Further research that examine the specific role of QL in trunk stabilization and its effect on the scoliotic curve progression are recommended to help refine the physiotherapy specific exercise for rehabilitation of individuals with AIS.

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IMMEDIATE EFFECT OF TRUNCAL MUSCLE FATIGUING ON SPINAL KINEMATICS AND INTER-REGIONAL MOVEMENT VARIABILITY DURING WALKING IN YOUNG INDIVIDUALS WITH MILD DEGREE OF SCOLIOSIS

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Background

Pelvis serves as the biomechanical base of the spinal column, which facilitates transfer load from upper body to lower extremities. The dynamic interplay of movements between the spine and pelvis is crucial in everyday tasks including postural stability and walking. Adolescent idiopathic scoliosis (AIS), a condition contributing to three-dimensional structural deformity, would lead to impaired spinal kinematics during the execution of daily functional movements in individuals with AIS. While compositional differences between concave- and convex-side paraspinal muscles have been reviewed in AIS, comprehensive studying of muscle endurance and its impacts on movement quality remains limited.

Objective (s)

This study aimed to investigate the changes in the movement kinematics during walking occur after fatiguing of the truncal muscles.

Study Design

Cross-sectional study

Methods

3D kinematics of the spine and pelvis during self-paced walking measured by surface topography in 59 young individuals (27 individuals with AIS and 32 healthy controls (HC)) were compared before and after the truncal endurance tasks (modified Sorensen test for thoracic extensors, bilateral side plank for truncal side flexors, and abdominal curl up for truncal flexors). The pre-to-post changes in spinal kinematics taking place in the coronal plane and the variability of inter-regional movement coordination between thoracic rotation and the pelvis during self-paced walking, were compared between two groups of participants, upon the completion of the truncal muscle endurance tasks.

Results

The minimal and maximum coronal imbalance in the AIS group were found significantly different from the HC group in the walking tasks following the endurance tasks. Participants with AIS displayed with a significantly greater listing towards their concave side during the swing phase of their gait cycle during the self-

paced walking trial after the truncal muscle endurance tests. No significant time-and-group interaction was found in the inter-regional rotation coordination variability between T4 and pelvis. However, the variability in movement patterns was significantly higher in HC participants ($p = 0.006$) compared to AIS participants.

Conclusion(s)

A reduced coordination variability revealed in AIS participants during the swing phase might have attributed to overall spine stiffness. Despite the immediate effect of truncal muscle fatigue not substantially influencing the coordination of trunk-pelvis movement in AIS group, a negative impact featured by an impairment of trunk control in coronal plane was revealed, following the trunk muscle endurance tasks. An increase in lateral listing on concave side was observed in AIS group after fatigue task, which may indicate the role of truncal muscle endurance on the trunk control during gait cycle.

Clinical significance

Further research to investigate the specific role of QL in trunk stabilization and its effect on the scoliotic curve is recommended to help refine the physiotherapy specific exercise for rehabilitation of individuals with AIS.

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PHYSIOTHERAPEUTIC SCOLIOSIS-SPECIFIC EXERCISES (SEAS SCHOOL) FOR CHILDREN WITH IDIOPATHIC SCOLIOSIS ARE A COMPLEX REHABILITATION INTERVENTION: A DELPHI STUDY USING THE COCHRANE REHABILITATION “GUIDE-REHAB” REPORTING GUIDELINE

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Background

SOSORT Guidelines defined exercise treatment as Physiotherapeutic Scoliosis-Specific Exercises (PSSE) where the adjective physiotherapeutic was not meant to indicate specific professionals but the complexity of the approach (Negrini 2012). SOSORT searched the commonalities

among the different PSSE schools, identifying active self-correction and stabilisation as their main characteristics (Weiss 2005). Since then, no further step forward followed. Contrarily, in the last years prevailed underlying (minor?) differences with the appearance of new schools. Recently, Cochrane Rehabilitation developed the Guideline for Interventions Description in Rehabilitation (GUIDE-Rehab) (Negrini 2024) as a tool to open the so-called “black box” of rehabilitation complex interventions (UK Medical Research Council 2021) that could offer a framework to describe PSSEs further and identify commonalities and differences among the schools.

Objective (s)

To use GUIDE-Rehab to describe the SEAS (Scientific Exercises Approach to Scoliosis) PSSE school as a complex rehabilitation intervention.

Study Design

This is the first part of a mixed-methods qualitative study within a tertiary-level scoliosis outpatient institute, including Delphi rounds (Part I) and focus groups with final consensus (Part II).

Methods

We inquired all expert physicians, physiotherapists, motor scientists and psychologists working in our Institute (73 potential participants), where we use the SEAS School. The whole project includes:

Part I – Delphi Study (December 2024):

- First Round to identify a set of treatment targets (definition: *“a measurable aspect of the functioning or contextual factors hypothesised to be directly changed by the active ingredients of the intervention”*);
- Second Round to identify the most common targets’ ingredients (definition: *“a constituent of the intervention responsible alone or with other ingredients for the therapeutic action”*).

Part II – Final GUIDE-Rehab description (February 2025):

- Focus Groups to identify all GUIDE-Rehab elements (treatment and components theories; ingredients quantity, tailoring, and quantity changes).
- Consensus Conference.

After each Delphi Round, we grouped the answers through a nominal data analysis and an Artificial Intelligence (AI) analysis using ChatGPT 4.0.

Results

We had 53 (response rate 75%) and 57 (78%) participants in the Delphi Rounds. Both analyses provided the following targets (% of respondents): scoliosis stabilisation (34%), psychological well-being and quality of life (19%) and compliance (15%). AI analysis added fitness (32%), aesthetic improvement (28%), education and self-consciousness (21%) and family support (19%). The table reports the ingredients we identified for the three most common targets.

Table . Main ingredients of the 3 main targets proposed by participants

Scoliosis stabilization				Adherence to treatment			
AI analysis		Nominal analysis		AI analysis		Nominal analysis	
Self-Correction	63%	Active self-correction without external aids	52%	Patient Motivation and Engagement	30%	Shared decision making	
Physical Activity and Sports	46%	Sports/Physical activity	43%	Clear Communication and Continuous Feedback	24%	Compliance tools	
Consistency and Regularity in Exercises	24%	Introduction of self-correction in everyday activities without the brace	33%	Personalization of Treatment and Flexibility	18%	Motivation at each encounter professional	
Patient Motivation and Incentivization	17%	Patient Motivation and Incentivization	17%	Regular Meetings and Relationship with the Team	14%	Gamification Playful Engagement	
Ergonomics and Physiotherapy Education	11%	Stability exercises	15%	Use of Technologies and Applications	10%		
		Motor reprogramming through dynamic exercises keeping the best possible correction	11%	Involvement of Family and Friends	10%		
		Ergonomics and Physiotherapy Education	11%				

Conclusion(s)

The targets and ingredients identified by experts go beyond “simple” exercise treatment, confirming the hypothesis of the SEAS School as a complex rehabilitation intervention. Phase II will allow us to describe it completely. Opening the black box and providing a complete description of the different schools could increase our understanding of PSSEs and identify new areas of research.

Clinical significance

Although complex, the exercise of identifying targets and ingredients allowed us to better focus clinically on some treatment components currently underestimated.

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EFFECTIVENESS OF UTILIZING INDIVIDUALIZED TREATMENT PROGRAMS IN MANAGEMENT OF ADULTS WITH SCOLIOSIS: A SHORT AND LONG TERM PERSPECTIVE

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Background

There is limited research on the application of Physiotherapeutic Scoliosis-Specific Exercises (PSSE) for the adult scoliosis population.¹ Approximately 90% adults with scoliosis report pain.² Monticone et al. demonstrated active self-correction, task-oriented exercises and cognitive-behavioral strategies to be superior for adult scoliosis.³ Treating adults with scoliosis poses challenges due to a heterogeneous population, distinct classification systems, differing pain sources, comorbidities, and bone density.^{3,4}

Objective (s)

To evaluate the effectiveness of combining PSSE with functional optimization based on Schwab criteria as a treatment approach for managing adults with scoliosis.

Study Design

Case Series

Methods

This examines two case studies of 71 year old patients with adolescent idiopathic scoliosis that progressed into adulthood. Case A involves a patient with a primary right thoracic curve and modifiers (+ + + +) based on the SRS-Schwab classification⁴. Case B focuses on a patient with a primary lumbar curve and a single modifier (+). Both patients presented with large cobb angles ($\geq 80^\circ$), though their functional and clinical presentations differed. Interventions were tailored to individual needs, tolerance, and patient presentations, with differences in the application of PSSE and positional strategies.

Results

Patients were assessed with SRS 22, cobb angle, ATR, and functional measures. Patient A's data is shown for one episode of care (12 visits, 3 months). Patient B's data is shown longitudinally through re-evaluation over time.

Patient A	Initial Evaluation	Discharge
Cobb	93	93
NPRS	9	1
ODI	70	48
SRS 22	2.5	3.0
Trunk Imbalance (cm R)	3	3
Modified ATR (deg)	21	21
SLS	R: 8", L: 6"	R: 24", L: 20"
30" STS	11	15
TUG	7.12"	5.96"

Patient B	2018	2020	2021	2023	2024
Visits	7	6	6	7	4
Cobb	80	82	80	80	82
NPRS	5	4	3	1-2	1
ODI	26	22	24	26	28
SRS 22			3.6	3.6	3.9 → 4.2
Trunk Imbalance (cm R)	2	2	5	2	2
Modified ATR (deg)	R: 8 L: 11	R: 8 L: 11	R: 6 L: 13	R: 6 L: 11	R: 4 L: 10

SLS		R: 30"	R: 25"	R: 27"	R: 12" → 30"
		L: 6"	L: 22"	L: 23"	L: 9" → 25"
30" STS			13	16	16
TUG			8.61"	8.6"	9.74"

Conclusion(s)

This case report highlights the importance of tailoring adult scoliosis treatment programs to individual patient presentations, considering factors including motivation, intrinsic curve stability, SRS-Schwab modifiers, and exercise tolerance. Both patients demonstrated improvements in functional capacity and pain within each episode of care and demonstrated stability longitudinally (Patient B).

Clinical significance

These findings suggest that incorporating PSSE and functional integration can be effective in managing adult scoliosis with pain in the short and long term.

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CLINICAL ANALYSIS OF CONSERVATIVE TREATMENT FOR ADOLESCENT IDIOPATHIC SCOLIOSIS BASED ON THE THEORY OF TISSUE STRESS REMODELING

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Background

Adolescent Idiopathic Scoliosis (AIS) is the most common type of scoliosis, Conservative treatment for adolescent idiopathic scoliosis includes exercise therapy, brace therapy, gymnastics training, physical therapy, etc. However, there is a lack of systematic treatment methods guided by the overall theory of etiology. The theory of tissue stress remodeling can establish a conservative treatment system for AIS from an etiological perspective.

Objective (s)

This study aims to explore the clinical effects of comprehensive conservative treatment guided by the theory of tissue stress remodeling on patients with adolescent idiopathic scoliosis (AIS).

Study Design

The study was approved by the medical ethics committee of the hospital and implemented strictly in accordance with the inclusion criteria, exclusion criteria, and dropout criteria. A case-control study was conducted to compare the differences in Cobb angle and AVT between the observation group and the control group after treatment, confirming that conservative treatment of AIS under the guidance of tissue stress remodeling theory is more effective.

Methods

A total of 48 AIS patients admitted to Tai'an Central Hospital from February 2023 to November 2024 were selected and randomized into two groups, with 24 patients each. The control group received traditional treatments, including exercise therapy, Schroth therapy, and brace correction, while the observation group underwent a more comprehensive conservative treatment based on the theory of tissue stress remodeling, which included posture management, manual therapy, exercise therapy, three-dimensional traction, and brace correction. We compared the outcomes of both groups, including Cobb angle and Apical Vertebral Tilt (AVT).

Results

After 2 months of intervention, the total effective rate of the observation group was significantly higher than that of the control group, with statistically significant differences ($P < 0.05$); the Cobb angle and AVT in the observation group were also significantly lower than those before intervention and in the control group, with significant differences ($P < 0.05$).

Conclusion(s)

Comprehensive conservative treatment guided by the theory of tissue stress remodeling significantly improves the spinal curvature angle, posture, and functionality in AIS patients, suggesting its wide application in clinical practice.

Clinical significance

This study highlights the positive clinical effects of comprehensive conservative treatment for adolescent idiopathic scoliosis based on the theory of tissue stress remodeling. By understanding and applying this theory, it is possible to intervene at the etiology level of spinal curvature, providing support for formulating more effective orthotic plans. This comprehensive treatment approach can rapidly and effectively correct spinal curvature, significantly enhancing the aesthetics and quality of life of AIS patients.

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SPECIFIC MOBILITY OF THE SCOLIOTIC CURVE: HERO OR VILLAIN?

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Background

Patients with scoliosis are known to have a higher prevalence of hypermobility, which can influence treatment and outcomes. The rigidity or mobility of the spine at the start of treatment plays a significant role in the results achieved. Understanding this relationship can help professionals tailor treatment strategies to meet individual patient needs, potentially leading to better treatment outcomes.

Objective (s)

To assess the correlation between the specific mobility of the scoliotic curve, Cobb angle, and ATR in patients with scoliosis treated using the SEAS (Scientific Exercises Approach to Scoliosis) Approach and the 3D Rigo-Chêneau brace.

Study Design

Retrospective correlational study.

Methods

This study used data from a private clinic in Brazil, involving 67 patients, from January 2021 to April 2024. All patients underwent conservative treatment with the SEAS approach and the 3D brace. Inclusion Criteria: Patients diagnosed with adolescent idiopathic scoliosis undergoing conservative treatment for a minimum of 6 months. Exclusion Criteria: Patients with lower limb amputations, identifiable causes of scoliosis, spinal surgery, or incomplete evaluations. Each patient was evaluated twice by the same physiotherapist, measuring the Angle of Trunk Rotation (ATR), Stiffness Scoliosis Test (SST), and Cobb Angle. The SST was performed by having patients bend toward the convexity of the curve during forward bending of the trunk, with the degree of the rib hump measured. The Rotational Flexibility Index (RFI) was calculated using the formula: $RFI = (ATR - SST) / ATR \times 100$. Pearson's correlation was calculated between mobility (SST and RFI) and Cobb angle and ATR ($p < .05$). A sample size calculation indicated 29 subjects.

Results

Sixty-one curves from 40 patients were included, 36 females (90%), with 32 (52.5%) thoracic and 29 (47.5%) lumbar curves and a mean age of 12.3 ± 1.8 years. For thoracic curves, the mean Cobb angle was $31.3^\circ \pm 11.2^\circ$, ATR $9.2^\circ \pm 3.6^\circ$, SST $-3.8^\circ \pm 5.2^\circ$, and RFI $173\% \pm 65\%$. For lumbar curves, the mean Cobb angle was $30.4^\circ \pm 10.5^\circ$, ATR $6.1^\circ \pm 5.2^\circ$, SST $-7.5^\circ \pm 5^\circ$, and RFI $190\% \pm 78\%$. For both thoracic and lumbar curves, the correlation between SST and Cobb/ATR was positive and significant (ranging from 0.32 to 0.46). The correlation between RFI and Cobb/ATR was negative and significant (ranging from -0.37 to -0.58).

Conclusion(s)

There is a weak to moderate correlation between the specific mobility of the scoliotic curve (SST and RFI) at the start of treatment and the final outcomes (Cobb angle and ATR). The more mobile

the patient at the start of treatment, the lower the Cobb angle and ATR after at least 6 months of conservative treatment with the SEAS approach and the 3D brace.

Clinical significance

This study represents a first step in guiding specific mobility work for the scoliotic curve, which can be incorporated into conservative treatment. Further research is needed to explore this relationship.

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MECHANICAL AND BIOLOGICAL IMPACT OF TROPOCOLLAGEN ON MYOFASCIAL STRUCTURES ON THE CONCAVE SIDE OF THE LUMBAR SPINE AS AN ESSENTIAL ELEMENT OF CORRECTIVE THERAPY FOR SCOLIOSIS

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Background

One of the essential functions of fascial structures is to maintain the integrity of the human body while preserving its strength and flexibility. The colloidal nature of fascial tissues, combined with the presence of collagen fibers, enables rapid adaptation to biomechanical changes. The myofascial structures of the lumbar spine play a critical role in maintaining pelvic alignment and symmetry hence its important role in etiopathogenesis of scoliosis. Asymmetry in the tension of these structures can lead to lateral curvature of the lumbar spine, contributing to scoliosis progression.

Conservative treatment of idiopathic scoliosis presents a significant therapeutic challenge, partly due to adhesive changes within the myofascial structures on the concave side of the spinal curvature. Approximately 80% of cases involve double-curve scoliosis, characterized by leftward curvature in the lumbar region and rightward curvature in the thoracic region.

Objective (s)

The study aimed to evaluate the impact of ultrasound-guided tropocollagen injections into the adhered layers of deep fascia on the concave side of the lumbar spine curvature on the effectiveness of manual therapy treatment in scoliosis correction.

Study Design

clinical trial

Methods

This study was conducted with ethical approval (approval number: KE-0254/211/10/2022) and included 16 female participants aged 12–17 diagnosed with right thoracic and left lumbar scoliosis. The participants were divided into two groups:

Study group (8 patients): Received one week manual therapy treatment preceded by tropocollagen injections into adhesive fascial structures in order to separate them

Control group (8 patients): Received one week manual therapy treatment only.

All participants underwent 60-minute physiotherapy sessions three times a week. The therapy included Muscle Energy Techniques (MET) and Proprioceptive Neuromuscular Facilitation (PNF) exercises targeting stretching myofascial structures on the concave side of the curvature. The range of lateral bending tests were assessed before and after the first session and three weeks later.

Results

In the control group, the mean difference in lateral bending tests for the right quadratus lumborum muscle before and immediately after therapy was 3,52 cm, SD $\pm$ 0,31 cm. After three weeks, this mean difference decreased to 0.55 cm SD $\pm$ 0,16 cm

In the study group, the same tests showed an improvement of 4.2 cm, SD $\pm$ 0,21 cm before and after therapy, which decreased slightly to 3.11 cm, SD $\pm$ 0,18 cm after three weeks.

Conclusion(s)

1. Tropocollagen injection therapies appear to enhance the outcomes of corrective exercises for scoliosis treatment.

Clinical significance

1. Incorporating these injections into routine clinical practice improves therapeutic results by stimulating the repair processes of damaged connective tissue and positively influencing the organization and integrity of collagen fibers.

2. Further research is necessary to fully understand the mechanisms of tropocollagen's effects on altered connective tissue in scoliosis and to optimize therapeutic protocols.

BRACE AND KYPHOSIS SPECIFIC EXERCISES FOR ADOLESCENT SCHEUERMANN KYPHOSIS TREATMENT

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Background

Thoracic Scheuermann Kyphosis is defined by radiological (3 consecutive wedged vertebrae) and clinical (angular hump and rigidity) criteria. The aim of non-operative treatment is to stop progression, avoid surgery, improve kyphotic angle and aesthetics. To date, only few studies investigated the effect of conservative treatment for Scheuermann kyphosis.

Objective (s)

Our aim was to evaluate the efficacy of a combined treatment with brace and kyphosis specific exercises (KSE) for Scheuermann kyphosis treatment during growth.

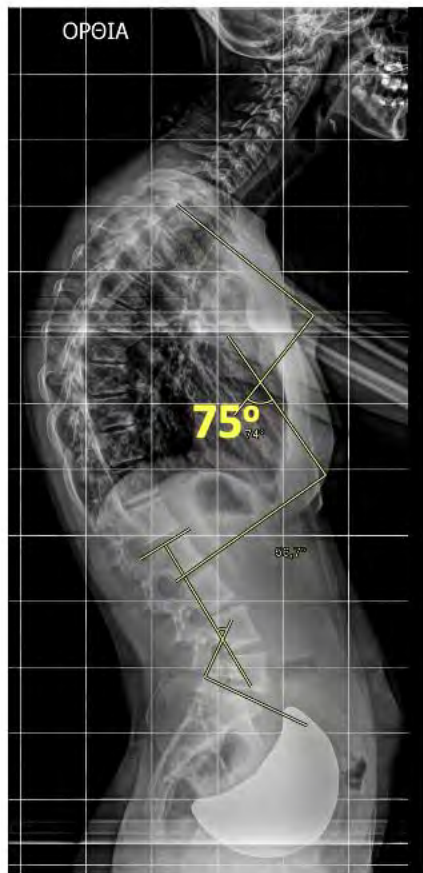
Study Design

Prospective cohort study

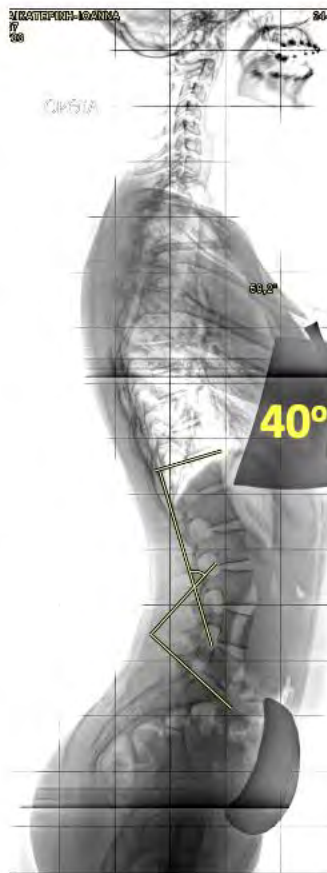
Methods

89 patients (18 girls - 71 boys, mean age 14.1 years, Risser sign 1.8, kyphotic Cobb angle 61.8°) enrolled in our study, from our prospective database. Our inclusion criteria were kyphotic angle >45° with both radiological and clinical Scheuermann findings, Risser 0-3 and age > 10 years. All subjects were prescribed brace and Kyphosis Specific Exercises (KSE). Our outcome parameters were pre/post kyphosis angle, vertebra wedging and SRS-22 questionnaire scores. Average follow-up time was 33.5 months. Compliance was self-reported. Analysis of Variation (ANOVA) test was used for statistical analysis.

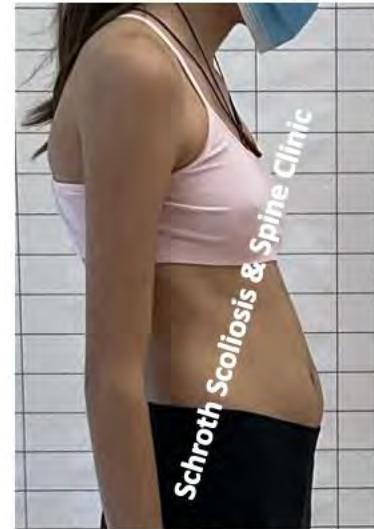
Results



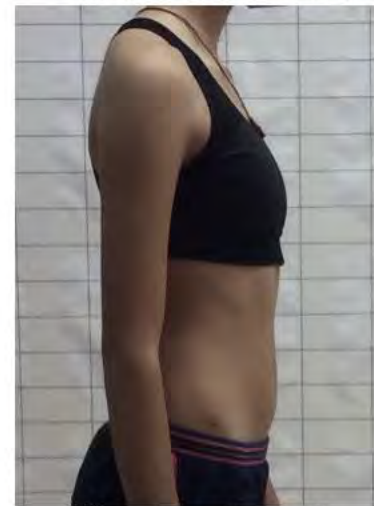
Before treatment



After treatment



Before treatment



After treatment



Before treatment



After treatment

In total, 53 patients (59.6%) improved their kyphotic angle $> 5^\circ$, 30 remained stable (33.7%) and 6 worsened $> 5^\circ$ (6.7%). The mean in-brace correction was 43.8%. Mean kyphotic angle post-intervention was significantly improved (49.4o, $p=0.002$). A statistically significant improvement was measured for the vertebral wedging at apical region, from 9.4o to 7.3o ($p=0.003$). Self-image (from 3.2 to 4.1, $p= 0.02$), pain (from 3.6 to 4.1, $p=0.05$), mental health (from 3.4 to 4.2, $p=0.02$) and total SRS-22 score (from 72.3 to 81.6, $p=0.004$) improved after treatment. Only, function did not significantly change (from 4.3 to 4.5, $p=0.09$).

Conclusion(s)

Brace and KSE achieved a success rate of 93.3% for Scheuermann kyphosis treatment, avoiding progression. Our study confirms that growth modulation can be observed with conservative treatment by decreasing the vertebral wedging. Finally, all health-related quality of life measurements were significantly better post-treatment. To conclude, non-operative treatment can be effective for Scheuermann kyphosis around the growth spurt.

Clinical significance

Non-operative treatment for Scheuermann kyphosis is under-reported in the literature. Our study proved that a combination of brace and KSE can be implemented for Scheuermann kyphosis treatment, providing good clinical and radiological outcomes.

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THE IMPACT OF INTENSIVE SCHROTH THERAPY ON PHASE TIMINGS AND VELOCITY OF THE UPPER THORACIC SEGMENT DURING SIT-TO-STAND IN ADOLESCENTS WITH IDIOPATHIC SCOLIOSIS

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Background

Adolescent Idiopathic Scoliosis (AIS) has a significant impact on spinal kinematics and gait. Previous reports have highlighted that analysing multi-segment spinal movement during gait provides valuable insights for scoliosis management. Studies by Witchell et al. (2018) further suggest that during the sit-to-stand transition, angular velocities are more effective than temporal features in distinguishing between healthy individuals and patients. Building on this understanding, the present study investigates the effect of intensive Schroth Therapy on spinal kinematics, with a particular focus on the dynamic posture of the thoracic region.

Objective (s)

To evaluate the changes in timings and velocity of the upper thoracic segment during a sit-to-stand in patients with AIS following intensive Schroth Therapy.

Study Design

Cohort observation

Methods

After obtaining necessary ethical approval, 7 participants (5F, 2M) with AIS and a mean age of 15.43 years (SD 2.37), height of 168cm (SD5.73), body mass of 56 Kgs (SD12.54) attending a Schroth camp, providing informed consent were recruited. A 10-camera motion capture system (Vicon, Oxford, UK) collected kinematic data at 100 Hz. As shown in our previous papers (Needham et al 2016), reflective markers were placed on the spine, back, pelvis, and lower limbs. Baseline data were collected before the camp, and follow-up data were collected immediately at the camp's conclusion. Participants performed a standardised sit-to-stand activity as instructed. Inspired by the Roebroeck et al (1994) study, the phases (horizontal and vertical) were defined. The timing and velocity for the upper thoracic segment were assessed across the anterior posterior and the vertical axes.

Results

	Phase time (s)				UT segment velocity (m/s)			
	Horizontal		Vertical		Horizontal		Vertical	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
P1	1.02	0.83	1.07	1.05	0.84	1.02	0.66	0.67
P2	0.97	0.71	1.10	1.02	0.67	0.57	0.57	0.58
P3	0.84	0.70	0.92	0.88	1.00	0.87	0.76	0.76
P4	0.74	0.73	0.99	0.91	0.71	0.71	0.61	0.71
P5	1.07	0.92	1.03	1.02	0.64	0.77	0.60	0.61
P6	0.95	1.04	0.97	1.05	0.81	0.80	0.69	0.61
P7	0.74	0.93	0.88	0.89	0.65	0.84	0.63	0.68
Mean	0.90	0.84	0.99	0.97	0.76	0.80	0.65	0.66
SD	0.13	0.13	0.08	0.08	0.13	0.14	0.06	0.07

UT - upper thoracic, SD - standard deviation

The post-camp mean data clearly showed a reduction in time for both horizontal and the vertical phases. There was also an increase in upper thoracic segment velocity, post-camp in both phases. Our results demonstrate that although two of the participants did not follow the trend of the mean data, the individual variability and their response to the treatment were very clear. These changes showcase increased movement efficiency.

Conclusion(s)

The findings confirm that Schroth therapy influences dynamic postures during sit-to-stand. These changes may reflect improved neuromuscular control and posture correction due to targeted therapy.

Clinical significance

This study demonstrates that intensive Schroth Therapy can improve movement efficiency and neuromuscular control during dynamic activities such as the sit-to-stand transition in adolescents with AIS. These findings highlight the potential of targeted therapy to enhance postural control and functional mobility in this population.

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SHORT-TERM OUTCOMES OF COMBINED SCHROTH THERAPY AND CHÊNEAU BRACING IN ADOLESCENTS WITH IDIOPATHIC SCOLIOSIS: A PROSPECTIVE STUDY

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Background

Recent studies indicate that optimal treatment outcomes for adolescents with idiopathic scoliosis (AIS) are best achieved through a combined approach of bracing and physiotherapeutic scoliosis-specific

exercises (PSSE), which have shown superior efficacy compared to bracing alone. This combined treatment with bracing and PSSE exhibits three-dimensional effects on both clinical and radiological outcomes in AIS patients and manages to stabilize or even reduce scoliosis during growth.

Objective (s)

The aim of the study is to evaluate improvements of clinical parameters in AIS patients prior to bracing, following a structured 3-weeks Schroth treatment program. Furthermore, clinical parameters after 3 weeks will be compared with the ones after 6 months, which represent the short-term outcome of combined treatment (Schroth+Cheneau brace).

Study Design

This was a prospective study approved by the local Ethical Committee.

Methods

Sixty AIS patients (45 females, 15 males) aged 10-16 years, with initial Cobb angle: 20° - 47° and Risser 0-4 mean score 2 (IQR 3), primary thoracic scoliosis was present in 28 patients (46.7%), while primary lumbar scoliosis was present in 32 patients (53.3%). Clinical parameters included the Angle of Trunk Rotation (ATR), sagittal balance, sagittal index, coronal balance and TRACE scores. Initial measurements were taken prior to treatment, 3 weeks after intensive Schroth therapy and after 6 months of combined treatment (Cheneau+Schroth). The patients were braced after 3 weeks of Schroth therapy. Statistical analysis was performed using SPSS 29.0 (IBM Corp.2023).

Results

The mean age was 13.3 ± 1.6 years, the mean Cobb angle at the start of therapy was $29.7 \pm 7.6^\circ$, whereas on six months' follow-up $23.3 \pm 10.4^\circ$. Table 1 shows the final clinical outcomes and the differences of the measured parameters from baseline to 21 days and from 21 to 6 months and the statistically significant improvement.

Table 1: Clinical characteristics of patients before the treatment and follow-up assessments

Clinical Parameter (n = 60)	Before the treatment	3 Weeks	6 Months	p-value
Scoliometer (°)	10.1 ± 4.2	7.8 ± 4.0	5.7 ± 4.4	<0.001b
TRACE Score	11 (2)	9 (2)	9 (0)	<0.001b
Sagittal Index (%)	60.8 ± 27.3	57.8 ± 20.9	50.4 ± 21.2	0.009a
Sagittal Balance (mm)	8.5 ± 18.6	8.0 ± 13.3	17.3 ± 19.1	0.001b
Coronal Balance (mm)	15.1 ± 9.4	4.5 ± 4.4	6.2 ± 5.8	<0.001a

Data are presented as mean ± standard deviation (SD) or median (interquartile range, IQR).
a ANOVA test, b Friedman test.

Differences of the measured parameters form baseline to 21 days and from 21 to 6 months.

Scoliometer	Δ : baseline/21 days 2.3±1.9;	Δ 21 days/6 months 2.1±3.6;	p= 0.770 ^a
TRACE	Δ baseline/21 days 2 (2);	Δ 21 days/6 months 0 (2);	p= <0.001 ^b
Sagittal Index	Δ baseline/21 days 3.0±18.7;	Δ 21 days/6 months 7.4±23.5;	p= 0.321 ^a
Sagittal Balance	Δ baseline/21 days 0.5±12.9;	Δ 21 days/6 months -9.3±22.3;	p= <0.008 ^a
Coronal Balance	Δ baseline/21 days 10.6±8.6;	Δ 21 days/6 months 17.3±19.1;	p= <0.001 ^a

Conclusion(s)

The findings highlight the significant clinical improvements achieved with Schroth treatment prior to bracing in only 3 weeks, in scoliometer reading that is in thoracic deformity and the sagittal index. Since the aesthetical correction is one of the most important goals of treatment according to SOSORT guidelines, the results of our study emphasize the critical importance of initially applied Schroth therapy before the brace application in order to achieve early and visible improvements. This can serve as a strong foundation for continued therapeutic progress in later phases of combined treatment with bracing and exercises.

Clinical significance

To date, no studies have specifically investigated the short-term outcomes of treatment using the Chêneau brace and Schroth therapy, either as standalone interventions or in combination, underscoring the novel contribution of this research to the field.

EFFECTIVENESS OF PHYSIOTHERAPEUTIC SCOLIOSIS SPECIFIC EXERCISES COMPARED TO GENERAL EXERCISES IN ADOLESCENT IDIOPATHIC SCOLIOSIS

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Background

Scoliosis is defined as a complex, three-dimensional rotational deformity of the vertebral column and trunk. Maintaining spinal stability during the growth phase is a primary treatment. Physiotherapeutic scoliosis-specific exercises, have been shown to play a critical role in stabilizing the condition, especially in the early stages. Early and targeted intervention with these exercises may help reduce the risk of progression.

Objective (s)

To compare the effectiveness of the physiotherapeutic scoliosis-specific exercises versus general exercises in preventing progression of adolescent idiopathic scoliosis.

Study Design

Retrospective study

Methods

In total, 30 subjects with adolescent idiopathic scoliosis. PSSE group (n=15) included 12 girls and 3 boys, with a mean age of 12.85 years. The control group (n=15) consisted of 10 girls and 5 boys, with a mean age of 13.3 years. PSSE group was followed with physiotherapeutic scoliosis-specific exercises 5 times a week (at home and clinic), while control group with general exercises (at home and Hospital). The inclusion criteria were a Cobb angle of 15-25°, a Risser sign of 0-2, and an angle of trunk rotation (ATR) greater than 5 degrees, measured using a scoliometer. Outcome measures (paired t-test) included the Cobb angle and ATR, pre and post intervention, with stability, defined as a change in the angle of more or less than 5°. The average follow-up period time was 16 months.

Results

Our study included 30 adolescents with AIS, divided equally into PSSE (n=15) and control groups (n=15).

PSSE group: 80% female, mean age 12.7 years. Cobb angle stable from 19.16° to 16.49° (-

2.67°)(p=0.081).Risser classification:Risser 0(20%),Risser 1(33.3%),Risser 2(46.7%).Mean thoracic and thoraco-lumbar curves were 20.4° and 17.9°,with ATR measurements of 6.25° and 6.6° (p=0.009).

Two subjects had curve progression; one required bracing(27.5°).Control Group:66.67% female, mean age 13.4 years.Cobb angle worsened from 18.33° to 27.52°(-9.19°)(p=0.01).Risser classification:Risser 0(13.3%),Risser 1(33.3%),Risser 2 (53.3%). Mean thoracic and thoraco-lumbar curves were 18.1° and 18.7° with ATR measurements of 6.87° and 6.5°(p=0.01). Six subjects experienced curve progression,all requiring bracing(mean 32°).

Conclusion(s)

Our study demonstrated that physiotherapeutic scoliosis-specific exercises effectively prevents progression of adolescent idiopathic scoliosis, stabilizing the Cobb angle and ATR.The objective of halting progression was achieved, with scoliosis remaining stable.

Clinical significance

Physiotherapeutic scoliosis-specific exercises can serve as an initial and essential approach in managing and preventing the progression of scoliosis.

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EVALUATING SCOLIOSIS TREATMENT OUTCOMES IN SWIMMERS AND RHYTHMIC GYMNASTS

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Background

Adolescents engaged in physical activities are especially vulnerable to developing or exacerbating scoliosis due to the biomechanical stress imposed on their developing spines. Tanchev et al. (2000) observed a 10-fold higher prevalence of scoliosis among rhythmic gymnasts, attributed to delayed menarche, joint hypermobility, and asymmetric spinal loading. Conversely, swimming has traditionally been promoted for its symmetric engagement of the musculoskeletal system. However, Zaina et al. (2015) revealed that competitive swimming may exacerbate trunk asymmetries, hyperkyphosis, and low back pain in female athletes.

Objective (s)

Compare the effectiveness of Physiotherapeutic Scoliosis Specific Exercises (PSSE), bracing, and combined treatments in managing scoliosis among rhythmic gymnasts and swimmers, focusing on their impact on the Cobb angle, sagittal balance, and flexibility outcomes.

Study Design

Retrospective cohort study

Methods

Thirty-three patients with adolescent idiopathic scoliosis, meeting the inclusion criteria, divided into two groups: 21 rhythmic gymnasts and 11 competitive swimmers. All participants underwent treatment with PSSE, which included one 90-minute supervised session per month with a physiotherapist and a home-based program performed 5 days per week for 20 minutes. The exercise protocol focused on 3D postural correction, expansion techniques, muscle activation, and integration. 14 patients (6 swimmers and 8 gymnasts) were treated with a rigid brace. Primary outcomes were changes in Cobb angle, sagittal balance, and flexibility, while secondary outcomes included changes in height and body mass index (BMI). Descriptive statistics, paired t-tests were used to evaluate within-group changes, and independent t-tests were employed. Statistical significance at $p < 0.05$.

Results

Table 1. Comparison of Demographic, Training, and Clinical Parameters Between Rhythmic Gymnasts and Swimmers Undergoing Conservative Scoliosis Treatment

Parameters	Group 1 (gymnastics) Mean $\pm$ SD	Group 2 (swimming) Mean $\pm$ SD	p-value
N (sex)	21 Females 21 (100%) Males 0	11 Females 7 (63,6%) Males 4 (36,4%)	n/a
Age	12.13 $\pm$ 1.72	12.5 $\pm$ 1.32	0.27
Follow-up period in months	30.48 $\pm$ 16.14	25.45 $\pm$ 14.87	0.36
Weight (kg)	37.94 $\pm$ 8.68	46.43 $\pm$ 9.97	<0.05
Weight change (kg)	8.64 $\pm$ 7.17	8.14 $\pm$ 6.42	0.42
Height (cm)	149.12 $\pm$ 11.65	159.3 $\pm$ 11.15	<0.05
Height change (cm)	9.37 $\pm$ 8.39	9.71 $\pm$ 8.6	0.46
Training (times per week)	5.48 $\pm$ 0.68	4.82 $\pm$ 0.75	<0.05
Training (hours per day)	4.85 $\pm$ 1.42	1.5 $\pm$ 0.63	<0.05
Initial Cobb (degrees)	22.33 $\pm$ 8.31	26.6 $\pm$ 12.57	0.13
Final Cobb (degrees)	15.76 $\pm$ 7.94	23.6 $\pm$ 18.14	0.05
Initial/final Cobb p-value	<0.05	0.33	
Initial Cobb (non-progressive cases)	22.75 $\pm$ 8.29	24.25 $\pm$ 11.96	0.35
Final Cobb (non-progressive cases)	15.6 $\pm$ 7.9	18 $\pm$ 12.3	0.27
Initial/Final Cobb (non-progressive cases) p-value	<0.05	0.16	
Cobb difference in non-progressive cases	7.15 $\pm$ 5.58	5.56 $\pm$ 3.68	0.22
Initial kyphosis (degrees)	20.86 $\pm$ 11.8	30.55 $\pm$ 18.98	0.05
Final kyphosis (degrees)	20.57 $\pm$ 9.98	31.09 $\pm$ 12.68	<0.05
Initial/Final kyphosis p-value	0.47	0.41	
Initial lordosis (degrees)	29.95 $\pm$ 10.21	30 $\pm$ 11.86	0.49
Final lordosis (degrees)	29.05 $\pm$ 6.89	32.36 $\pm$ 9.16	0.13
Initial/Final lordosis p-value	0.36	0.30	
Initial Sagittal index (mm)	30.71 $\pm$ 31.04	54.55 $\pm$ 44.47	<0.05
Final Sagittal index (mm)	38.57 $\pm$ 17.4	55.91 $\pm$ 29.22	<0.05
Initial/Final SI p-value	0.15	0.46	
Initial ATI sum (degrees)	8.43 $\pm$ 4.08	9.09 $\pm$ 6.02	0.36
Final ATI sum (degrees)	5.62 $\pm$ 4.05	6.55 $\pm$ 5.93	0.31
Initial/Final ATI p-value	<0.05	0.18	
Initial Sit and Reach (cm)	17.52 $\pm$ 6.69	-1.09 $\pm$ 13.8	<0.05
Final Sit and Reach (cm)	21.24 $\pm$ 5.38	4 $\pm$ 15.06	<0.05
Initial/Final Sit and Reach p-value	<0.05	0.22	

< 0.05 indicates a statistically significant difference between the compared groups.

The average age of participants is 12.13 ± 1.72 years for rhythmic gymnasts and 12.5 ± 1.32 years for swimmers ($p = 0.27$). The mean follow-up period are 30.48 ± 16.14 months for rhythmic gymnasts and 25.45 ± 14.87 months for swimmers ($p = 0.36$). Gymnasts trained more frequently (5.48 ± 0.68 vs. 4.82 ± 0.75 times per week, $p < 0.05$) and for longer hours per day (4.85 ± 1.42 vs. 1.5 ± 0.63 , $p < 0.05$). Significant Cobb angle reduction was observed in gymnasts ($22.33 \pm 8.31^\circ$ to $15.76 \pm 7.94^\circ$, $p < 0.05$), but not in swimmers ($26.6 \pm 12.57^\circ$ to $23.6 \pm 18.14^\circ$, $p = 0.33$). Swimmers had significantly higher sagittal index values (Initial: 54.55 ± 44.47 mm vs. 30.71 ± 31.04 mm; $p < 0.05$) and greater kyphosis (Initial: $30.55 \pm 18.98^\circ$ vs. $20.86 \pm 11.8^\circ$; $p = 0.05$). Gymnasts showed greater flexibility improvements in Sit-and-Reach test (17.52 ± 6.69 cm to 21.24 ± 5.38 cm, $p < 0.05$).

Conclusion(s)

Conservative treatments, including PSSE and bracing, effectively improve scoliosis outcomes in rhythmic gymnasts, while swimmers demonstrate stability with distinct sagittal balance and kyphosis profiles, underscoring the need for sport-specific management strategies.

Clinical significance

Evaluating the impact of competitive sports activities on conservative scoliosis treatment.

Limitation: Not all participants are reached skeletal maturity, and compliance data is incomplete.

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THE INFLUENCE OF THE PHYSIOTHERAPY BASED ON THE RIGO CONCEPT AND WHOLE-BODY VIBRATION ON THE ANGLE OF TRUNK ROTATION IN SUBJECTS WITH ADOLESCENT IDIOPATHIC SCOLIOSIS

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Background

The standard conservative treatment for adolescent idiopathic scoliosis (AIS) includes physiotherapeutic scoliosis-specific exercises (PSSE) and bracing. Rigo Concept focuses on 3D postural correction, expansion technique, muscle activation and integration. Recently, there has been a growing interest in incorporating whole-body vibration (WBV) into physiotherapy programs. WBV is a reflex-based neuromuscular training method that has been shown to improve muscle strength and power. Furthermore, WBV can influence neuronal activity through short periods of intervention with high frequency of muscle contractions. This effect may be beneficial in treating AIS.

Objective (s)

This study aimed to assess the influence of the physiotherapy program based on the Rigo Concept in combined with WBV on the angle of trunk rotation (ATR) in subjects with AIS.

Study Design

A prospective case-series study.

Methods

The study included 22 adolescents (20 girls and 2 boys) aged 12.6 ± 1.9 years, with Cobb angles for the proximal thoracic (PT) $28.0^\circ \pm 2.8$, main thoracic (MT) 25.7 ± 7.4 , thoracolumbar (Th-L) 29.9 ± 8.9 , and lumbar (L) 18.4 ± 5.4 . The subjects participated in 5-days individualized intensive physiotherapy program based on the Rigo Concept. Additionally, WBV was applied during the upright position (UP) technique performed using two poles, according Rigo Concept, on a Galileo Med25 platform. WBV was administered in 3x3-minute sessions per day at a frequency of 25Hz and an amplitude of 2mm. The ATR of PT, MT, Th-L, L and posterior superior iliac spine (PSIS) was measured before and immediately after each session of UP with WBV.

Results

For all measured spinal segments, a decrease in ATR was observed when comparing measurements before and after the 5-day physiotherapy. The ATR for PT decreased from 2.8 ± 1.5 to 1.7 ± 1.4 ($p=0.003$), for MT from 8.3 ± 4.0 to 6.4 ± 3.5 ($p=0.000$), for Th-L from 5.0 ± 3.4 to 3.1 ± 2.6 ($p=0.000$), for L from 3.9 ± 2.5 to 1.8 ± 1.9 ($p=0.000$), and for PSIS from 1.5 ± 1.5 to 0.5 ± 0.9 ($p=0.004$). Additionally, for the MT, a decrease in ATR was observed immediately after the fourth day of UP with WBV (7.6 ± 4.5 vs 6.6 ± 3.6 ; $p=0.026$). In the L segment, ATR decreased immediately after the first (3.9 ± 2.5 vs 2.7 ± 2.6 ; $p=0.001$), second (3.1 ± 3.1 vs 2.1 ± 2.4 ; $p=0.028$), and fourth (2.6 ± 2.3 vs 1.7 ± 2.0 ; $p=0.046$) day of UP with WBV. For the remaining spinal segments, no reduction in ATR was observed immediately after WBV ($p>0.05$).

Conclusion(s)

The Rigo Concept, also when combined with whole-body vibration in upright position, might reduce the angle of trunk rotation in subjects with mild and moderate AIS. The lumbar segment seems to be particularly susceptible to changes caused by WBV.

Clinical significance

This study can serve as a pilot for future research assessing the effects of PSSE combined with WBV in reducing trunk asymmetry in subjects with AIS.

IMPROVEMENTS IN ANGLE OF TRUNK ROTATION AND FORCED VITAL CAPACITY ARE SUSTAINED AT 24 MONTHS AFTER A FOUR-WEEK TREATMENT COURSE OF PHYSIOTHERAPY SCOLIOSIS SPECIFIC EXERCISE

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Background

Scoliosis can cause reduced pulmonary function which can be impacted by thoracic Angle of Trunk Rotation (ATR). Physiotherapy Scoliosis Specific Exercise (PSSE) can improve thoracic ATR and Forced Vital Capacity (FVC). However, it is unknown whether these improvements are maintained at follow-up.

Objective (s)

Are post-treatment improvements in FVC and ATR maintained at follow-up?

Study Design

Retrospective cohort design.

Methods

607 consecutive patients with thoracic idiopathic scoliosis who completed a four-week course of PSSE were recruited. Data was collected during routine assessment of patients between January 2015 and October 2024. ATR, measured with Bunnell's Scoliometer, and FVC, measured with a spirometer, were taken pre- and post-treatment, and at each follow-up appointment. Participants with ATR measurements below 5 and above 30 degrees were excluded. Percentage of predicted FVC (PPFVC) was calculated using a formula and normal reference values derived by Falaschetti et al (2004). Paired samples T-Tests, Wilcoxon signed-rank tests and a simple linear regression were used using IBM SPSS Statistics 29.0. P-values of <0.05 were considered statistically significant.

Results

446 participants remained. 83% were female. The ages ranged from 7-78 with a mean age of 21.6.

The mean PPFVC significantly improved from 80.93 pre- to 81.55 post-treatment ($p=.046$, 95%CI[-1.23, -.01]).

There was no significant difference between post-treatment and follow-up at 6- ($n=82$, $p=.466$, 95%CI[-1.70, .79]), 12- ($n=53$, $p=.79$, 95%CI[-2.35, 1.80]), 18- ($n=32$, $p=.47$, 95%CI[-3.83, 1.79]), and 24- ($n=19$, $p=.610$, 95%CI[-2.88, 4.78]) months, showing post-treatment improvements were maintained.

The mean ATR significantly improved from 10.18 pre-to 9.21 post-treatment ($p<0.01$, 95%CI[.78, 1.16.]).

There was a significant improvement in ATR from post-treatment to 6 months ($n=215$, $p=0.02$, $95\%CI[.17,.78]$). There was no significant difference between post-treatment and follow-up at 12- ($n=136$, $p=.484$, $95\%CI[-.60,.29]$), 18- ($n=96$, $p=.354$, $95\%CI[-.90,.32]$), and 24- ($n=77$, $p=.434$, $95\%CI[-.83,.36]$) months follow-up, showing post-treatment improvements were maintained.

A significant regression was found between ATR and PPFVC ($F(2,447)=26.42$, $p<.001$). ATR explained 10.6% of the variance in PPFVC ($R^2=.106$).

In the cohort with $<70\%$ PPFVC, there was a significant improvement of the mean PPFVC from 61.50 pre- to 64.47 post-treatment ($n=100$, $p=.01$, $95\%CI[-4.38,-1.56]$).

The PPFVC between post-treatment and 6-months significantly improved ($n=21$, $p=.041$, $95\%CI[-6.47,-.15]$). There was no significant difference between post-treatment and 12-months ($n=13$, $p=.164$, $95\%CI[-8.49,1.62]$), showing post-treatment improvements maintained.

Conclusion(s)

Patients improved their pulmonary function which could be attributed to improving their thoracic ATR after a four-week course of PSSE. These improvements were maintained to 24-months follow-up. There were greater clinical changes in patients with lower PPFVC baselines pre-treatment which were maintained at 12-month follow-up.

Clinical significance

FVC indicates respiratory muscle function, which can be influenced by thoracic ATR. The maintenance of FVC and ATR improvements shows the lasting influence PSSE could have upon respiratory muscle function and trunk surface rotation.

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CAN A COURSE OF PHYSIOTHERAPY SCOLIOSIS SPECIFIC EXERCISE INFLUENCE CHEST WALL MOBILITY PARAMETERS IN PATIENTS WITH IDIOPATHIC SCOLIOSIS?

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Background

There is a known correlation between chest wall mobility and lung function parameters in those without scoliosis. Chest wall mobility can be more restricted in patients with scoliosis and lung function can be impacted by scoliosis, particularly in those with high Thoracic Angle of Trunk Rotation (ATR). Physiotherapy Scoliosis Specific Exercises (PSSE) are known to aid in reducing thoracic ATR and improving lung function. However, it is unknown if PSSE will also influence the mobility of the chest wall.

Objective (s)

To investigate the effect of a course of PSSE on chest wall mobility in patients with idiopathic scoliosis.

Study Design

Prospective cohort study

Methods

66 consecutive patients with idiopathic scoliosis with thoracic curves who completed a course of PSSE treatment between January and November 2024 were recruited.

Upper- (UCE) and lower-chest-expansion (LCE) measurements were taken pre- and immediately post-treatment. The differences in centimeters between maximum inspiration and expiration, measured by a measuring tape were recorded.

Data was analysed using a paired T-test and a regression model in SPSS. P-values of <0.05 , two-sided, were considered statistically significant.

Results

45 complete datasets were analysed. 76% were female. 49% were paediatric (mean=14, range=8-17) and 51% were adults (mean=37, range=19-62).

For UCE, in the full cohort (n=45), the mean difference was 4.41 (SD=2.14, SEM=0.32) pre-treatment and 5.53 (SD=2.36, SEM=.35) post-treatment ($p<.001$, 95% CI [-1.71, -.53]). In the adult group (n=23), the mean difference was 4.43 (SD=2.16, SEM=.45) pre-treatment and 5.56 (SD=2.60, SEM=.54) post-treatment ($p=.007$, 95% CI [-1.90, -.34]). In the paediatric group (n=22), the mean difference was 4.39 (SD=2.16, SEM=.46) pre-treatment and 5.50 (SD=2.14, SEM=.46) post-treatment ($p=.026$, 95% CI [-2.09, -.15]).

For LCE, in the full cohort (n=45), the mean difference was 4.07 (SD=4.07, SEM=.41) pre-treatment and 5.63 (SD=3.17, SEM=.47) post-treatment ($p<.001$, 95% CI [-2.12, -.99]). In the adult group (n=23), the mean difference was 4.13 (SD=2.89, SEM=.60) pre-treatment and 6.00 (SD=3.46, SEM=.72) post-treatment ($p<.001$, 95% CI [-2.74, -1.00]). In the paediatric group (n=22), the mean difference was 4.01 (SE=2.72, SEM=.58) pre-treatment and 5.25 (SD=2.87, SEM=.61) post-treatment ($p=.003$, 95% CI [-2.01, -.46]).

Relationships between the change in UCE and LCE and thoracic ATR in all the groups were not significant ($p>.05$).

Conclusion(s)

PSSE resulted in significant improvements in both UCE and LCE in all groups. This post-treatment improvement in chest wall mobility may explain why lung function parameters are often improved by PSSE. No relationship was found between the change in UCE and LCE pre- to post-treatment and the reduction in ATR.

Clinical significance

Increasing chest wall mobility, enables the respiratory muscles to work at their optimal length, which aids lung function. Improved lung function reduces co-morbidities, increases exercise capacity and limits respiratory symptoms.

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IS FORCED VITAL CAPACITY AFFECTED BY AGE IN PATIENTS WITH THORACIC IDIOPATHIC SCOLIOSIS?

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Background

Thoracic scoliosis is known to affect pulmonary function. Physiotherapy Scoliosis Specific Exercise (PSSE) has previously shown to improve pulmonary function. However, it is not known if these improvements are influenced by age, nor whether age affects these results at follow-up.

Objective (s)

To establish the impact of age on pulmonary function, post-treatment and at follow-up.

Study Design

Retrospective cohort design.

Methods

607 consecutive patients with thoracic idiopathic scoliosis who completed a four-week course of PSSE were included. Data was collected during routine assessment of all patients between January 2015 and October 2024. Forced Vital Capacity (FVC), measured with a spirometer, was taken pre- and post-treatment, and at each follow-up appointment. Participants with thoracic angle of trunk rotation below 5 or above 30 degrees were excluded. Percentage of predicted Forced Vital Capacity (PPFVC) was calculated using a formula and normal reference values derived by Falaschetti et al (2004). Paired samples T-Tests were used using IBM SPSS Statistics 29.0. P-values of <0.05 were considered statistically significant.

Results

446 participants remained after exclusions and removal of missing data, of which 83% were female (n=371). Ages ranged from 7-78 (mean=21.6).

The cohort was stratified by age into Paediatric (<18), Young Adult (18-39), and Older Adult Patients (≥40).

In the full cohort, the mean PPFVC was 80.93 pre-treatment and 81.55 post-treatment (p=.046, 95% CI [-1.23, -.01]).

Among Paediatric patients (n=266), the mean PPFVC was 77.21 pre-treatment and 78.03 post-treatment (p=.037, 95% CI [-1.59, -0.05]). Results at 6- (n=52, p=.637, 95% CI [-1.12, 1.81]), 12- (n=37, p=.316, 95% CI [-1.19, 3.58]), and 24- (n=13, p=.322, 95% CI [-1.94, 5.44]) months, were not significantly different to post-treatment.

Among Young Adult patients (n=129), the mean PPFVC was 82.92 pre-treatment and 83.35 post-treatment (p=.420, 95% CI [-1.49, 0.62]). Results at 6 months were significantly different to post-treatment results (n=19, p=.032, 95% CI [-3.77, -0.19]), but not at 12 months (n=9, p=.160, 95% CI [-7.42, 1.46]).

Among Older Adults (n=51), the mean PPFVC was 95.26 pre-treatment and 95.32 post-treatment (p=.963, 95% CI [-2.46, 2.35]) which was not significant. No significant difference was found between post-treatment and 6 months follow-up (n=11, p=.573, 95% CI [-7.83, 4.58]).

Conclusion(s)

A PSSE course can help to improve PPFVC in patients with thoracic scoliosis. PSSE had greater impact on PPFVC in paediatric patients, with improvements being maintained through to 24-month follow-up. Younger adults, obtained some post-treatment improvement, which was only observed at 6-12 month follow-up. There was no significant improvement in PPFVC in older adult patients, however the mean pre-treatment baseline was high in this cohort.

Clinical significance

A PPFVC (below 80%) indicates respiratory disease. Improving PPFVC could improve exercise capacity, reduce co-morbidities and limit respiratory symptoms.

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DYNAMIC INTEGRATION OF SACRAL CENTER OF GRAVITY AND FOOT MECHANICS: A JI METHOD APPROACH TO IMPROVING POSTURAL STABILITY IN SCOLIOSIS

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Background

Scoliosis disrupts the alignment of the body's postural centers, including:

1. **Cervical Center of Gravity (C2):** Responsible for head weight distribution and rotational stability.
2. **Sacral Center of Gravity (S2):** Located approximately 5 cm anterior to the second sacral vertebra, anchoring the spine and pelvis.
3. **Foot Mechanics:** Critical for distributing ground reaction forces to the spine and pelvis.

This misalignment leads to uneven weight distribution, postural asymmetry, and reduced stability. The Ji Method integrates these three components through dynamic exercises aimed at restoring balance and improving postural control.

Objective (s)

To investigate the impact of the Ji Method on postural stability, sacral CoG alignment, and foot pressure distribution in scoliosis clients.

Study Design

A randomized controlled trial (RCT) comparing Ji Method exercises with standard postural correction exercises over a 12-week period.

Methods

Participants

- **Sample Size:** 60 scoliosis patients aged 15–40 years.
- **Inclusion Criteria:** Cobb angle between 18° and 78°, no prior spinal surgeries, and no neuromuscular disorders.

Interventions

1. **Ji Method Group (n=30):**
 - PVC ball exercises targeting sacral CoG alignment.
 - Barefoot balance training to optimize foot pressure distribution.
2. **Control Group (n=30):**
 - Standard postural correction exercises focusing on general alignment.

Assessment Metrics

- **Foot Pressure Balance:**
 - Measured using Tekscan pressure mats to analyze center of pressure (CoP) distribution.

- **Muscle Activation:**
 - Assessed via surface EMG to monitor deep core and postural muscle engagement.
- **Self-Reported Outcomes:**
 - Balance and stability improvements reported by participants.

Statistical Analysis

- Group comparisons using ANOVA.
- Pre- and post-intervention changes analyzed using paired t-tests.

Results



1. Improvement in Foot Pressure Balance:

- Ji Method Group demonstrated a 45% improvement in CoP distribution symmetry (CoP standard deviation reduced from 12.5mm to 6.9mm, $p < 0.001$).
- Control Group showed a 15% improvement (CoP standard deviation reduced from 12.8mm to 10.9mm, $p = 0.05$).

2. Increased Muscle Activation:

- Surface EMG data showed a 50% increase in deep core muscle activation in the Ji Method Group ($p < 0.001$).
- The Control Group demonstrated a 20% increase ($p = 0.04$).

3. Participant-Reported Stability:

- 85% of participants in the Ji Method Group reported significant improvements in balance and stability, compared to 40% in the Control Group.

Conclusion(s)

The Ji Method effectively integrates sacral CoG alignment and foot mechanics to enhance postural stability and balance in scoliosis patients. These results highlight the method's potential as a scientifically validated, non-invasive approach to scoliosis management.

Clinical significance

The Ji Method offers a novel approach to scoliosis rehabilitation by addressing postural alignment through sacral CoG alignment and foot mechanics. It provides a practical and effective strategy for enhancing stability and counteracting gravitational asymmetry.

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FOCUS-ENHANCED CORRECTIVE EXERCISE FOR SCOLIOSIS: INTEGRATING NEUROMUSCULAR CONNECTIONS THROUGH THE JI METHOD

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Background

Scoliosis corrective exercise requires precise neuromuscular coordination and cognitive focus. The Ji Method emphasizes that *how* exercises are performed is as critical as the movements themselves. Heightened focus enhances neuromuscular engagement and improves postural outcomes. By integrating sensory cues, particularly rhythmic auditory inputs like drum music, the Ji Method fosters an environment where focus and physical effort are synchronized, leading to better corrective outcomes.

Objective (s)

To evaluate the impact of focus-driven corrective exercise using the Ji Method on neuromuscular activation, exercise adherence, and postural outcomes in scoliosis clients.

Study Design

A 12-week randomized controlled trial comparing Ji Method focus-driven exercises with conventional scoliosis exercise protocols.

Methods

Participants

- **Sample Size:** 60 scoliosis clients aged 15–45 years.
- **Inclusion Criteria:** Cobb angle between 18° and 60°, no previous spinal surgeries, and no cognitive impairments.

Intervention Groups

1. **Ji Method Focus-Enhanced Group (n=25):**
 - Exercises performed with Ji Method techniques emphasizing auditory focus, guided instruction, and deliberate neuromuscular engagement.
2. **Control Group (n=25):**
 - Conventional scoliosis corrective exercises performed without specific focus-enhancing interventions.

Assessment Metrics

1. **Neuromuscular Activation:**
 - Measured via surface EMG during key exercises to track deep core and postural muscle engagement.
2. **Focus and Cognitive Engagement:**
 - Quantified using the Focus Assessment Scale (FAS).
3. **Exercise Adherence and Completion:**
 - Attendance and exercise completion rates monitored.
4. **Postural Outcomes:**
 - Measured using 3D motion analysis to assess improvements in spinal alignment.

Statistical Analysis

- ANOVA used for between-group comparisons.
- Paired t-tests conducted for pre- and post-intervention changes.

Results

1. **Neuromuscular Activation:**
 - Ji Method clients demonstrated a 55% increase in core muscle activation compared to 30% in the Control Group ($p < 0.001$).
2. **Focus and Cognitive Engagement:**
 - FAS scores improved by 50% in the Ji Method Group compared to 15% in the Control Group ($p < 0.001$).
3. **Exercise Adherence and Completion:**
 - Ji Method Group had a 92% adherence rate compared to 75% in the Control Group ($p < 0.01$).
4. **Postural Outcomes:**
 - Ji Method clients showed greater improvement in spinal alignment, with an average reduction of 6° in Cobb angle compared to 3° in the Control Group ($p = 0.03$).

Conclusion(s)

The Ji Method's focus-enhanced approach demonstrates that mental concentration and sensory-driven exercises significantly improve neuromuscular activation, exercise adherence, and postural correction outcomes in scoliosis clients. These findings highlight the importance of integrating focus as a key component in scoliosis rehabilitation.

Clinical significance

This study emphasizes that focus is not a supplementary factor but a fundamental element in achieving successful scoliosis rehabilitation. By fostering neuromuscular connections through heightened concentration, the Ji Method provides a unique and effective solution for clients with scoliosis.

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THE EFFECT OF SNAKE MOVEMENT IN THE JI METHOD ON THORACIC ROTATION AND SPINAL EXTENSION: TARGETING T7 AS THE CENTER OF FUNCTIONAL MOVEMENT

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Background

Thoracic vertebra 7 (T7) is the rotational axis and functional center of the thoracic spine, playing a pivotal role in spinal mobility and balance. In scoliosis management, restoring mobility, strength, and coordination around T7 is critical for achieving spinal alignment and functional improvement. The Ji Method introduces the *Snake Movement*, a dynamic exercise designed to facilitate thoracic rotation and spinal extension by targeting the muscles surrounding T7. This movement integrates elongation, muscle release, and activation to improve functional outcomes in scoliosis clients.

Objective (s)

To investigate the effects of the Ji Method's Snake Movement on thoracic rotation, spinal extension, and muscular activation, focusing on T7 as the center of movement.

Study Design

A 12-week randomized controlled trial comparing the Ji Method's Snake Movement exercise with standard spinal mobility exercises.

Methods

Participants

- **Sample Size:** 60 scoliosis clients aged 15–45 years.
- **Inclusion Criteria:** Cobb angle 20°–60°, no prior spinal surgeries, and no severe muscular or neurological disorders.

Intervention Groups

1. **Snake Movement Group (n=25):**
 - Exercises targeting thoracic rotation and spinal elongation using the Snake Movement. Focus on T7 as the rotational axis.
2. **Control Group (n=25):**
 - Conventional thoracic mobility exercises without specific focus on T7.

Assessment Metrics

1. **Thoracic Rotation:**
 - Measured using 3D motion analysis to quantify rotational range of motion (RoM).
2. **Spinal Extension:**
 - Evaluated through inclinometer-based spinal flexibility tests.
3. **Muscular Activation:**
 - Surface EMG used to monitor activation of thoracic and paraspinal muscles during exercise.
4. **Self-Reported Outcomes:**
 - Participants rated perceived improvements in spinal mobility and comfort using a 10-point scale.

Statistical Analysis

- ANOVA used for intergroup comparisons.
- Pre- and post-intervention changes analyzed using paired t-tests.

Results

1. **Thoracic Rotation:**
 - Snake Movement Group improved thoracic rotational RoM by 35%, compared to 15% in the Control Group ($p < 0.001$).
2. **Spinal Extension:**
 - Participants in the Snake Movement Group achieved a 40% increase in spinal extension, significantly higher than the 20% improvement in the Control Group ($p < 0.01$).
3. **Muscular Activation:**
 - EMG analysis showed a 50% increase in activation of thoracic stabilizing muscles in the Snake Movement Group, compared to a 25% increase in the Control Group ($p < 0.01$).
4. **Self-Reported Outcomes:**
 - 85% of Snake Movement participants reported enhanced spinal mobility and reduced discomfort, compared to 60% in the Control Group.

Conclusion(s)

The Ji Method's Snake Movement significantly improves thoracic rotation, spinal extension, and muscular activation by targeting T7 as the central axis of movement. These results support the use of dynamic, T7-focused exercises for scoliosis rehabilitation to enhance functional spinal outcomes.

Clinical significance

The Snake Movement provides a practical and effective approach to improving thoracic rotation and spinal extension in scoliosis clients, emphasizing the importance of T7 as a functional center in therapeutic exercises.

Final category: 4 Brace Treatment

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SHORT-TERM OUTCOMES OF WOOD CHENEAU RIGO BRACING IN THE IDIOPATHIC SCOLIOSIS POPULATION

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Background

Bracing has been the standard of care for the non-operative treatment of Idiopathic Scoliosis (IS) for decades. In recent years, the Rigo Cheneau brace and its variations have gained popularity in the United States. One commonly used variation is the Wood Cheneau Rigo (WCR) brace.

While the WCR brace follows the Rigo Cheneau concept, the approach differs in three key ways. First, orthotists must complete a fellowship-style training period, often lasting 1-2 years, before fitting WCR braces independently. Second, all WCR braces are fabricated at Align Clinic headquarters by a small,

consistent team of expert orthotists. Third, the WCR brace uses a lower-profile design to encourage adherence. With the increasing popularity of the WCR brace, it is crucial to assess the efficacy of the design in the treatment of IS.

Objective (s)

Our objective is to assess the efficacy of WCR bracing after 6 months of wear.

Study Design

Retrospective chart review

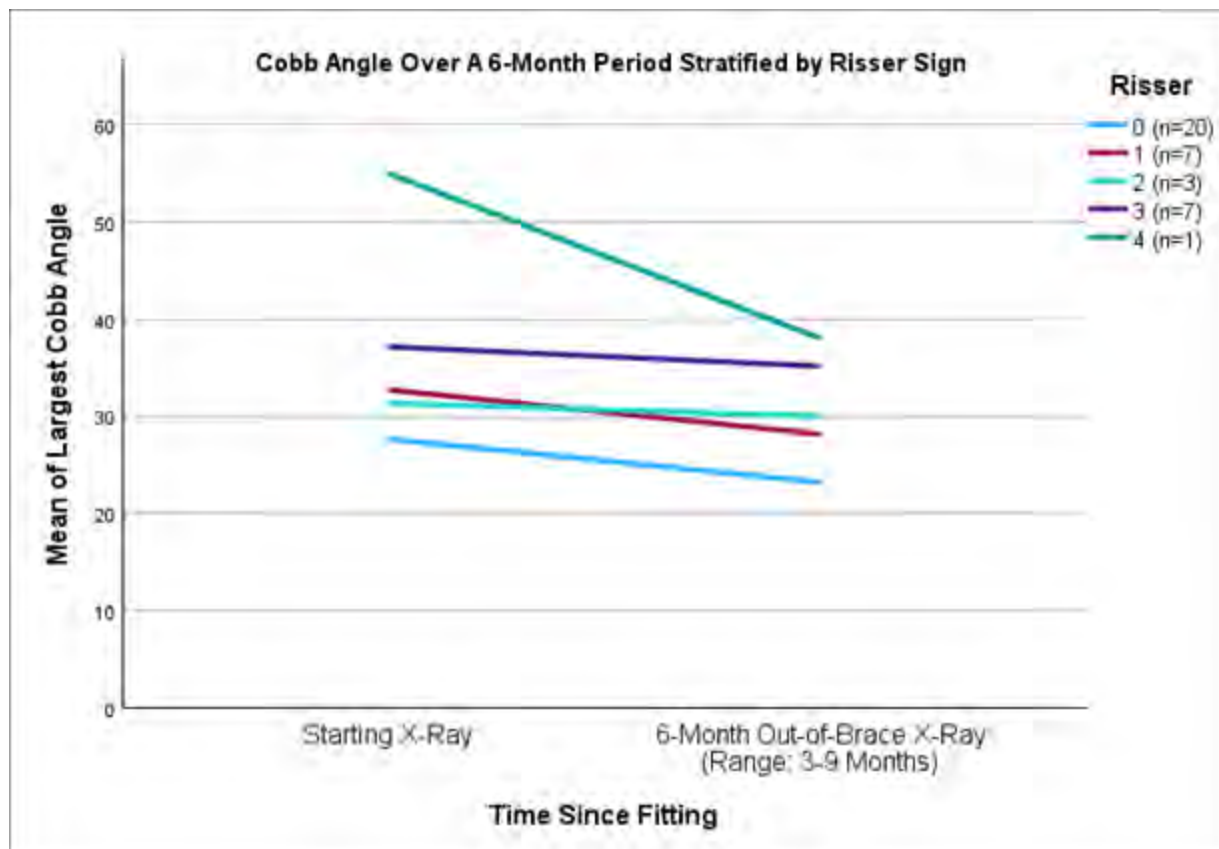
Methods

This retrospective chart review was approved by the BCM IRB (H- 53917). Subjects were included in the review if they had a diagnosis of Juvenile or Adolescent Idiopathic Scoliosis and were receiving a brace for the first time. All subjects were evaluated and fit with a WCR brace by one clinician at Align Clinic in the Woodlands, Texas. The initial, in-brace, and 6-month out-of-brace (OOB) x-rays were measured across all subjects. All x-rays were read by an external PSSE-trained physical therapist who was blinded to non-radiological information. Data were collected between June 2021 and February 2024.

The primary outcome was curve progression (6° + increase), stabilization ($\pm 5^\circ$), or regression (6° + decrease) based on the 6-month OOB x-ray. Descriptive statistics, Pearson Chi-Square, and ANOVA tests were used to look for associations between the primary outcome and patient characteristics.

Results

Forty-two subjects with a mean baseline age of 11.9 ± 1.8 were included in the final analysis. The cohort consisted of 35 females, and the predominant diagnosis was AIS ($n=37$). The majority of subjects ($n=30$) were Risser 0-2 at baseline. After 6 months of bracing, 11.9% of curves progressed, 45.2% stabilized, and 42.9% regressed. There was a significant decrease in the mean of the largest curves from baseline ($32.1^\circ \pm 9.3^\circ$) to 6-months OOB ($27.8^\circ \pm 10.0^\circ$, $p < .001$) (Figure 1). The sum of all curves also significantly decreased from baseline ($62.0^\circ \pm 21.3^\circ$) to 6-months OOB ($57.7^\circ \pm 22.5^\circ$, $p = .001$). There were no significant relationships found between the primary outcome and other variables, such as age at delivery, Risser, largest Cobb angle at baseline, in-brace correction, and Rigo brace type.



Conclusion(s)

WCR bracing is an effective treatment method for idiopathic scoliosis. This study sets the foundational groundwork for future long-term studies on WCR bracing efficacy.

Clinical significance

Curve correction appears to be attainable when orthotists take a tri-planar approach to a three-dimensional deformity.

13

WEARING A BRACE FOR IDIOPATHIC SCOLIOSIS ABOVE 18 HOURS/DAY SHOWS A DOSE-RESPONSE EFFECT ON THE OUTCOMES IMPROVEMENT AND END-OF-TREATMENT COBB ANGLE BELOW 30 DEGREES

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Background

The Brace Adolescent Idiopathic Scoliosis Trial (BrAIST) Study (Weinstein 2013) reported a bracing dose-response curve plotting the wearing time (up to a maximum of 18 hours/day) versus the outcome of “avoiding surgery” (remaining $<50^\circ$). SOSORT added three other important outcomes (Negrini 2018): improvement, avoiding progression and remaining $<30^\circ$ (which predicts possible health issues in adulthood).

Objective (s)

To check if there is a dose-response effect in a braced population of Risser 0-2 adolescents, with curves up to 45° and braces worn above 18 hours/day.

Study Design

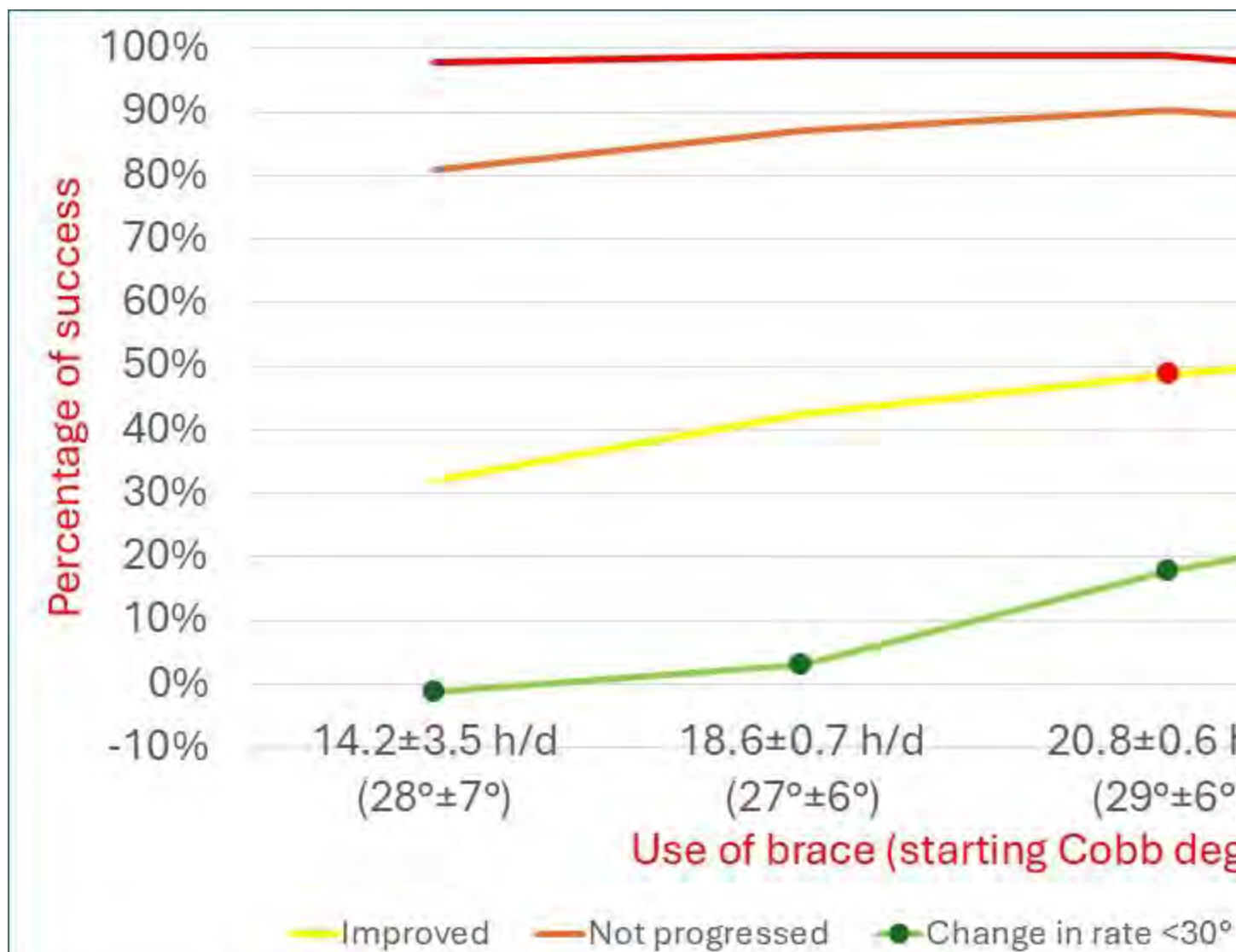
Secondary analysis of a retrospective study of prospectively collected data.

Methods

The original study (Negrini 2021) included 1948 patients. This analysis includes only the patients with a prescription of one of the following braces: 1) anterior closure, three-dimensional push-up TLSOs, either monocot rigid (Sibilla) or bivalve highly-rigid (Sforzesco) 2) for thoracolumbar and lumbar curves, either the short version (LSO) of the Sibilla brace, or a ventral closure frontal & transverse plane detorsion monocot rigid LSO (PASB). The worse the prognosis, the higher the brace rigidity and prescribed wearing time (range 18-24). We developed dose-response curves following the BrAIST methodology and considering the four SOSORT outcomes, 2 “positive”, i.e. looking for good results (finishing $<30^\circ$ and improving $>5^\circ$), and 2 “negative”, i.e. looking for avoiding bad results (remaining $<50^\circ$, avoiding progression $>5^\circ$). We divided patients into quartiles of brace-wearing hours and 1) checked the baseline differences using ANOVA after verifying for normal distribution, and 2) calculated percentage and 95% confidence intervals of patients achieving each outcome using a chi-square test for statistics. Since the population included patients who started treatment $<30^\circ$, for this outcome, we considered the change in the population rate $<30^\circ$ between the end and start of observation using the formula (patients $<30^\circ$ at the end) – (patients $<30^\circ$ at the start).

Results

The final sample included 884 patients (85% females), age 13.0 ± 1.3 , $28 \pm 7^\circ$ Cobb, Risser 1 ± 1 . The figure reports baseline data, results, dose-response curves and statistics. For compliant patients (brace-wearing time 18 hours/day or more – from the second quartile), the higher the quartile, 1) the worse the clinical situation (significantly greater $^\circ$ Cobb, ATR, TRACE and rigidity at baseline), but also 2) the better the $^\circ$ Cobb results. The dose-response curves showed statistically significant improvements for the “positive” outcomes (rate of patients $<30^\circ$ and improved $>5^\circ$) but not for the “negative” ones (remaining $<50^\circ$ and avoiding progression $>5^\circ$), which showed a high rate of success in all the population.



	Patients number	TRACE %	ATR degrees	Rigidity points (1-5)	Cobb start degrees	Compliance %	Cobb r degr
Total	884	46.4±13.7	9.4±3.2	2.6±0.8	27.7±6.7	81% (78-83)	-1.6±
First quartile	221	46±14.2 \$	9.6±3.3 \$	2.6±0.8 \$	28.3±7.1 \$	71% (65-77) #	-0.6±7.
Second quartile	202	46.9±13.1 \$	9.3±3 \$	2.6±0.8	27.3±6.1 \$	93% (89-96) *	-2.6±8.
Third quartile	248	49.2±13.8 *	9.8±3.2 \$	2.6±0.8 \$	29.2±6.5 #	97% (95-99) *	-4±6.7
Fourth quartile	213	51±16.9 *#	11.4±3.4 *#	2.8±0.7 *\$	35.5±5.7 *#	99% (97-100) *	-3.8±1

Conclusion(s)

Patients using the brace >18 hours/day show a dose-response effect on “positive” outcomes, even if the higher brace-wearing quartiles included the most demanding scoliosis.

Clinical significance

The more the brace is worn, the better the results, with a threshold of 18 hours/day between “negative” or “positive” outcomes.

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HEALTH-RELATED QUALITY OF LIFE OUTCOMES IN PATIENTS WITH ADOLESCENT IDIOPATHIC SCOLIOSIS UNDERGOING BRACE TREATMENT USING SCOLIOSIS JAPANESE QUESTIONNAIRE-27 (SJ-27)

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Background

Brace treatment has been reported to affect health-related quality of life (HRQOL) outcomes in patients with adolescent idiopathic scoliosis (AIS). We previously developed the Scoliosis Japanese Questionnaire (SJ-27) as a disease-specific, patient-reported outcome measure for female patients with AIS. However, HRQOL outcomes have not been studied in AIS patients with brace treatment using SJ-27 and little is known regarding the effect of bracing time on HRQOL outcomes.

Objective (s)

To assess the change in HRQOL after brace treatment using SJ-27 and clarify the effect of bracing time on the HRQOL outcomes in female patients with AIS.

Study Design

A multicenter prospective cohort study.

Methods

A total of 238 female AIS patients undergoing brace treatment were included in the study. Patients' characteristics at baseline and daily bracing time (<6, 6-12, 12-18, and 18≤ hours) at 1 year after brace initiation were examined. We assessed major Cobb angle and patients' HRQOL assessed by the SJ-27 (total score and five each domain score [Pain, Discomfort when wearing clothes, Appearance, Cognition, and Participation]) at baseline and 1 year after brace initiation. Major Cobb angle and the SJ-27 scores were compared between baseline and at 1 year in all eligible patients and each bracing time group.

Results

No significant difference in the Cobb angle between baseline and 1 year after brace initiation was observed (29.6 ± 5.1 vs. 29.0 ± 7.4 , $p = 0.137$) in all eligible patients. However, the total SJ-27 score (16.9 ± 12.6 vs. 19.9 ± 16.0 , $p = 0.002$) and various domain scores (Pain, Discomfort when wearing clothes, and Appearance) significantly worsened at 1 year. 34, 64, 48, and 76 were included in the <6, 6-12, 12-18, and 18≤ bracing time group, respectively. Among the <6-hour bracing time group, the Cobb angle showed a significant deterioration at 1 year (27.6 ± 3.8 vs. 30.5 ± 6.7 , $p = 0.002$), as well as worsening scores in the Discomfort when wearing clothes domain. On the other hand, in the ≥18-hour bracing time group, the Cobb angle significantly improved at 1 year (30.7 ± 5.2 vs. 29.0 ± 7.1 , $p = 0.004$); however, the total SJ-27 score and various domain scores significantly worsened.

Conclusion(s)

This study suggests that brace treatment for longer time may be effective in reducing the progression of scoliosis; however, it can negatively affect various HRQOL outcomes in female AIS patients, including discomfort when wearing clothes.

Clinical significance

Our findings imply that it is crucial to determine daily bracing time while considering adolescent HRQOL, which is influenced by brace treatment.

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TRANSITIONING FROM TRADITIONAL TO CAD/CAM METHODS IN SPINAL BRACING FOR ADOLESCENTS WITH IDIOPATHIC SCOLIOSIS: A CASE STUDY

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Background

This case study examines the transition of an orthotist experienced in spinal, cranial, and upper limb orthoses from traditional plaster moulding techniques to computer-aided design and manufacturing (CAD/CAM) technology for Adolescent Idiopathic Scoliosis (AIS) bracing. Initially, the adoption of CAD/CAM methods presented challenges, including technical difficulties and a learning curve, leading to suboptimal patient outcomes, with some experiencing a worsening of scoliosis (average progression of 12 degrees). However, with increased experience and collaboration, curve corrections improved over time.

Objective (s)

To evaluate the effectiveness of transitioning from traditional plaster-based methods to CAD/CAM technology for AIS bracing, focusing on its impact on patient outcomes, particularly Cobb angle corrections, over a one-year period.

Study Design

A retrospective cohort study analysing the outcomes of AIS patients treated during the orthotist's transition to CAD/CAM technologies.

Methods

The study included 298 AIS patients treated with CAD/CAM-based spinal braces between 2023 and 2024. Cobb angle measurements were obtained via X-ray at the initial fitting, six months, and one year. A multidisciplinary approach was adopted, incorporating feedback from patients, surgeons, and parents to refine treatment strategies. Statistical analysis utilized a mixed-effects model, adjusting for initial curve severity and follow-up intervals. The primary outcome was the change in Cobb angle over time.

Results

At six months, patients experienced an average Cobb angle correction of 7 degrees. By the end of one year, despite 41 unsuccessful cases (average progression of 19 degrees), the overall cohort showed a mean Cobb angle correction of 23 degrees ($p < 0.05$). The failure rate of approximately 10% aligns with reported rates for traditional methods. These results reflect both the orthotist's learning curve and the effectiveness of a collaborative approach to treatment.

Conclusion(s)

Transitioning from traditional to CAD/CAM methods for spinal bracing in AIS presents challenges, particularly in resource-limited contexts. However, this case study demonstrates that CAD/CAM technology, when combined with a collaborative, multidisciplinary approach, can lead to significant

improvements in patient outcomes. Continued refinement of techniques, frequent follow-up, and patient compliance are critical to achieving successful results.

Clinical significance

This study highlights the potential of CAD/CAM technologies in improving scoliosis treatment outcomes and offers valuable insights for clinicians working in resource-constrained settings.

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SPINAL MANIPULATION THERAPY FOR MODERATE-TO-SEVERE ADOLESCENT IDIOPATHIC SCOLIOSIS: A RANDOMIZED CONTROLLED TRIAL

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Background

Conservative treatments, such as spinal manipulation, have gained attention for their potential to address spinal deformities, and improve quality of life in patients with adolescent idiopathic scoliosis (AIS). However, existing research on the efficacy of spinal manipulation for AIS is limited due to the varying clinical research protocols and the lack of high-quality randomized controlled trials. This limits the application of spinal manipulation in AIS.

Objective (s)

This study aimed to investigate whether spinal manipulation therapy combine with bracing can improve spinal deformities and quality of life in patients with moderate-to-severe AIS.

Study Design

Randomized controlled clinical trial with outcome assessment and statistical analysis.

Methods

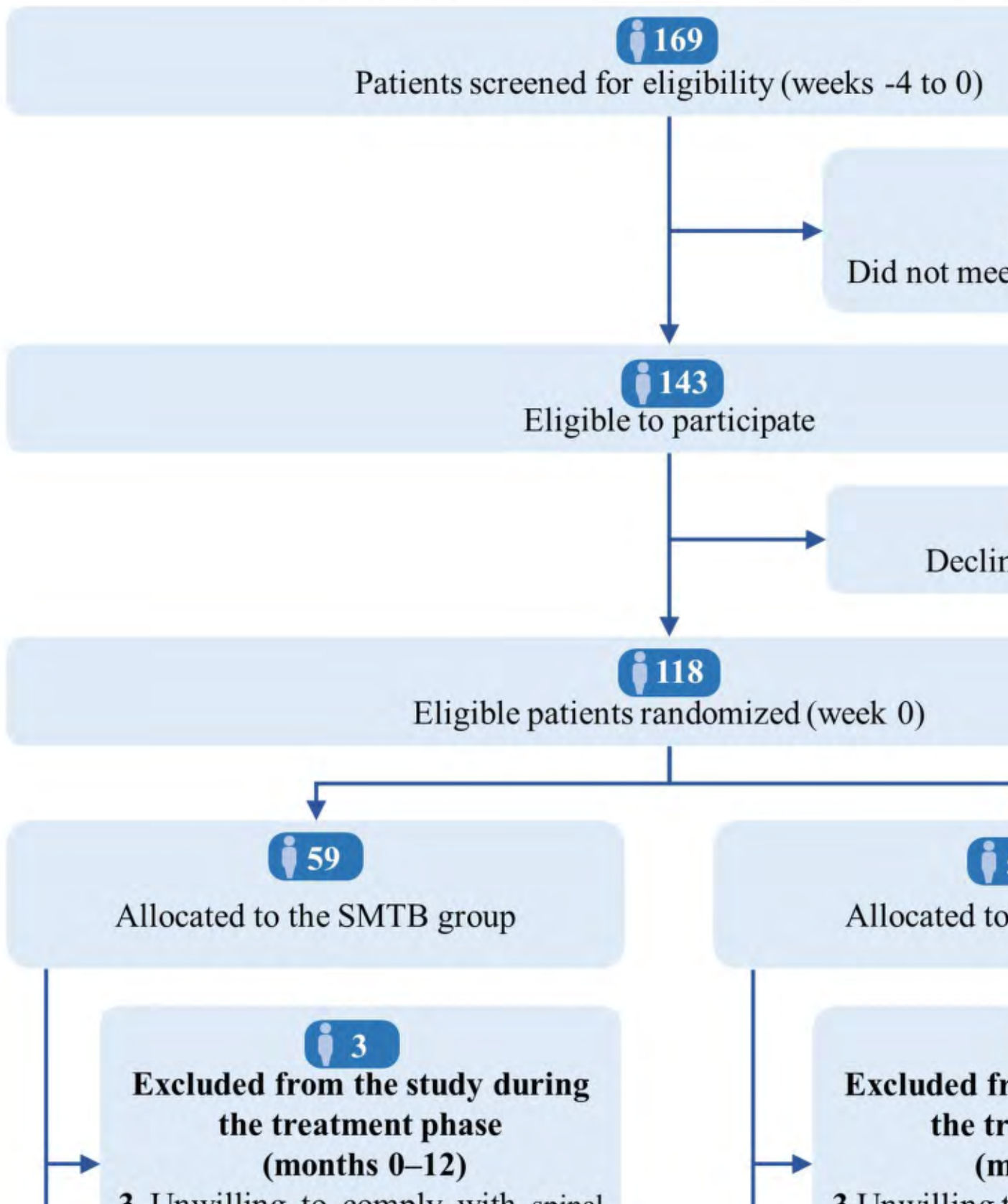
A total of 118 participants were randomly assigned to receive spinal manipulation therapy combined with bracing (SMTB group) or bracing alone (BA group). During the 12-month treatment period, all participants were prescribed a Chêneau brace (23 h/d), participants in the SMTB group additionally received a spinal manipulation (twice/w) regimen. The primary outcome was success rate, a curve reduction of $\geq 6^\circ$ (treatment success) or a curve reduction of $< 6^\circ$ (treatment failure) seen on pre- and post-treatment posteroanterior standing radiographs compared with the inclusion radiograph. The secondary outcomes related to scoliosis were also measured, including Cobb angle, angle trunk rotation (ATR), and Scoliosis Research Society-22 (SRS-22) score. Assessments were performed at baseline and after 3, 6, 9 and 12 months of treatment. Assess the Cobb angle (12 months), ATR (3, 6, 9, 12 months), and SRS-22 (6, 12 months). All primary analyses were conducted according to the modified intention-to-

treat principle (mITT). Independent and paired *t*-tests were performed for comparisons between and within groups. The statistical significance level was set at $P < 0.05$.

Results

The mITT analyses included 112 participants (101 women and 11 men; 69 moderate and 43 severe; mean [SD] age, 15.10 [1.72] years; Cobb: SMTB group, 36.64[11.17], BA group, 38.30 [10.76]). 6 participants were lost to follow-up (SMTB group 3 participants; BA group 3 participants). Treatment success was observed in 45 of the 56 participants (80.4%, moderate 32/36, severe 13/20) in the SMTB group and 34 of the 56 participants (60.7%, moderate 27/33, severe 7/23) in the BA group ($P = 0.023$). Among the secondary outcomes, Cobb angle (difference, -5.57 ; 95% confidence interval [CI], -7.83 to -3.31°), ATR (difference, -2.12 ; 95% CI, -3.30 , -0.95), and total SRS-22 (difference, 7.25 ; 95% CI, 5.28 to 9.22) differed significantly between the SMTB group and BA group (all $P < 0.001$). The results of subgroup analyses (moderate / severe) were consistent with those of the overall analysis.

(a) Flowchart of Participant Screening, Eligibility, Randomization, and Follow-up



Conclusion(s)

In this randomized clinical trial, spinal manipulation improved clinical efficacy, reduced the Cobb angle and ATR, and improved quality of life in patients with moderate-to-severe AIS.

Clinical significance

Spinal manipulation should be considered in the management of moderate-to-severe AIS.

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ANALYSIS OF FACTORS AFFECTING IN-BRACE CORRECTION RATE IN ADOLESCENT IDIOPATHIC SCOLIOSIS

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Background

Bracing is an effective conservative method for slowing curve progression in adolescents with idiopathic scoliosis (AIS). Since in-brace correction is a key indicator of treatment outcomes, understanding the factors that influence it in AIS patients is crucial for effective clinical practice.

Objective (s)

To evaluate the factors influencing the effectiveness of in-brace correction.

Study Design

A retrospective study

Methods

We conducted a statistical study involving 295 AIS patients who received TLSO brace treatment at our hospital from January 2017 to January 2021. The analysis assessed various factors, including demographic information, curve types, Risser sign, apical vertebral rotation, BMI, and the coronal deformity angular ratio (C-DAR) for both the main and secondary curves. We also evaluated the correction rates for the main and secondary curves while using the brace. The purpose of this analysis is to identify the factors that influence the in-brace correction rates.

Results

The outcome shows that the average in-brace correction (IBC) for the main curve in AIS patients using the TLSO brace is $63.8 \pm 22.5\%$, while the IBC for the secondary curve is $53.9 \pm 32.1\%$. Significant variations affect IBC were observed, including the degree of the main curve and secondary curve, the C-DAR of the main curve and secondary curve ($P < 0.001$). Additionally, IBC varies significantly among different types of scoliosis ($P < 0.001$). Notably, a larger main curve angle leads to a lower correction rate in the brace ($P < 0.05$), and a higher C-DAR of the main curve also results in a reduced correction rate ($P < 0.05$).

Conclusion(s)

For AIS patients with Cobb angles between 25° and 45° and who have immature bone age, TLSO (Chêneau-type Brace) treatment can achieve satisfactory in-brace correction. IBC is negatively correlated with curve types, the initial Cobb angles of both major and secondary curves, as well as with C-DAR.

Clinical significance

It is important for guiding the design of braces and predicting their correction rates.

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THE OUTCOMES OF PROVIDENCE BRACING IN ADOLESCENT IDIOPATHIC SCOLIOSIS: A SCOPING REVIEW

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Background

Adolescent Idiopathic Scoliosis (AIS) is a prevalent three-dimensional spinal deformity commonly managed with conservative treatment. The Providence brace (PNB), a night-time orthosis, is designed to prevent curve progression in mild to moderate AIS. The PNB has garnered growing interest due to potential advantages in clinical efficacy and impact on quality of life compared to full-time orthoses.

Objective (s)

This review evaluates the effectiveness of Providence bracing, compares its utility to full-time alternatives, identifies optimal usage strategies, and discusses future directions in PNB utilization.

Study Design

A scoping review was performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA-ScR) guidelines (Figure 1).

Methods

Following Open Science Framework registration, literature was queried using a keyword search in PubMed, Cochrane Central Register of Controlled Trials (CENTRAL), Web of Science Core Collection, Cinahl, and Scopus databases on August 19th, 2024. All articles were screened by two independent reviewers, and conflicts were resolved by a third reviewer. Articles were included if they primarily focused on PNB utilization in the treatment of AIS. Studies unrelated to the PNB, individuals diagnosed with AIS, or that were non-peer-reviewed, opinion, or editorial articles were excluded. Data on study participants, outcomes, and methodologies were extracted for analysis.

Results

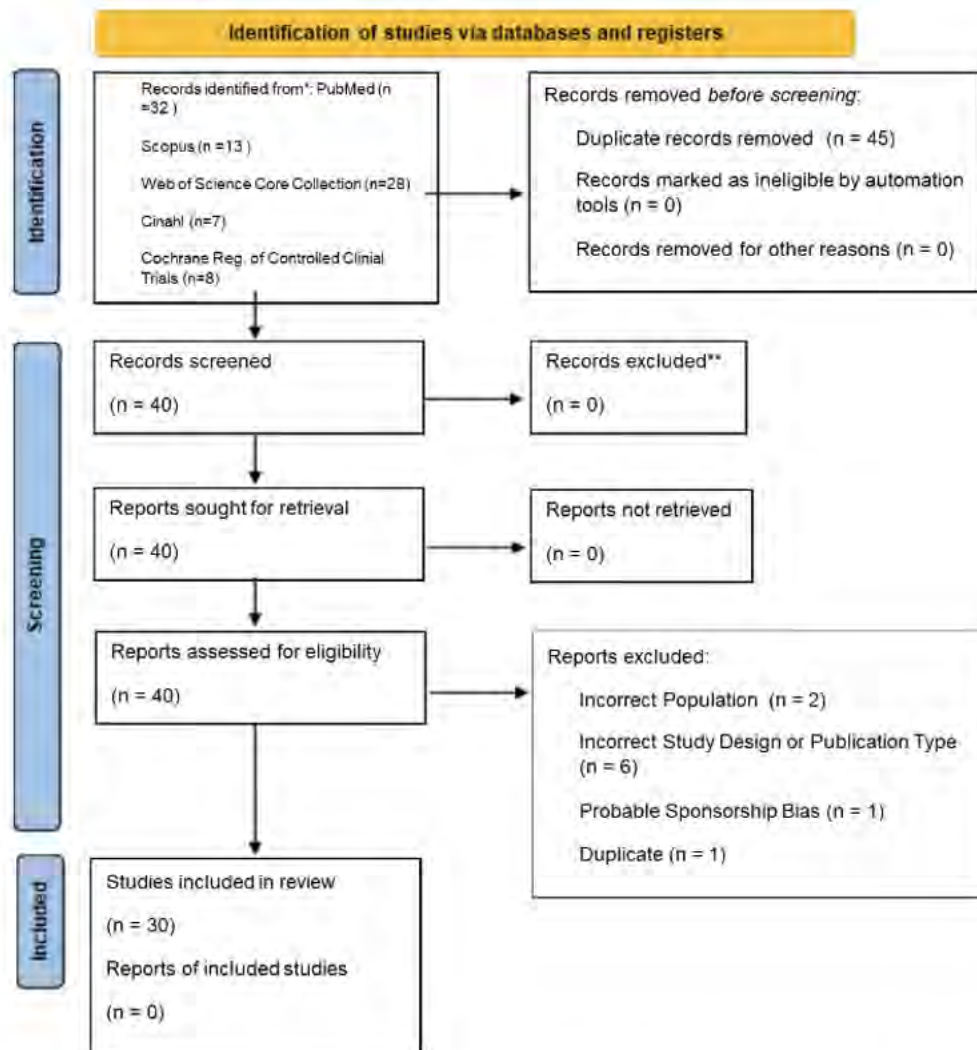


Figure 1. Depiction of PRISMA-ScR Article Screening Process

30 total articles published from 2001-2024 satisfied inclusion/exclusion criteria and formed the basis of this review. 8 studies examined outcomes in PNB bracing using the Scoliosis Research Society (SRS) inclusion and assessment criteria. 6 articles compared the efficacy of the PNB to a full-time orthosis. 13 studies investigated measures to improve PNB success, and an additional 3 studies evaluated the impact of PNB treatment on quality of life. The PNB effectively reduces scoliosis curve progression in specific AIS subsets, particularly in curves under 35° and those with an apex below T9. Initial curve flexibility, skeletal maturity, and brace compliance likely influence PNB success. 83% of comparative studies

suggest the PNB may offer similar or superior outcomes to full-time orthoses (i.e. Boston). The PNB is also associated with superior quality of life compared to full-time alternatives. Innovations such as artificial intelligence, ultrasound imaging, predictive models, and temperature sensors may improve brace fit, adherence, and future compliance measures.

Conclusion(s)

The Providence brace provides a viable, patient-compliant alternative in the treatment of mild to moderate AIS. While the PNB demonstrates promise, inconsistent findings and a lack of standardization in study design and indications further the need for future prospective, randomized studies utilizing SRS criteria and objective measures of compliance.

Clinical significance

The PNB effectively treats curves less than 35° in the lumbar, thoracic, or thoracolumbar regions and demonstrates more than adequate compliance in the treatment of AIS patients.

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THE IMPACT OF A HIGH IN-BRACE CORRECTIVE RATE ON THE TREATMENT OUTCOMES OF SEVERE ADOLESCENT IDIOPATHIC SCOLIOSIS WITH MAIN COBB ANGLE BETWEEN 40-60°

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Background

Bracing combined PSSE is confirmed to be effective for Adolescent Idiopathic Scoliosis (AIS) with a moderate curve, however, the treatment outcomes for adolescent idiopathic scoliosis with more severe Cobb angles between 40° and 60° remain limited.

Objective (s)

This study aims to evaluate the treatment outcomes of an effective brace (in-brace corrective rate ≥50%) combined with intensive rehabilitation based on our experience in China for severe adolescent idiopathic scoliosis with a Cobb angle between 40 and 60°.

Study Design

A prospective cohort study.

Methods

This is a prospective cohort study in which consecutive patients visiting a Xinmiao scoliosis center in Guangzhou, China, between March 30, 2015 and November 31, 2020, and met the following criteria were included: age 10-18 years; initial curve between 40°-60°; primary treatment method was braced and intensive rehabilitation; first in-brace corrective rate is $\geq 50\%$; and were followed-up for at least 2 years. Primary outcome measure was major curve angle change since treatment initiation, which was categorized as improved (6° or more), unchanged ($\pm 5^\circ$) and progressed (6° or more). The treatment outcomes were analyzed according to the corrective angle and corrective rate.

Results

We conducted a prospective analysis of data from 64 cases of adolescent idiopathic scoliosis (AIS) with a baseline curve of 40° or higher, who were denied surgery, followed up for over two years, and achieved a braced correction of at least 50%. Among the 64 AIS cases, 54 (86.8%) were female, with an average age of 13.7 ± 1.7 years and an average Risser sign of 3.0 ± 1.6 . The mean baseline curve was 46.4 ± 5.3 , ranging from 40° to 60°. The average brace wear time was 19.7 ± 2.2 hours, while the mean duration of specific scoliosis exercise (PSSE) was 49.5 ± 34.0 minutes. Patients were followed up for an average of 3.0 ± 1.2 years until the completion of treatment. After the treatment, all patients had curves reduced by at least 5°, and 32 (50%) patients had curves reduced by at least 15°. Overall, 63 (98.4%) patients had curves reduced by more than 10%, 48 (75%) patients had curves reduced by more than 20%, and 34 (53.1%) patients had curves reduced by more than 30%. The overall curve reduction was 15.1 ± 7.1 , with a decrease rate of 32.6%. At the final follow-up, all patients achieved the target angle of 50° to avoid surgery.

Conclusion(s)

Combining bracing with intensive rehabilitation effectively treats severe AIS patients who have curves measuring between 40° and 60° Cobb. Achieving positive treatment outcomes relies on a high in-brace corrective rate, consistent brace usage, and intensive rehabilitation.

Clinical significance

A well-designed brace with a corrective rate of 50% or higher, when combined with strict adherence to wearing the brace and intensive rehabilitation, leads to better treatment outcomes.

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COMBINED DAYTIME BALANCE AND NIGHTTIME BENDING BRACE TREATMENTS FOR AIS PATIENTS WITH CURVES EXCEEDING 40°

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Background

Brace has been confirmed effectively for moderate AIS patients. However, the scientific evidence supporting the efficacy of bracing for patients with curves greater than 40° remained limitation.

Objective (s)

This study aimed to investigate the clinical effectiveness of a new bracing protocol that combines a daytime balance brace with a nighttime bending brace for treating AIS patients with curves between 40° and 60°.

Study Design

A prospective study.

Methods

This prospective cohort study included consecutive patients who visited Xinmiao scoliosis center in Guangzhou, China, from October 1, 2019, to August 20, 2022. The inclusion criteria were: age between 10 and 18 years; AIS with a main curve measuring between 40° and 60°; treatment involving a daytime balance brace combined with a night bending brace and intensive rehabilitation; and a follow-up period of at least two years. Primary outcome measure was major curve angle change since treatment initiation, which was categorized as improved (6° or more), unchanged (+/-5°) and progressed (6° or more). The treatment outcomes were analyzed based on the angle correction and the rate of correction.

Results

A total of 33 patients with a mean age of 15.5 ± 2.0 years were enrolled, in which 31 (93.9%) were girls. The mean baseline curve was 47.6 ± 5.3 , ranging from 40° to 60°. The average brace wear time was 19.4 ± 1.7 hours, while the mean duration of specific scoliosis exercise (PSSE) was 77.3 ± 34.9 minutes per day. At last follow up, the main Cobb angle improved from 47.6° to 33.2°, showing an average reduction of 14.5°, with a decrease rate of 30.4%. Of these patients, 31 (93.9%) obtained curvature improvement of 5° at latest follow-up, 2 (6.1%) remained stable, and no patient experienced curve progression. Overall, 33 (93.9%) patients had curves reduced by more than 10%, 25 (75.8%) patients had curves reduced by more than 20%, and 18 (54.5%) patients had curves reduced by more than 30%. At the final follow-up, all patients attained the desired angle of less than 50° to avoid surgery.

Conclusion(s)

A daytime balance brace, a night bending brace, and intensive rehabilitation together offer an effective treatment for severe AIS patients with a main curve between 40° and 60°.

Clinical significance

Using a daytime balance brace along with a nighttime bending brace and intensive rehabilitation may improve treatment outcomes for severe Adolescent Idiopathic Scoliosis (AIS) with a primary curve of 40° to 60°.

BRACE TREATMENT FOR SCOLIOSIS SECONDARY TO CHIARI MALFORMATION TYPE 1 OR SYRINGOMYELIA WITHOUT NEUROSURGICAL INTERVENTION: A MATCHED COMPARISON WITH IDIOPATHIC SCOLIOSIS

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Background

Chiari malformation type 1 (CM-1), defined as the cerebellar tonsillar descent below the level of foramen magnum more than 5 mm, is frequently associated with syringomyelia and scoliosis in pediatrics. Due to no hindbrain-related symptoms, some of these patients visited the outpatient clinic primarily for scoliosis and didn't need a prophylactic neurosurgery. Brace treatment could serve as a conservative strategy to prevent scoliosis progression for them.

Objective (s)

To to evaluate the clinical outcome of brace treatment for CM-1 or syringomyelia (CMS) associated scoliosis without any prior neurosurgical intervention and to compare its effectiveness with matched idiopathic scoliosis.

Study Design

This was a retrospective case-control study.

Methods

34 CMS patients who received brace treatment without neurosurgical intervention were recruited. Another 68 matched patients with idiopathic scoliosis who received bracing served as the control group. The matching criteria included gender, age (± 1 years), Risser sign (± 1 grade), initial curve magnitude ($\pm 5^\circ$), curve patterns and follow-up time (± 6 months). Patients who encountered curve progression and scoliosis surgery were compared between different groups.

Results

Until the last visit, 16 (47%) patients in CMS group and 18 (26%) patients in IS group occurred curve progression; 9 (26%) patients and 15 (22%) patients underwent scoliosis surgery, respectively. Compared to idiopathic scoliosis, patients with CMS-associated scoliosis had a

significantly higher rate of curve progression ($P = 0.038$). However, no significant difference was observed between two groups regarding to the rate of surgery ($P = 0.867$). Patients with combined CM-1 and syringomyelia had a higher rate of surgery than patients with isolated CM-1 or syringomyelia ($P = 0.049$). The double major curve pattern was identified as the risk factor for curve progression.

Conclusion(s)

Brace treatment is effective for CMS-associated scoliosis without neurosurgical intervention. Compared to idiopathic scoliosis, brace can provide similar prevention for scoliosis surgery in CMS patients, but slight or moderate curve progression may occur. Specifically, patients with combined CM-1 and syringomyelia should be followed closely with a higher expectation of curve progression.

Clinical significance

Brace treatment was effective for CMS patients to avoid scoliosis surgery when the prophylactic neurosurgical treatment was not necessary.

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THE EFFECT OF CHENEAU CONCEPT 3D PRINTED BRACES ON ADOLESCENT IDIOPATHIC SCOLIOSIS: A PREFERENCE RANDOMIZED CONTROLLED STUDY

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Background

Brace is the most effective means to control the progression of moderate AIS. Pain in stress area, skin pressure sores and quality of life decrease after brace wearing affect patients' compliance with brace wearing. Wearing 3D printed braces with good breathability has become a topic of concern in low-latitude areas of China. However, few studies have reported on the corrective effects of 3D printing braces and their impact on quality of life in southern China.

Objective (s)

The objective of this study was to investigate the effect of Cheneau concept 3D brace made according to Rigo classification on AIS patients' correction and quality of life in southern China.

Study Design

A preferred randomized control design was used in this study. This study was approved by the Human Subject Committee of Guangzhou Sport University (2018LCLL-008).

Methods

We respected the patient's choice and divided the participants into a control group and a matching group. The control group wore 3D printing braces, while the matching group wore CAD/CAM braces. The Cheneau concept braces were made according to Rigo classification. We respected the patient's choice and divided the participants into a control group and a matching group. The control group wore 3D printing braces, while the matching group wore CAD/CAM braces. The Cheneau concept braces were made according to Rigo classification.

Results

Forty-eight patients with 12.5 ± 2.1 years of age and a median grade 2 Risser sign were enrolled in the study. The age, gender and risser signs of the two groups were matched with each other, and the difference was not statistically significant ($P > 0.05$). There were no significant differences in Cobb Angle correction rate, sagittal plane parameters and apex rotation between the two groups ($P > 0.05$). The failure rate of control group was lower than that of matched group at 6 months follow-up (1 case in control group and 3 cases in matching group) ($P < 0.05$). The control group was superior to the matched group in the C-Brq 34 questionnaire at 1, 2, 3 and 4 months, respectively ($P < 0.05$).

Conclusion(s)

The Cheneau concept 3D printed Brace show superior short-term results. Specifically, the control group had a lower rate of corrective failure and a better C-Brq 34 score than the matched group, which may suggest that a higher quality of life contributes to improved adherence to wearing braces in southern China.

Clinical significance

The Cheneau concept 3D printed brace has better air permeability, which can help improve the adherence of patients wearing braces in hot areas of southern China, thereby reducing the failure rate of correction.

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A COMPARATIVE STUDY ON THE EFFECT OF SELF-STRETCHING AND MACHINE-STRETCHING PRIOR TO ORTHOTIC TREATMENT FOR ADOLESCENTS WITH IDIOPATHIC SCOLIOSIS

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Background

Orthotic treatment has been well-acknowledged for managing patients with moderate adolescent idiopathic scoliosis (AIS). Research showed that the orthotic treatment outcomes were highly correlated with spinal flexibility of individual patients. Stretching is a method for reducing muscle tightness and improving joint flexibility. However, few studies have explored the role of stretching in promoting orthotic treatment outcomes.

Objective (s)

To compare the effect of self-stretching and three-dimensional (3D) machine-stretching in preparing orthotic treatment on the curve correction of patients with AIS.

Study Design

This study is a prospective study.

Methods

This study recruited subjects aged 10-16, with Risser stage of 0-2, Cobb angle 20-45°, and newly prescribed for orthotic treatment. Forty-two subjects were assigned to either self-stretching exercises (SSE) or 3D machine-stretching (3DMS), and 5 patients dropped out the study for personal reasons. The subjects in the SSE group were instructed to perform daily 30-minute stretching exercises for one month, while 3DMS group received 14 consecutive days of 3D electronic machine stretching before the orthosis fitting, with 30 minutes per day. A portable ultrasound system was used to assess the curve magnitude after the first three months of orthosis usage. A temperature sensor was embedded into the rigid thoracic-lumbar-sacral orthosis (TLSO) to monitor the wearing compliance. A chi-square test was performed to compare the qualitative variables of the two groups, and an independent t-test was used to compare baseline and outcome measures between groups.

Results

The analyses included 19 subjects (14 girls, 5 boys) of 3DMS group and 18 subjects (16 girls, 2 boys) of SSE group with mean age of 13.76 years. There was no significant difference between the curve flexibility following machine-stretching (79%) and self-stretching (75%) ($p=0.07$). However, the first in-orthosis Cobb correction rate was 63% after machine stretching, as compared with 49% after self-stretching exercises ($p<0.05$). The ultrasound curvature after the first three months of orthosis usage were 9.72° and 15.91° for 3DMS and SSE groups, respectively ($p<0.05$). The hours of orthosis wearing were 12.92 and 16.74 for 3DMS and SSE groups, respectively ($p=0.33$). The comparisons of both groups are presented in Table 1.

Table 1. The comparison of the self-stretching and machine-stretching groups			
Characteristics	3DMS (n=19)	SSE (n=18)	P value
Age (year)	13.68 ± 1.16	13.83 ± 1.20	0.72
BMI (kg/m2)	17.17 ± 1.81	17.37 ± 1.68	0.73
Cobb angle (°)	20.43 ± 4.01	24.38 ± 8.38	0.10
TS (cm)	0.86 ± 0.73	1.05 ± 0.96	0.63
CF	59 % ± 25%	63% ± 20%	0.47
ST (°)	28.07 ± 11.97	27.85 ± 9.64	0.96
SL (°)	34.80 ± 8.86	33.77 ± 11.22	0.79
IUC (°)	12.28 ± 3.72	18.61 ± 8.41	0.10
Gender (n, %)			
Girl	14 (74%)	16 (89%)	0.24
Boy	5 (26%)	2 (11%)	
Curve type (n, %)			
Single curve	10 (53%)	4 (22%)	0.06
Double curves	9 (47%)	14 (78%)	
AVR			
0	4 (21%)	2 (11%)	0.48
1	9 (47%)	7 (39%)	
2	6 (32%)	9 (50%)	
Risser Stage			
0	5 (26%)	3 (17)%	0.65
1	4 (21%)	4 (22%)	
2	10 (53%)	11 (61%)	
Compliance (hours)	12.92 ± 7.96	16.74 ± 3.98	0.33
CCF (%)	20 % ± 22%	13% ± 21%	0.19
P-CF (%)	79% ± 18%	75% ± 14%	0.07
IST (°)	26.42 ± 12.59	24.94 ± 8.53	0.68
ISL (°)	32.89 ± 9.23	31.67 ± 10.50	0.71
IBC (°)	7.54 ± 2.94	12.97 ± 8.45	0.01*
CC (°)	12.89 ± 4.09	11.41 ± 5.53	0.25
CCR (%)	63% ± 16%	49% ± 23%	0.01*
3MUC (°)	9.72 ± 3.09	15.91 ± 6.13	0.01*
CUC (°)	2.57 ± 2.24	2.70 ± 3.90	0.91

BMI: body mass index; TS: trunk shift; CF: curve flexibility;

ST: sagittal thoracic angle; SL: sagittal lumbar angle; IUC: initial ultrasound curvature;

AVR: angle of vertebral rotation;

CCF: change of curve flexibility;

P-CF: post-stretching curve flexibility;

IST: first in-orthosis sagittal thoracic angle;

ISL: first in-orthosis sagittal lumbar angle;

IBC: first in-orthosis Cobb angle;

CC: change of Cobb angle;

CCR: Cobb angle regression rate;

Conclusion(s)

The 3D machine-stretching group showed a significantly better immediate in-orthosis Cobb correction rate and a smaller ultrasound curvature after the first three months of orthotic usage than the self-stretching group. However, the curve flexibility and orthosis usage hours were similar for both groups. These findings suggest that machine-stretching before orthosis fitting may offer superior correction for patients with AIS, at least in a short-term assessment. A long-term follow-up with more subjects is deserved.

Clinical significance

This study demonstrated that the 3D machine-stretching before orthosis fitting is more effective in achieving immediate Cobb angle correction and reducing curvature in the patients with AIS compared to self-stretching exercises, despite similar compliance in orthosis usage.

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EFFECT OF BRACE ON TREATING MODERATE IDIOPATHIC SCOLIOSIS IN SKELETALLY IMMATURE PATIENTS

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Background

Skeletally immature patients with moderate idiopathic scoliosis is high risk of progression. Brace helps to control the progression, however the research on this topic is still limited.

Objective (s)

This study aims to evaluate the effect of brace in the treatment of skeletally immature idiopathic scoliosis (IS) with Risser ≤ 2 .

Study Design

A retrospective study.

Methods

A total of 40 IS patients, 3 males and 37 females, who were admitted to the Guangdong Xinmiao Scoliosis Prevention Center from January 2016 to November 2020 were included. Inclusion criteria were as follows: 1) treatment-naïve patients diagnosed with IS for the first time; 2) Cobb angle of the major curve between 20° to 45°; 3) Risser sign grade 0-2 at the time of treatment; 4) being treated with full-

day brace; and 5) follow-up until skeletally mature (Risser $\geq$ 4) . Scoliosis correction in all patients was assessed using the following criteria: improvement (decrease in the major curve Cobb angle of $\geq 5^\circ$), stabilization (change in the major curve Cobb angle between -5° and 5°), and progression (increase in the major curve Cobb angle of $\geq 5^\circ$).

Results

The average age of 40 IS patients at the time of treatment was 11.3 ± 1.2 years (range from 7 to 12). After 38.2 ± 11.2 months of treatment, the Cobb angle of the major curve was corrected from an average of $30.1^\circ \pm 7.8^\circ$ to $26.1^\circ \pm 8.8^\circ$, with an average correction of $3.9^\circ \pm 8.9^\circ$. Among them, 50% (20/40) patients achieved improvement in the major curve Cobb angle, 32.5% (13/40) achieved stabilization, and 17.5% (7/40) progressed.

Conclusion(s)

Brace is effectively prevents the progression or corrects the scoliosis in patients with skeletally immature idiopathic scoliosis with a Cobb angle between 20° and 25° .

Clinical significance

Brace is also effective for controlling the progression of the moderate IS patients.

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BRACE TREATMENT FOR EARLY ONSET IDIOPATHIC SCOLIOSIS PATIENTS

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Background

Early onset patients with moderate idiopathic scoliosis is high risk of progression. Brace helps to control the progression, however the research on this topic is still limited.

Objective (s)

This study aims to evaluate the effect of brace in the treatment of early onset idiopathic scoliosis (IS) range from 5 to 10 years old.

Study Design

A retrospective study.

Methods

A total of 35 IS patients, 7 males and 28 females, who were admitted to the Guangdong Xinmiao Scoliosis Prevention Center from August 2016 to November 2021 were included. Inclusion criteria were as follows: 1) treatment-naïve patients diagnosed with IS for the first time; 2) Cobb angle of the major curve between 20° to 45°; 3) age between 5 to 10 years old at the time of treatment; 4) being treated with full-day brace; and 5) follow-up more than 2 years. Scoliosis correction in all patients was assessed using the following criteria: improvement (decrease in the major curve Cobb angle of $\geq 5^\circ$), stabilization (change in the major curve Cobb angle between -5° and 5°), and progression (increase in the major curve Cobb angle of $\geq 5^\circ$).

Results

The average age of 35 IS patients at the time of treatment was 8.6 ± 1.4 years (range from 5 to 10). After 36.8 ± 12 months of treatment, the Cobb angle of the major curve was corrected from an average of $28.9^\circ \pm 7.9^\circ$ to $21.1^\circ \pm 11.3^\circ$, with an average correction of $8.1^\circ \pm 8.6^\circ$. Among them, 71.4% (25/35) patients achieved improvement in the major curve Cobb angle, 20% (7/35) achieved stabilization, and 8.6% (3/35) progressed.

Conclusion(s)

Brace is effectively prevents the progression or corrects the scoliosis in early onset IS patients with a Cobb angle between 20° and 25°.

Clinical significance

Brace is also effective for controlling the progression of early onset patients with moderate IS.

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EFFECTIVENESS OF THE MODIFIED CUSTOMISED BOSTON-STYLE BRACE VERSUS THE RIGO-CHENEAU BRACE FOR ADOLESCENT IDIOPATHIC SCOLIOSIS (AIS): AN INTERIM RETROSPECTIVE STUDY

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Background

Existing literature does not have strong evidence for outcomes of Rigo-Chaneau rigid braces, so we evaluated the outcomes in our centre.

Objective (s)

The objective of this study was to compare the outcomes of the Rigo-Cheneau and modified customised Boston-style brace in AIS patients at least 1 year after bracing treatment.

Study Design

Retrospective analysis of patient records for patients randomly fitted with modified Boston-style rigid TLSO and Rigo-Cheneau rigid TLSO braces.

Methods

We retrospectively review patient records for patients with at least 1-year follow-up X-rays from brace initiation since October 2022, including patients ≥ 10 years, Risser 0-II, major curve $15-40^\circ$, and had no prior bracing. 56 patients prescribed the Rigo-Cheneau brace met the inclusion criteria, and 56 patients prescribed the modified Boston-style brace were randomly selected. The Rigo-Cheneau classification was used. Patients were instructed to wear the brace full-time. Outcomes included the following: in-brace correction (%), brace compliance, major curve non-progression of $\geq 6^\circ$ (treatment success), stability and magnitudes of major curves, progression to surgery, and major curve $\geq 45^\circ$. Independent samples t-test and chi-squared test were used to compare the differences between the two brace cohorts.

Results

Out of 112 patients, 67 patients (60%) were followed up till 1.5-year (± 1 month) and 50% reached Risser 4-5 at latest visit. Baseline characteristics of the two bracing groups were similar, except for curve pattern, as there were 22% more patients with type B curves and 12% more patients with type E curves in the Boston-style group ($p=0.027$). However, the major curve locations ($p=0.891$) and magnitude ($29.30 \pm 5.34^\circ$ for Rigo-Cheneau vs. $29.66 \pm 5.88^\circ$, $p=0.481$) were similar between the two groups.

In-brace corrections were similar except for lumbar curves, where correction was greater with the Boston-style group ($64.95\% \pm 19.84\%$ vs. $43.21\% \pm 24.88\%$, $p=0.001$). Brace compliance was similar (12.30 ± 4.75 for Boston-style vs. 11.83 ± 4.74 , $p=0.602$).

At latest follow-up, the major curve magnitudes ($26.82 \pm 6.51^\circ$ for Boston-style vs. $28.42 \pm 7.74^\circ$, $p=0.481$) were similar between the two groups. Treatment success rate was 91% for the Boston-style group and 84% for the Rigo-Cheneau group. 2 patients (4%) in the Boston-style group and 4 (7%) in the Rigo-Cheneau group progressed to surgery or had curves $\geq 45^\circ$.

Table: Bracing treatment and outcomes

Parameter	All patients n=112	Rigo-Cheneau n=56	Modified customised Boston-style n=56	p-value
Initial in-brace correction (°)				
Major	13.00±7.12	14.22±7.53	11.76±6.52	0.071
Thoracic	13.86±7.14	14.42±7.61	13.15±6.55	0.442
Thoracolumbar	10.69±6.06	11.45±6.92	10.00±5.24	0.446
Lumbar	13.22±7.08	15.67±6.86	10.35±6.34	0.007
Percent initial in-brace correction (%)				
Major	58.61±21.28	55.18±21.62	62.03±20.56	0.089
Thoracic	51.12±21.45	49.44±22.27	53.22±20.50	0.440
Thoracolumbar	63.21±18.14	61.03±18.83	65.20±17.69	0.464
Lumbar	53.46±24.96	43.21±24.88	64.95±19.84	0.001
S-curve percent correction (%)	53.15±20.41	49.41±21.43	58.32±18.03	0.122
Single percent correction (%)	60.33±19.78	55.02±17.60	63.88±20.63	0.090
Brace wear time per day (hrs)	12.06±4.73	11.83±4.74	12.30±4.75	0.602
Final major curve at last two visits	(n=112)	(n=56)	(n=56)	
>30	32 (29%)	19 (34%)	13 (23%)	0.296
>50	1 (1%)	0 (0%)	1 (2%)	1.000
≥45°	2 (2%)	1 (2%)	1 (2%)	1.000
Progression to surgery	4 (4%)	3 (5%)	1 (2%)	0.618
Progression to surgery or ≥45°	6 (5%)	4 (7%)	2 (4%)	0.679
Progression ≥6°	10 (9%)	6 (11%)	4 (7%)	0.742
Decrease ≥6°	25 (22%)	11 (20%)	14 (25%)	0.651
Unchanged (±5°)	73 (65%)	36 (64%)	37 (66%)	1.000
Major curve (°)	27.60±7.15	28.42±7.74	26.82±6.51	0.248
Risser at last visits				
0-3	55 (50%)	24 (44%)	31 (56%)	0.094
4-5	54 (50%)	30 (56%)	24 (44%)	
Patient number at last visits				
1-year (±1month)	100 (89%)	51 (91%)	49 (88%)	0.761
1.5-year (±1month)	67(60%)	29 (52%)	38 (68%)	0.123

Conclusion(s)

This retrospective review shows that the rates of treatment success in brace-wearing patients in our center from 2022-2023 was 84-91% for about 12 hours each day, higher than average for rigid full time bracing of 73.2% (95% CI 61-86%) according to Costa et al. (2021). There was no significant difference in brace compliance and treatment outcomes between Boston-style or Rigo-Cheneau brace.

Clinical significance

Compared to existing literature, this study presented the strongest evidence for Rigo-Cheneau bracing outcomes. Success rates were high, and there is no significant difference in treatment outcomes between the two types of braces.

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OBSERVATION ON THE EFFICACY OF BALANCE TRAINING UNDER BRACE COMBINED WITH SPINAL SAGITTAL POSITION IN AIS PATIENTS

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Background

Chinese adolescents cannot concentrate on scoliosis orthopaedic training for a long time under heavy schoolwork. Scoliosis does not worsen or even improves during learning, which is the focus of our study. Therefore, we investigated the observation of Cobb Angle effect of 3D printed brace fixation - Full time: Less than half a day without the brace (19-22h) combined with sagittal balance training for AIS in adolescent patients with idiopathic scoliosis.

Objective (s)

According to the law of trouble, to explore whether increasing the physiological curvature of the spine in sagittal position can reduce the coronal lateral curvature of the spine.

Study Design

The subjects were divided into two groups, and the test variables were determined by whether the spinal sagittal balance training was performed, and the results were obtained by comparing the posture and Cobb Angle before and after treatment.

Methods

A total of 42 adolescent scoliosis patients, aged 10-17 years and Cobb degrees 21-35, who were admitted to Tai 'an Central Hospital of Shandong Province from January 2023 to September 2024, were selected as the study subjects. According to the different treatment time, they were divided into control group and treatment group, 21 cases in each group. The control group was treated with 3D printed brace for 19 to 22 hours a day for 6 months, and the treatment group was treated with 3D printed brace for 19 to 22 hours a day (wearing time was the same as the control group) combined with spinal sagittal balance training including cat breathing and diaphragm breathing for 6 months. Body posture was reviewed after 3 months of home treatment, body posture was reviewed after 6 months of home treatment and X-ray was taken. The differences of body posture, lateral Cobb Angle, apex vertebra deviation distance and trunk deviation distance of AIS patients were compared between the two groups after treatment.

Results

The posture of AIS patients in both groups was improved 3 months after treatment compared with before treatment, and the posture, lateral Cobb Angle, apex vertebroid deviation distance and trunk deviation distance index of AIS patients in both groups were improved compared with before treatment at 6 months after treatment, and the improvement in the treatment group was greater than that in the control group.

Conclusion(s)

3D printing support fixed Full-time: Less than half a day without the brace (19-22h) Combined spinal sagittal balance training therapy can significantly improve the posture and Cobb Angle of AIS patients, and adjust the balance of muscle strength on both sides of the spine.

Clinical significance

It is of great significance for AIS patients who cannot focus on scoliosis orthopaedic training in clinical practice, especially students.

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EVALUATION OF THE PREDICTION ROLE OF RIB-VERTEBRAL ANGLE (RVA) IN ORTHOTIC TREATMENT OF ADOLESCENT IDIOPATHIC SCOLIOSIS (AIS)

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Background

Orthotic treatment offers promising effects on AIS. However, its treatment outcome could be influenced by various factors, such as compliance and maturity. If scoliosis deformity worsens, it could lead to complications such as thoracic cage distortion, which subsequently affect patient's cardiopulmonary function and quality of life.

Objective (s)

This study aims to investigate the influence of rib-vertebral angle differences (RVAD) on treatment outcomes in the patients with AIS undergoing orthotic interventions.

Study Design

Prospective cohort study

Methods

This study has collected data from 33 patients with moderate AIS (20°-45° Cobb angle) at the thoracic region. Each patient underwent four X-ray examinations: standing and supine position before orthotic treatment, first standing in-orthosis, and discharged standing out-orthosis X-ray. Patients were divided into two groups, the change in Cobb angle between the standing position before treatment and the end of orthotic treatment was considered. An increase within 5 degrees or reduced Cobb angle was defined as treatment success (Group 1), while an increase over 5 degrees was defined as treatment failure (Group 2).

Results

In the standing position X-ray before orthotic treatment, the average RVAD for Groups 1 and 2 were $8.04^{\circ} \pm 6.79^{\circ}$ and $7.42^{\circ} \pm 5.41^{\circ}$ respectively. In the supine X-ray before treatment, the average RVAD for Groups 1 and 2 were $6.26^{\circ} \pm 4.98^{\circ}$, and $5.84^{\circ} \pm 4.33^{\circ}$. After fitting, the first in-orthosis mean for Group 1 was $6.83^{\circ} \pm 5.01^{\circ}$, and for Group 2 was $7.88^{\circ} \pm 4.86^{\circ}$. After treatment, the data for Group 1 was $9.53^{\circ} \pm 7.93^{\circ}$, and Group 2 was $14.32^{\circ} \pm 3.73^{\circ}$.

When comparing the variation at the two timepoints, no significant difference was observed between the first and second visits in both groups. Specifically, the comparison between the supine and the first in-orthosis standing X-ray revealed that the convex side RVA variation in Group 1 was $6.82^{\circ} \pm 4.86^{\circ}$, while in Group 2 it was $3.42^{\circ} \pm 3.18^{\circ}$, showing a significant difference ($t=2.328$, $p=0.027$). However, the concave side exhibited an opposite variation to the convex side. For Group 1, the variation was $4.34^{\circ} \pm 3.33^{\circ}$, whereas for Group 2 was $6.05^{\circ} \pm 4.44^{\circ}$. No statistical difference was found between the two groups in concave side variation. The significant difference in convex side RVA variation between the two groups highlights a potential indicator for treatment success.

However, the study has limitations, including a relatively small sample size and focusing only on changes in curve apices. Further research could delve into the implications of these findings for optimizing orthotic treatment strategies for scoliosis.

Conclusion(s)

The study suggests that RVA variation may have predictive potential in treating AIS apart from early-onset scoliosis. Future plans should expand sample size, measure all RVAD changes comprehensively.

Clinical significance

By identifying the characteristics of RVA and RVAD variations, patient treatment outcomes can be predicted, thereby enhancing the efficiency of orthotic treatment.

EFFECTS OF BODY MASS INDEX ON BRACE TREATMENT OUTCOMES IN ADOLESCENTS WITH IDIOPATHIC SCOLIOSIS

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Background

Adolescent Idiopathic Scoliosis (AIS) affects 2%–5% of adolescents worldwide. Brace treatment is the standard non-surgical intervention to prevent curve progression in moderate cases. The efficacy of brace treatment is influenced by multiple factors, including compliance, skeletal maturity, and brace design. However, the impact of Body Mass Index (BMI) on treatment outcomes remains poorly understood and controversial.

Objective (s)

To evaluate the influence of BMI on Cobb angle changes and deterioration rates during brace treatment in AIS.

Study Design

A retrospective cohort study of patients with AIS treated with custom thoracolumbar braces in a public hospital.

Methods

A total of 104 patients aged 10 to 15 years, with Cobb angles ranging from 20° to 40°, were analyzed. The patients were classified into three BMI groups based on CDC BMI-for-age percentiles: underweight (<5th percentile, n=19), normal weight (5th–85th percentile, n=80), and overweight (≥85th percentile, n=5). The study measured outcomes including the primary outcome of Cobb angle change and the secondary outcome of curve deterioration, defined as a worsening of the Cobb angle by 5° or more. One-way ANOVA and Chi-square/Fisher's Exact Test were utilized for the data analysis.

Results

Baseline Cobb angles were similar across different BMI groups ($p = 0.382$). The changes in Cobb angles after treatment did not show significant differences among the groups ($p = 0.681$): underweight patients had an average change of $-1.7^\circ \pm 10.5^\circ$, normal weight patients had $0.5^\circ \pm 9.0^\circ$, and overweight patients had $-2.8^\circ \pm 10.2^\circ$. However, the rates of curve deterioration varied significantly by BMI category ($p = 0.047$): 50.0% in underweight patients, 17.2% in normal weight patients, and 33.3% in overweight patients. Normal weight patients experienced the lowest deterioration rates, suggesting they had better outcomes.

Table 1: Curve Cobb angles and deterioration rates among the 3 BMI groups

	Underweight group (n=19)	Normal weight group (n=80)	Overweight group (n=5)	<i>p-value</i>
Pre-brace Cobb angle (°)	32.8 ± 3.9	30.1 ± 5.5	31.2 ± 3.7	<i>p</i> = 0.382
Post-brace Cobb angle (°)	34.5 ± 13.4	29.6 ± 10.6	33.9 ± 7.7	<i>p</i> = 0.387
Cobb angle change (°)	-1.7 ± 10.5	0.5 ± 9.0	-2.8 ± 10.2	<i>p</i> = 0.681
Curve deterioration ≥ 5°	50.0%	17.2%	33.3%	<i>p</i> = 0.047

Conclusion(s)

BMI plays a significant role in the risk of curve deterioration during brace treatment for patients with AIS, even though it does not affect the degree of Cobb angle correction. Underweight patients may not have enough muscle mass to stabilize the spine effectively, while overweight patients might experience excessive adiposity, which can reduce the effectiveness of corrective forces. Conversely, patients with a normal weight are likely to experience optimal biomechanical conditions for brace application. Personalizing brace design and treatment protocols based on BMI could improve patient outcomes.

Clinical significance

Considering BMI in treatment protocols may enhance the effectiveness of brace treatment in AIS. Future research should explore BMI-specific brace designs and optimize management strategies.

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OBSERVATION OF THE EFFECT OF WEARING ORTHOPEDIC BRACES UNDER TRACTION ON ADOLESCENT IDIOPATHIC SCOLIOSIS.

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Background

Brace therapy is the most commonly used non-surgical treatment for adolescent scoliosis. Traction exercise therapy is a kind of application of external force to a certain part of the body or joint, so that it can be separated and the surrounding soft tissue can be properly stretched. It is explored whether the combination of the two can make the brace wear better.

Objective (s)

To investigate the clinical effect of traction brace fixation on Cobb Angle recovery in adolescents with scoliosis.

Study Design

将符合要求的 AIS 患者作为研究对象并进行平均分组，将是否在支具佩戴前一个月进行牵引作为研究变量，一定时间后对患者进行复查、随诊，通过对比 Cobb 角度等指标推断研究结果。

Methods

36 adolescent scoliosis patients, aged 10-17 years old and Cobb degrees 21-35, who were admitted to Tai'an Central Hospital of Shandong Province from January 2024 to September 2024, were selected as the study objects. According to the treatment time, they were divided into control group and study group, with 18 cases in each group.

The control group was treated with 3D printing supports (Total time: Almost no pauses (23-24h) for 3 months; the study group was treated with long-term, low-load traction (30% of body weight, 1.5h) for 1 month and then the support was fixed (wear time as above) for 3 months.

After 3 months, X-ray films were taken to compare the differences of lateral Cobb Angle, apex vertebra deviation distance, trunk deviation distance, apex vertebra rotation degree and trunk rotation Angle between the two groups after treatment.

Results

After treatment, the Cobb Angle of lateral curvature, top vertebra deviation distance, trunk deviation distance, top vertebra rotation degree and trunk rotation Angle index of the two groups were improved compared with before treatment, and the improvement was greater in the study group than in the control group, the difference was statistically significant ($P < 0.05$).

Conclusion(s)

The combination of small weight, long time traction and 3D printing brace fixation therapy can significantly improve the Cobb Angle of AIS patients, effectively release the tense soft tissue around the spine, and adjust the balance of muscle strength on both sides of the spine.

Clinical significance

Traction can make scoliosis not progress or even improve in a short period of time, and patients can wear the brace better in the case of improved scoliosis.

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USE OF SLS-PRINTED BRACES IN A TREATMENT OF PATIENT WITH SCOLIOSIS

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Background

96 patients were provided with SLS-printed braces. Conservative treatment of scoliosis with braces is currently covered in sufficient detail. In this paper, we would like to propose to review the results of treatment of children with SLS-printed braces and compare them with the results of treatment with braces made of classical materials (HDPE).

Objective (s)

The purpose of this study was to determine the possibility of using SLS-printed braces in the treatment of scoliosis, as well as to evaluate the degree of correction and comfort of wearing SLS-printed braces and braces made of classical materials (HDPE).

Study Design

We conducted experimental clinical study. The group of patients with scoliotic spinal deformity were included in the study between 2022 and 2023. All patients had SLS-printed braces made according to individual 3D scans. Clinical examination was performed every 2 months and X-ray control every 6 months thereafter. We retrospectively compared the results of correction during treatment with HDPE braces. The observation period was 13 months.

Methods

96 patients with scoliotic spinal deformity aged 11 to 17 years, girls, were included in the study. Between 2022 and 2023. All patients had scoliotic spinal deformity with deformity ranged from 25° to 60°, according to M. Rigo's classification, all variants were presented. All patients had functional-corrective braces made according to individual 3 D scans using the principles of orthosis correction proposed by Jean Jacques Chenault. The SLS-printing method was used for brace production. Patients were given courses of therapeutic physical training according to SEAS and BSPTS methods. Clinical examination was performed every 2 months, 3D scans were performed at each examination for further dynamic comparison of scans. X-ray control was performed at the time of brace issuance, then every 6 months thereafter. Correction of braces was carried out at regular checkups if necessary. We retrospectively compared the results of correction during treatment with braces made of classical materials (HDPE). Patients independently, using questionnaires, subjectively evaluated and compared the comfort of using braces made of different materials. The observation period was 13 months.

Results

Clinically, a stable picture was observed. The patients indicated in the questionnaire that the braces made by SLS-printing method: the design of the brace is more attractive than HDPE brace - 85% of cases, the brace is lighter than HDPE brace - 100% of cases, it is better ventilated than HDPE brace - 100% of cases, the body sweats less in 90% of cases. The intensity of complaints about discomfort in SLS-printed braces is on average two times lower than in braces made of classical materials (HDPE).

Conclusion(s)

The use of SLS-printed functional-corrective braces in children with scoliotic spinal deformity showed good radiologic and clinical correction. At the same time, they are more comfortable to wear due to the adjustable rigidity of the brace. This leads to a more responsible compliance with the wearing regime and, consequently, a more stable correction of the deformity.

Clinical significance

SLS-printed functional-corrective braces provide a more significant therapeutic effect. This result is provided by a number of advantages: lighter material of the brace, more accurate thermoregulation of the body.

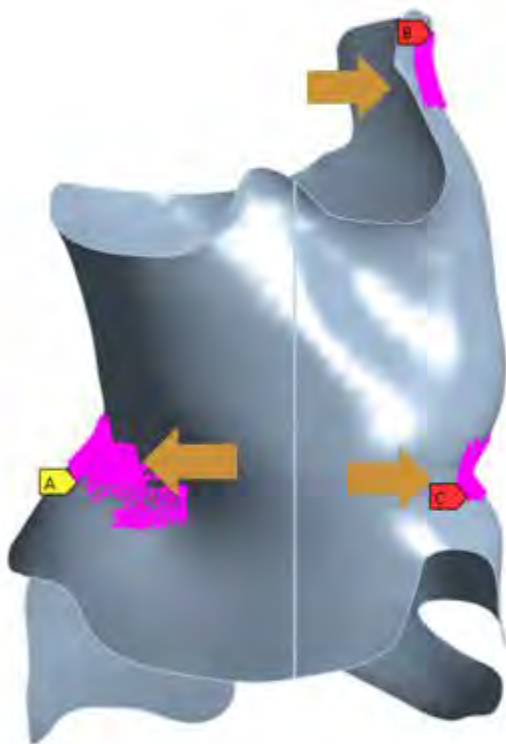
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POTENTIALS AND CHALLENGES OF TAILORED FIBER PLACEMENT AND MULTI-MATRIX COMPOSITES FOR SCOLIOSIS BRACE DESIGN

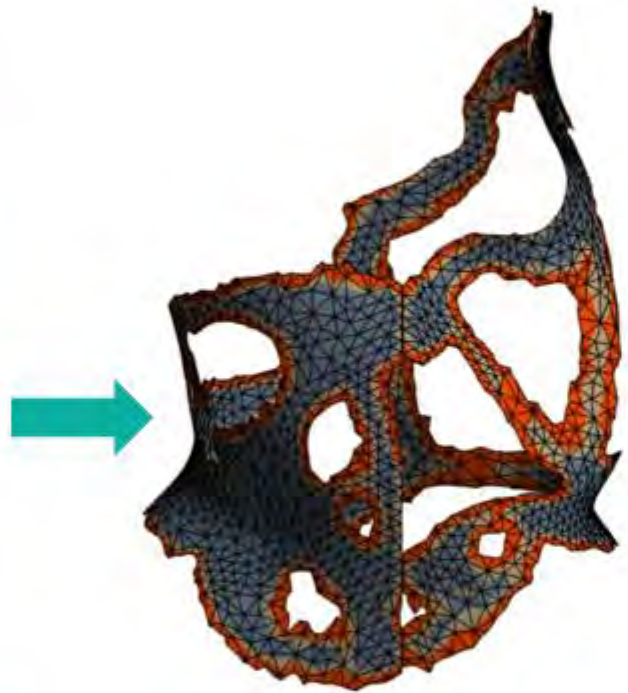
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Background



Polyethylene (PE)



Topology optimized variant

Conventional Chêneau-type scoliosis braces, typically made from thermoformed polyethylene (PE) or polypropylene (PP), are often rigid and bulky, compromising both comfort and wearability. For effective therapy, however, full-time rigid braces demand high compliance and must be worn at least 20 hours daily [Tang et al., 2024]. Recent advancements in multi-matrix composites (MMC) offer the potential to design braces that are not only lighter but also more flexible in specific areas, while maintaining the structural integrity required for therapeutic support.

Objective (s)

Multi-matrix composites (MMCs) are fiber-reinforced plastics using at least two different matrices (e.g. stiff and flexible). They can provide continuous in-plane stiffness while offering local out-of-plane bending flexibility.

This study aims to investigate the potentials and challenges of MMC and continuous fiber-reinforcement via Tailored Fiber Placement (TFP) for use in scoliosis braces. Mechanical properties and performance of MMC braces are compared to conventional PE braces, focusing on weight reduction, stiffness optimization, and the integration of localized bending zones.

Study Design

A comparative numerical analysis is conducted between a conventional full-time rigid Chêneau-type brace using PE and a fiber-reinforced composite, respectively, as material, with focus on their mechanical performance and shell thickness. Assumptions for the acting corrective pressures are deducted from literature [Pham et al., 2008]. An evaluation of the positioning of bending zones for improved opening of an MMC brace was carried out on an optimized lightweight brace design.

Methods

Using finite element analyses (FEA), the deformation under load of a conventional PE brace geometry is simulated as reference. Based on topology optimization, a lightweight design was generated. To derive the potential weight reduction, the thickness of a basal fiber-reinforced PLA composite shell was adjusted in numerical analysis to match the stiffness of the reference PE brace.

In Addition, a parametric study was performed to identify suitable positioning concepts for bending zones with reduced stiffness to improve the opening of the brace. The parameters were size, number, and position of the bending zones.

Results

Using fiber-reinforced composites, shell thickness can be reduced by up to 50% and a weight reduction of 60 % compared to a PE brace is possible, while maintaining structural stiffness. For MMCs, optimized positioning and dimensioning of bending zones leads to an improved opening of the brace, while maintaining required in-plane stiffness.

Conclusion(s)

The integration of fiber-reinforced polymers in scoliosis braces offers significant lightweight potential. Incorporating bending zones through MMC improves brace opening for a better fit and allows to soften

specific areas for enhanced wearing comfort. Despite remaining challenges in molding of complex geometries, this study builds the basis for future investigations of MMCs in scoliosis brace therapy.

Clinical significance

This study investigates the potential of multi-matrix composites for scoliosis braces, showcasing their potential for the development of lightweight braces with local stiffness variation.

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THE INFLUENCE OF SKELETAL MATURITY AT BRACE DISCONTINUATION ON SCOLIOTIC CURVE PROGRESSION

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Background

Brace treatment for adolescent idiopathic scoliosis (AIS) should ideally continue until skeletal maturity to ensure effective remodeling of the motion segments during active vertebral cartilage development. Indirect indicators like the Risser sign and the ossification of the ring-vertebral apophyses help determine skeletal maturity. However, the relationship between these indicators and chronological age, as well as the end of spinal growth, can vary widely among individuals.

Objective (s)

This study aimed to investigate the impact of premature brace discontinuation at different Risser stages on scoliotic curve progression, focusing on differences in thoracic and lumbar curves.

Study Design

This is an observational controlled cohort study nested in a prospective clinic ongoing database.

Methods

We selected 188 consecutive adolescent idiopathic scoliosis (AIS) patients who discontinued brace treatment between 2000 and 2022. 92 AIS patients were included and divided into three groups based on their Risser sign at discontinuation: Group A (Risser 0-2), Group B (Risser 3), and Group C (Risser 4). Curve magnitude (CM) and torsion of the apical vertebra (TA) were measured at the start of treatment (t1), at discontinuation (t3), and at least two years post-discontinuation (t5).

Results

The results of Cobb value for all groups are reported in Table 1.

Higher baseline rotation was strongly correlated with larger Cobb angles at follow-up ($p < 0.0005$).

Furthermore, all three groups showed a decrease in dorsal curve correction compared to the initial measurement. However, there was only a minimal decrease in the correction of lumbar curves in Groups B and C (Risser 3 and 4), with a statistically significant difference in t5-t1.

	Group A	Group B	Group C
Cobb t1	32.5 ± 10.77	28.98 ± 7.95	30.52 ± 7.58
Cobb t3	20.21 ± 15.74	14.90 ± 9.1	16.41 ± 8.02
Cobb t5	38.79 ± 28.11	25.73 ± 11.38	25.48 ± 9.87
Cobb t3-t1	-12.36 ($p=0.0080$)	-14.08 ($p<0.0001$)	-14.11 ($p<0.0001$)
Cobb t5-t1	6.214 ($p=0.5903$)	-3,244 ($p=0.0686$)	-5.03 ($p=0.0007$)

Conclusion(s)

Our study investigated the impact of early brace discontinuation on scoliotic curve progression in adolescent idiopathic scoliosis (AIS) patients. We found that while all three groups experienced some loss of correction in dorsal curves, lumbar curves in groups B and C (Risser 3 and 4) maintained more of their initial correction.

The significant differences in Cobb degrees between t3-t1 for all groups and between t5-t1 for Group C highlight the importance of continuing brace treatment until skeletal maturity, especially for patients with lower Risser signs (Risser 0-2). The correlation between baseline rotation and follow-up Cobb angle further emphasises the need for early intervention and consistent brace wear in patients with severe scoliosis.

Clinical significance

Early brace discontinuation, particularly at lower Risser stages, can lead to significant curve progression in AIS patients. Continuing brace treatment until skeletal maturity, especially for patients with lower Risser signs, is crucial to optimize outcomes

CHANGES AND CLINICAL SIGNIFICANCE OF Sibilla BRACE ON HIP MOTION DURING WALKING BEFORE AND AFTER WEARING IN ADOLESCENT IDIOPATHIC SCOLIOSIS (AIS)

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Background

The range of motion of the hip while walking is affected at different periods after and before wearing Sibilla brace, which will reduce the compliance of brace wearing in Adolescent Idiopathic Scoliosis (AIS), and adversely affect the therapeutic effect.

Objective (s)

The purpose of this study was to evaluate the changes of range of motion of the hip while walking at various angles in different periods of AIS patients before and after wearing Sibilla braces through three-dimensional gait analysis, so as to explore the influence of hip joint motion when wearing Sibilla braces, in order to provide objective basis and dynamic monitoring indicators for hip joint training of AIS patients.

Study Design

To evaluate the changes of hip joint range of motion (ROM) before and after wearing Sibilla brace in AIS patients by three-dimensional gait analysis.

Methods

- (1) Included 20 AIS patients with Cobb Angle in the range of 20-50 degrees, lateral curvature appearing in the first thoracic and second thoracic discs to the fifth lumbar vertebrae from DiscT1-T2 to L5, aged 10 to 16 years, high dependence on brace wearing, and wearing brace for 23-24 hours a day. Three-dimensional gait analysis was performed at different periods after wearing the Sibilla brace. The results of three dimensional gait analysis before wearing the brace were used as control group.
- (2) The test results were recorded, and the evaluation indexes included hip Angle in different walking periods and hip moment in different walking periods, and the changes of hip Angle motion in different periods before and after wearing the brace were compared.
- (3) SPSS 20.0 software was used for statistical analysis of the data. The measurement data conforming to normal distribution are expressed as mean $\pm$ standard deviation ($\bar{x} \pm s$), and those not conforming to normal distribution are expressed as median $\pm$ quartile ($M \pm Q$). Independent sample t test or non-parametric test were used to compare the data indicators between the AIS group and the control group. Pearson correlation analysis was used to analyze the correlation between hip motion before and after wearing the brace, and $P < 0.05$ was used as the standard of significant difference.

Results

There were significant differences in hip Angle and hip torque between AIS patients and control patients at different walking periods after wearing Sibilla brace, with statistical significance ($P < 0.05$).

Conclusion(s)

The wearing of Sibilla brace has a negative effect on hip joint flexibility at different angles in patients with idiopathic scoliosis. Training for hip joint specific Angle flexibility should be included in scoliosis specific motion therapy (PSSE) training to reduce the negative effect of brace wearing on hip joint motion.

Clinical significance

Improve the training content, better improve the structure of Sibilla brace wearing brace, and reduce the negative impact of Sibilla brace wearing.

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AN ANALYSIS OF BRACE EFFECTIVENESS BY MATURITY LEVEL AT INITIATION OF TREATMENT

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Background

This is the first in a series of independent analyses that evaluate the career-long patient database of a single clinician at a single institution. The first inquiry looks at the effectiveness of a single brace design in treating Adolescent Idiopathic Scoliosis when bracing is started at different levels of maturity, measured by the Risser Sign.

Objective (s)

To compare the effectiveness of the ART brace in controlling or improving Cobb Angle in patients with AIS when starting treatment at different Risser levels.

Study Design

: This longitudinal analysis of 892 consecutive adolescents treated with the ART brace between 2013 and 2018 includes at least 5 years of treatment and follow up data.

Methods

After IRB approval and de-identification of the patient database, 892 consecutive patients with AIS that were treated with the ART brace were evaluated by an independent team of researchers. Radiographs measured Cobb angle prior to brace treatment, along with the Risser Sign. Follow up radiographs measured Cobb angle in brace, during treatment, and 2 years after weaning from the brace. Brace effectiveness was assessed by calculating the percent change between pre-treatment and 2 year follow up for each patient. Patients were divided into groups based on their pre-treatment Risser Sign.

Results

Risser Sign groups 0-5 were compared, and all demonstrated improvement in the Cobb angle at 2 year follow up. The following table reports the average percent of change for the patients in each Risser group, with the 95% confidence interval reported in parentheses.

Risser Sign at Initiation of Tx	n	Initial Cobb Thoracic	% Change in Cobb at 2 yr (95% CI)
0	167	27.60 $\pm$ 8.06°	10.08 (2.51-17.65)
1	139	29.08 $\pm$ 8.07°	24.28 (17.80-30.77)
2	147	30.87 $\pm$ 11.4°	25.43 (19.15-31.71)
3	154	30.52 $\pm$ 9.48°	25.99 (20.27-31.70)
4	206	31.54 $\pm$ 9.51°	27.37 (23.02-31.72)
5	79	35.63 $\pm$ 10.08°	23.91 (18.54-29.28)

Conclusion(s)

In this large sample of patients receiving a consistent bracing treatment, those who began treatment later in maturity saw similar improvements in their scoliosis curve to those who began treatment earlier. This analysis would support the treatment of AIS in adolescents of all Risser Stages, rather than just those who are immature.

Clinical significance

This analysis refutes the theory that only adolescents with immature Risser Stages will benefit from brace treatment. Although the end of growth is near for those who begin treatment at Risser Stage 4 or 5, improvement in their Cobb angle at 2 years follow up was still present after brace treatment. This suggests that bracing + exercise does more than just “harnessing growth” and has an effect on other drivers of scoliosis, potentially soft tissue remodeling and epigenetics.

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IN BRACE CORRECTION IN IDIOPATHIC SCOLIOSIS: EVALUATING THE ROLE OF NON-MODIFIABLE RISK FACTORS

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Background

Idiopathic scoliosis in pediatric populations often requires bracing treatment to mitigate progression. While non-modifiable factors such as age, sex, and Sanders stage are often considered when initiating treatment, their impact on in-brace correction remains an area of active investigation. The Cobb angle has previously been shown to influence the degree of in-brace correction. Additionally, patient-specific characteristics such as Sanders stage may also play a role in brace correction, though their impact is not well defined. This study investigates the relationships between in-brace correction and non-modifiable patient specific characteristics.

Objective (s)

To examine whether in-brace correction correlates with major Cobb angle, curve apex age, sex, and Sanders stage. Our findings aim to clarify the predictive value of these variables, providing insights into optimizing brace treatment strategies.

Study Design

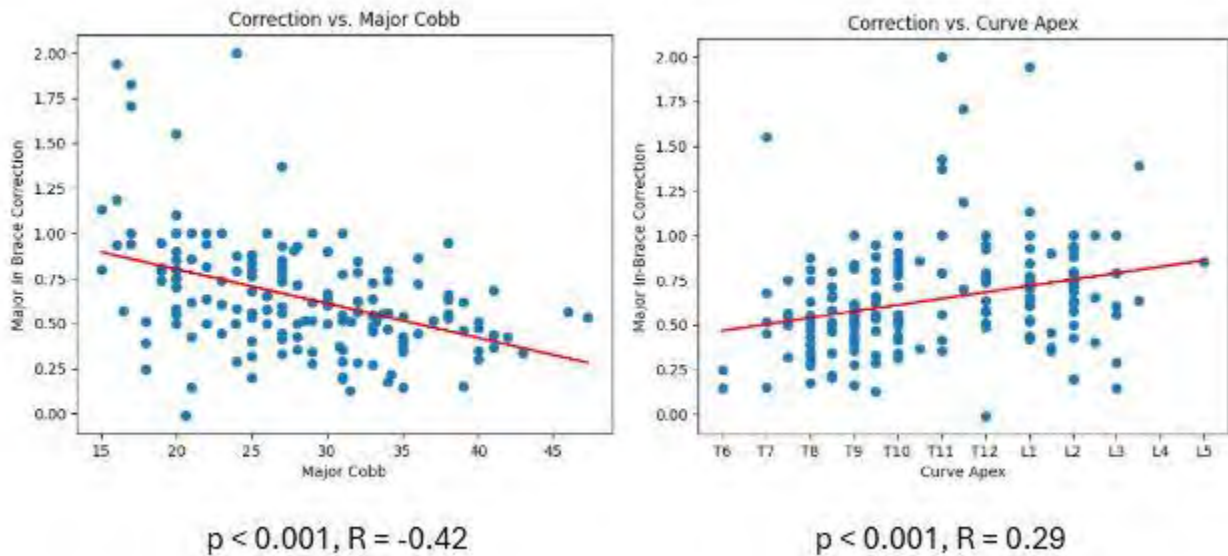
Retrospective Cohort

Methods

This retrospective study included 246 patients with idiopathic scoliosis treated with bracing at a single institution. Data was collected through chart review and included age at brace prescription, major Cobb angle, sex, curve apex, and Sanders stage. Pre-brace and in-brace X-rays were analyzed to determine the major Cobb correction percentage. Linear regression and t-tests were conducted to assess the relationship between in-brace correction and non-modifiable patient variables. A multi-linear regression was conducted to investigate the relationship between statistically significant variables.

Results

The cohort included 209 females and 36 males with an average age of 11.4 years (SD: 2.18) at prescription. The mean major Cobb angle was 28.21° (SD: 7.30) and the average in-brace correction was 64.76% (SD: 31.68). Linear regression showed that Cobb angle was inversely correlated with in-brace correction ($R = -0.42$, $p < 0.001$), indicating more correction for lower Cobb angles. Additionally, curve apex was found to be significantly correlated with in-brace correction ($R=0.29$, $p<0.001$), with more correction for lower apices. No significant correlation was observed for age ($p = 0.235$) or sex ($p = 0.98$), and ANOVA showed no relationship with Sanders stage ($p = 0.599$). A multi-linear regression found Cobb angle and curve apex to independently impact in-brace correction ($R=0.47$, $p<0.001$).



Conclusion(s)

This study highlights the inverse relationship between Cobb angle and in-brace correction in a large cohort of patients, consistent with current literature. In contrast, other non-modifiable factors, including sex, age, and Sanders stage were not significantly associated with correction. These findings suggest that skeletal maturity markers and demographic factors may have limited predictive utility for in-brace correction. Clinicians may find these insights valuable when setting treatment expectations and tailoring bracing strategies, emphasizing the importance of addressing modifiable factors such as brace design and compliance.

Clinical significance

These findings underscore the importance of considering Cobb angle as a key predictor of in-brace correction, while recognizing the limited utility of non-modifiable factors such as Sanders stage, age, and sex.

BRACE COMPLIANCE BEFORE IN-BRACE VISIT DOES NOT CONFOUND IN-BRACE CORRECTION

Omar Taha, Matthew Weintraub, Mehdi Elfilali, Chidebelum Nnake, John Tunney, Ritt Givens, Michael Vitale, Benjamin Royce

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Background

Brace wear time is a critical factor in brace treatment success. Brace wear adherence can be monitored with thermal sensors to ensure that patients are achieving adequate wear time during treatment. Another important factor is in-brace correction. While the relationship between wear time and treatment success is clearly established, the relationship between brace wear hours and the degree of in-brace correction at the initial in-brace visit has not been studied.

Objective (s)

To evaluate whether brace wear time during the initial adjustment period confounds the observed percentage of in-brace correction.

Study Design

Retrospective Cohort

Methods

A retrospective review identified 75 subjects with idiopathic scoliosis undergoing brace treatment at a single institution with available wear time data. All braces were fabricated by a single orthotist with over 10 years of experience. Average brace wear hours per day were calculated during the time period between brace delivery and the first in-brace visit using data from temperature-sensitive sensors embedded in the braces. The percentage of in-brace correction was calculated using pre-brace and in-brace radiographs. Linear correlation was performed to assess the relationship between compliance hours and percentage of in-brace correction.

Results

Our cohort consisted of 65 female and 10 male patients. At the time of brace prescription, the average patient age was 11.69 ± 1.80 years, and the average Cobb angle was $28.13^\circ \pm 6.90$. The mean brace wear time between prescription and first in-brace visit was 11.63 ± 4.42 hours, and the mean percentage of in-brace correction was $64.04\% \pm 28.47\%$. No statistically significant correlation was found between compliance hours and in brace-correction ($p = 0.18$).

Conclusion(s)

Brace wear compliance during the initial adjustment period did not significantly influence in-brace correction observed at the first in brace visit in our cohort. These findings suggest that short-term adherence does not confound in-brace correction outcomes. In other words, there does not seem to be a minimum level of compliance needed to accept the findings of the in-brace x-ray. This emphasizes that observed correction is likely a consequence of other factors, such as brace design, fit, and the patient's individual characteristics.

Clinical significance

Brace wear compliance during the initial adjustment period does not significantly affect in-brace correction outcomes. These findings suggest that factors such as brace design, fit, and individual patient characteristics may play a more substantial role in determining the degree of correction observed, rather than short-term wear time alone. This highlights the clinical importance of focusing on optimizing brace design and fitting techniques to achieve effective in-brace correction, regardless of early adherence levels.

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INCREASED LATERAL WAIST TO THORACO-LUMBAR HEIGHT RATIO CORRELATES WITH IMPROVED IN-BRACE CORRECTION

Matthew Weintraub, Omar Taha, Mehdi Elfilali, Chidebelum Nnake, John Tunney, Ritt Givens, Michael Vitale, Benjamin Roye

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Background

Bracing is the primary non-operative treatment for scoliosis, with effectiveness influenced by wear time and in-brace correction. Prior research identified spine flexibility and curve location as key predictors, while BMI showed no significant correlation. However, recent research suggests that alternative body shape metrics, such as the Body Roundness Index, may better capture health-related outcomes. This study hypothesizes that body habitus may play a role in bracing outcomes and seeks to quantify its impact using a novel measurement: the waist-to-thoracolumbar height (WH) ratio.

Objective (s)

Evaluate the relationship between WH ratio, in-brace correction, and BMI.

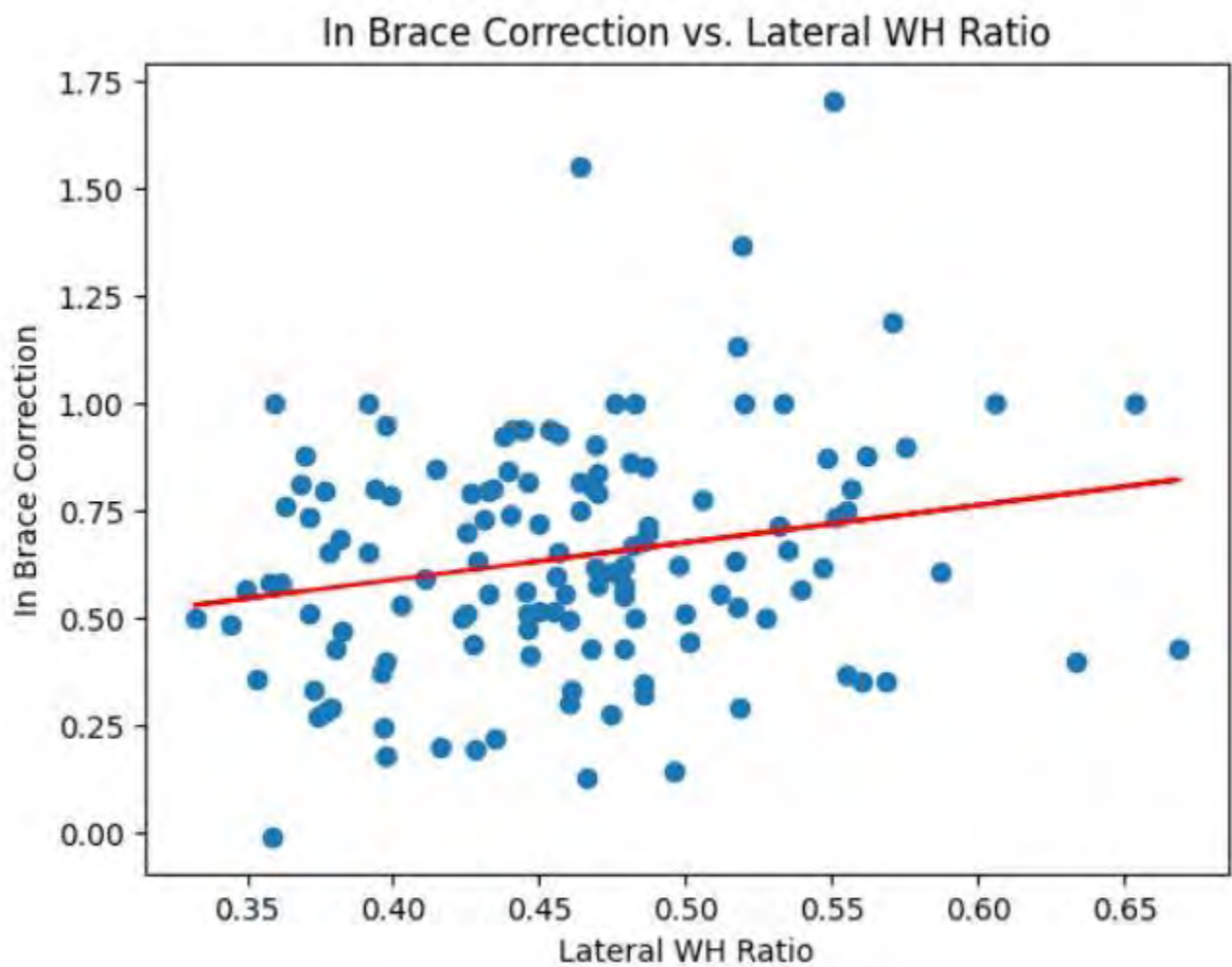
Study Design

Retrospective Cohort

Methods

209 female patients with idiopathic scoliosis treated with Rigo-style braces between 2014 and 2024 were identified. Collected data included age, BMI, Sanders stage, and Cobb angles at brace prescription and first in-brace X-ray. Thoracolumbar (TL) height was measured from the caudal endplate of L1 and the rostral endplate of T1. Waist width was measured as the soft tissue width over the iliac crest on both AP and lateral radiographs. TL height change was only determined for patients with pre-brace and in-brace X-rays taken at the same site and using the same X-ray machine type. Linear regression evaluated the relationships between in-brace correction and three variables: BMI, waist-to-height ratios, and TL height change.

Results



$$b = 0.8687, P = 0.014, R^2 = 0.046$$

The mean age of our cohort at brace prescription was 11.4 ± 2.1 years, BMI 17.73 ± 2.77 , and pre-brace Cobb angle $28.2^\circ \pm 7.30^\circ$, with an average in-brace correction of $64.8\% \pm 31.58\%$. The mean AP and lateral WH ratios were 0.68 ± 0.07 and 0.46 ± 0.07 , respectively. AP and lateral WH ratios correlated positively with BMI (AP: $p < 0.001$, $R = 0.47$; Lateral: $p < 0.001$, $R = 0.37$). Lateral WH ratio also correlated positively with in-brace correction ($p = 0.014$, $R = 0.21$), while BMI and AP ratio did not show a statistically significant relationship with in-brace correction. Among 47 patients with same-site pre- and in-brace imaging, height change trended positively but was not statistically significant ($p = 0.30$, $R = 0.155$).

Conclusion(s)

While BMI has been previously explored as a predictor of in-brace correction, its utility is inherently constrained by its inability to account for the unique proportions of each patient's anatomy. This study introduces the lateral WH ratio as a novel metric that correlates with in-brace correction, providing new insights into body habitus and bracing outcomes. The positive correlation suggests higher lateral ratios may enhance in-brace correction, potentially due to an increased capacity for elongation during bracing, which aligns with the principles of Rigo bracing. These findings also highlight the need for further exploration of sagittal parameters to optimize bracing strategies.

Clinical significance

This study introduces a novel lateral WH ratio as a predictive tool for brace efficacy, shedding light on lateral parameters and body habitus in bracing.

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IN BRACE CORRECTION VARIES BY RIGO CURVE TYPE

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Background

Bracing success in scoliosis management depends on wear time and in-brace correction. Previous research indicates that curve location (thoracic, lumbar, or thoracolumbar) may play a role in in-brace correction, with thoracolumbar and lumbar curves generally experiencing better outcomes. We hypothesize that the Rigo curve classification will also impact in-brace correction and offer insight into how patient-specific anatomy influences in-brace correction.

Objective (s)

Evaluate in-brace correction across various Rigo curve classification types.

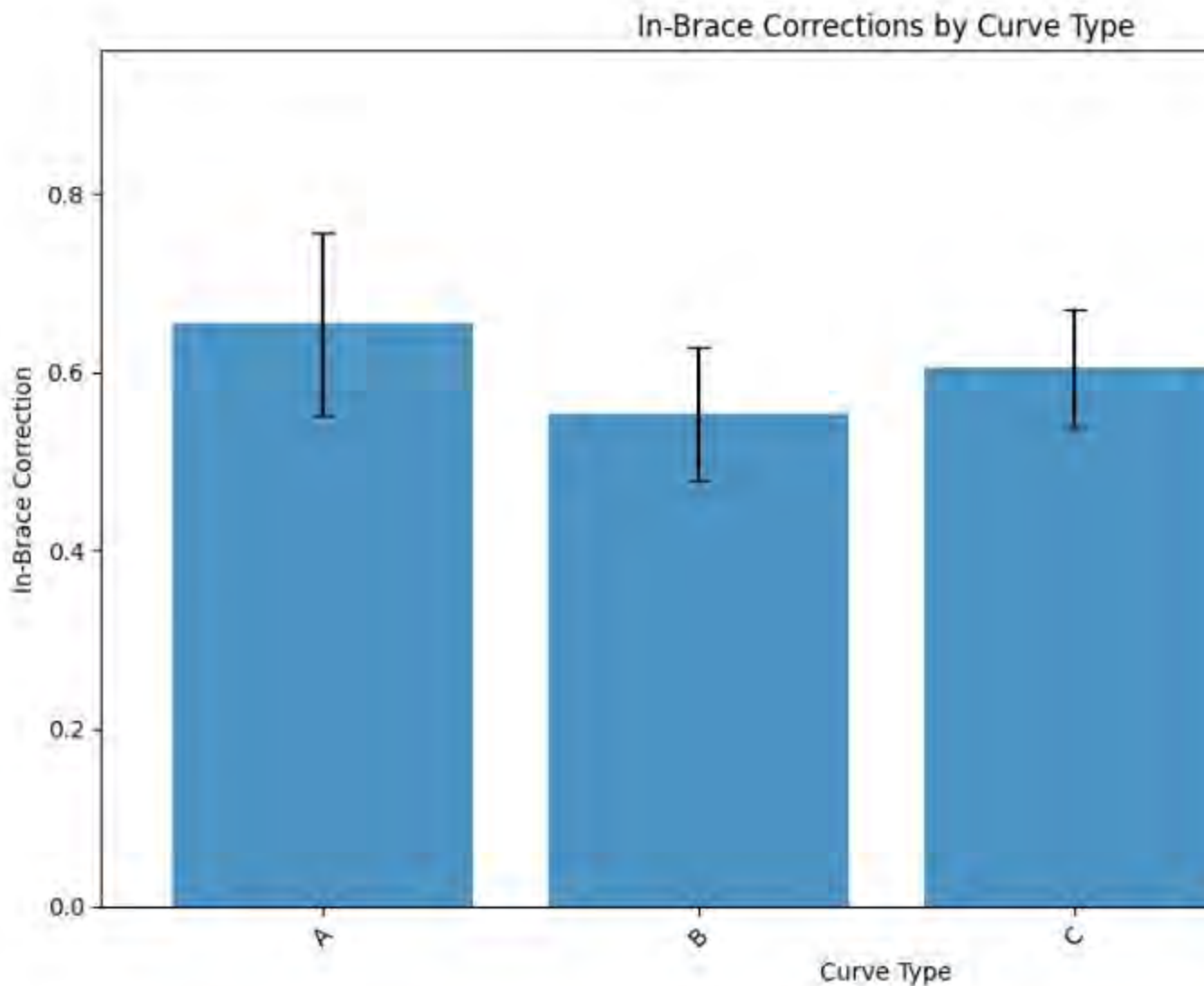
Study Design

Retrospective Cohort

Methods

This retrospective study included 183 patients with idiopathic scoliosis treated with Rigo-style braces from 2014 to 2024, all fabricated by a single orthotist with over 10 years of experience. Data collected included age, sex, BMI, Sanders stage, and major Cobb angles at brace prescription and first in-brace X-ray. Major Cobb correction was calculated as $[\text{pre-brace Cobb} - \text{in-brace Cobb}] / \text{pre-brace Cobb} \times 100\%$. Each curve was classified into one of the Rigo types (A1, A2, A3, B1, B2, C1, C2, E1, E2) and grouped by 'parent' types (A, B, C, E). "A" types are characterized by three-curve patterns, "B" by four-curve patterns, "C" by balanced thoracic curves, and "E" as single lumbar/thoracolumbar curves. ANOVA and post-hoc analyses were performed to assess the impact of curve type on in-brace correction.

Results



The cohort comprised of 157 females and 26 males with an average age of 11.49 ± 2.04 years at brace prescription. The mean pre-brace Cobb angle was $28.13^\circ \pm 7.23^\circ$ and the average in-brace correction was $65.13\% \pm 31.33\%$. The number of patients with type A, B, C, and E curves were 49, 32, 64, and 38 respectively. There were no differences in age, Sanders, and BMI amongst curve types, but there were differences in mean Cobb angles between groups (A: 29.97° , B: 32.67° , C: 27.06° , E: 24.18° , $p < 0.001$). ANOVA showed different in-brace correction with respect to curve type ($p = 0.003$). Post-hoc analysis with adjustment for multiple comparisons identified a significant difference between curve types B and E (55.38% vs. 80.66% , $p = 0.0036$) as well as between C and E (60.55% vs. 80.66% , $p = 0.0079$). Analysis of curve type while controlling for Cobb angle confirmed statistical significance between in-brace correction and curve type ($p = 0.036$).

Conclusion(s)

In brace correction varies across Rigo curve types, with type E curves achieving the highest average correction and type B and C curves achieving the least. Despite these variations, all curve types achieved therapeutic correction levels, underscoring the ability of an experienced orthotist to optimize brace outcomes, regardless of curve type. Future research should explore the biomechanical factors driving these differences to further refine bracing construction.

Clinical significance

The findings highlight the utility of the Rigo curve classification in predicting in-brace correction and informing patient counseling on expected outcomes.

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RELATIONSHIP BETWEEN BRACE WEARING COMPLIANCE ON CURVE DETERIORATION AND SURGERY RATES IN PATIENTS WITH ADOLESCENT IDIOPATHIC SCOLIOSIS

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Background

The effectiveness of brace treatment in adolescent idiopathic scoliosis (AIS) depends significantly on patient compliance to prescribed wearing times.

Objective (s)

To evaluate the impact of brace-wearing compliance on the need for surgical intervention and identify a compliance threshold for improved outcomes.

Study Design

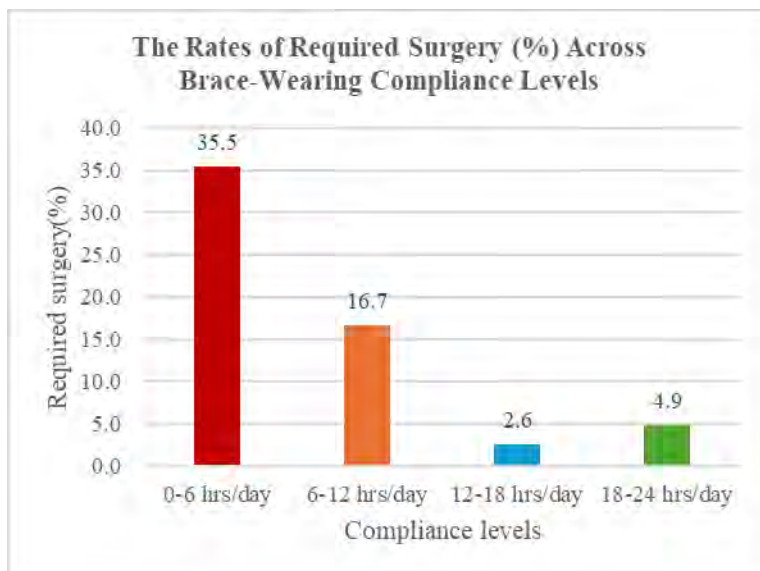
A retrospective cohort study

Methods

This study included a total of 331 AIS patients, who underwent brace treatment and were monitored until skeletal maturity or until spinal surgery was recommended or performed. Brace-wearing compliance, as reported by patients and their families and documented by physicians during follow-ups, was categorized into four intervals: 0–6, 6–12, 12–18, and 18–24 hours per day. Surgery requirements were defined as Cobb angle progression to $\geq 50^\circ$ or scheduled/performed spinal surgery. Statistical analyses compared surgery rates across compliance levels and assessed actual brace-wearing times between surgery and non-surgery groups.

Results

The average daily brace-wearing time among all patients was 14.0 ± 5.6 hours. Out of 331 patients, 35 (10.6%) experienced curve deterioration to over 50° or underwent surgery, with an average compliance of 9.1 ± 5.4 hours per day. In contrast, patients who did not require surgery ($n = 296$) had an average compliance of 14.6 ± 5.3 hours per day. Surgery rates were highest among those in the 0–6 hour (35.5%) and 6–12 hour (16.7%) compliance groups, while significantly lower rates were observed in the 12–18 hour (2.6%) and 18–24 hour (4.9%) groups. Patients who adhered to wearing their braces for at least 12 hours per day showed significantly reduced surgery rates and less curve progression compared to those who wore braces for fewer than 12 hours per day. Notably, there was no significant difference in surgical rates between patients wearing braces for 12–18 hours and those wearing them for 18–24 hours daily, suggesting that 12 hours per day may be a potential minimum effective compliance threshold.



Conclusion(s)

Consistent brace wearing for 12 or more hours daily significantly reduces the likelihood of curve deterioration to 50° and surgical intervention in AIS patients. These findings underscore the importance of adherence to brace prescriptions and identifying 12 hours as an effective minimum compliance threshold.

Clinical significance

These findings highlight the importance of patient compliance and establish 12 hours/day as an effective minimum compliance threshold for successful brace treatment.

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Background

The wide variety of generic braces correlates with the diverse range of scoliosis, yet this diversity often complicates therapeutic decisions. It is, therefore, more pragmatic to categorize braces based on their mechanisms of action.

Objective (s)

This study aims to identify and classify these mechanisms into three categories: passive, active, and secondary.

Study Design

Qualitative analysis was used to group and simplify the various mechanisms of action.

Methods

To achieve this, a comprehensive and systematic review of existing literature in both English and French was conducted, utilizing databases such as MEDLINE, the COCHRANE Library, and GOOGLE SCHOLAR.

Articles were considered for inclusion if they discussed the biomechanics of braces, while those focused on modeling the scoliotic spine were excluded. In total, 1,393 articles were identified from the English-language literature. Out of these, 260 articles were retained because they addressed at least one mechanism of action of the brace. Additionally, 22 pertinent articles were sourced from French literature, culminating in 282 articles. After removing duplicates, 69 articles were found to highlight 24 mechanisms of action: comprising 12 passive, 6 active, and 6 secondary.

Results

Passive is a mechanism that performs its functions without recourse to an external energy source. In the initial section, 38 articles pertain to passive mechanisms (table 1).

	Passive mechanisms of action	
1	Rib-cage/spine coupling patterns [T2-T10]	Convex correctiong contact Concave expansion or not
2	Concave to convex tissue transfer [under T10]	Concave expansion/ Concave wall (push-up) / Concave iliac plateau (lifting)
3	3D plane geometry with apical derotation	Flexion / translation Derotation through convexity or concavity
4	3D sold geometry with detorsion	Hyperboloid Geometrical & Mechanical detorsion by coupled movements

5	3 points or derotating force couple	One Force and two counterforces applied proximally and distally to the first one
6	Z axis elongation or coupled movements	Translation along the Z axis
7	Bending global or regional	For one or two curves with or without girdles
8	Lumbar Lordosis or delordosis	Derotation with lordosis Sagittal push-up with delordosis & pelvic grip
9	Mobility inside the brace	Neck ring – Soft tissue Oriented Sliding Escape Pads
10	Unloading	(Composite beam law) Maximum surface contact
11	Apical nucleus recentering	Night hypercorrecting braces < 11 years
12	Sagittal normalization	Isostatic balance / pelvic incidence

Conclusion(s)

Generic braces are a testament to the geographical schools of thought and research experiences from which they originate. They exemplify the selection of action mechanisms. Certain mechanisms have become feasible due to advances in plastic materials and the implementation of CAD/CAM technology.

Clinical significance

The ideal brace remains nameless, as it represents a balanced choice of action mechanisms, striving for a compromise between effective three-dimensional correction and patient tolerance.

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A SYSTEMATIC REVIEW AND SYNTHESIS OF DIFFERENT MECHANISMS OF ACTION FOR SCOLIOSIS BRACES IN ENGLISH AND FRENCH LITERATURE (PART 2: ACTIVE & SECONDARY)

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Background

The wide variety of generic braces correlates with the diverse range of scoliosis, yet this diversity often complicates therapeutic decisions. It is, therefore, more pragmatic to categorize braces based on their anatomical-physiological mechanisms involved in the correction of scoliotic curves.

Objective (s)

After studying passive mechanisms, this study aims to identify and classify active and secondary mechanisms of action.

Study Design

Qualitative analysis was used to group and simplify the various mechanisms of action.

Methods

To achieve this, a comprehensive review of existing literature in both English and French was conducted, utilizing databases such as MEDLINE, the COCHRANE Library, and GOOGLE SCHOLAR.

Articles were considered for inclusion if they discussed the biomechanics of braces, while those focused on modeling the scoliotic spine were excluded. In total, 1,393 articles were identified from the English-language literature. Out of these, 260 articles were retained because they addressed at least one mechanism of action of the brace. Additionally, 22 pertinent articles were sourced from French literature, culminating in 282 articles. After removing duplicates, 69 articles were found to highlight 24 mechanisms of action: comprising 6 active, and 6 secondary.

Results

Active is a mechanism performing its functions in the opposite direction of the usual mechanism. Secondary is a non-operative mechanism, not part of the core action.

In this second section, 31 articles pertain to active and secondary mechanisms, including:

	Active mechanisms of action	
13	Vertebral growth modulation	In-brace correction > 50%
14	Rebalance stress distribution	Mirror technique
15	Active body pulling against gravity	Neck ring / Shoulder corkscrew effect
16	Active pushing / Breathing mobilization	Contact during breathing
17	Elastic forces or levers	Actuators
18	Ponseti-type intervention	Serial casting Progressive correction adjustable braces
	Secondary mechanisms of action	
19	Vital capacity	Thoracic growth Tubular thorax
20	Material / Tolerance	Rigidity - Resistance / Shock absorber QOL
21	Opening / closure	Anterior / Posterior (sagittal push-up) Velcro / Strap / Ratchet

22	Gait modification	Speed / Cadence / energy cost Stride length / Gait load asymmetry
23	Management	Plastic deformation Elastic deformation Progressive weaning for bone mass
24	Monitoring	Compliance

Conclusion(s)

Generic braces are a testament to the geographical schools of thought and research experiences from which they originate. They exemplify the selection of action mechanisms. Certain mechanisms have become feasible due to advances in plastic materials and the implementation of CAD/CAM technology.

Active mechanisms involve a fourth dimension, which is time. Secondary mechanisms can be both negative and positive. The challenge for the CPO is to choose the most appropriate mechanisms of action to build a brace adapted to each scoliosis.

Clinical significance

The ideal brace remains nameless, as it represents a balanced choice of action mechanisms, striving for a compromise between effective three-dimensional correction and patient tolerance.

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REPEATABILITY OF DIGITAL SCOLIOSIS BRACE RECTIFICATION: THE EFFECT OF BRACE DESIGN, CURVE TYPE, AND THE USE OF TEMPLATES

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Background

Adolescent idiopathic scoliosis (AIS) affects up to 5% of adolescents aged 11–18 and is commonly managed with spinal braces. Advances in CAD/CAM have streamlined brace fabrication, but rectification consistency remains underexplored. Identifying factors influencing repeatability may enable clinical workflows to be optimised and brace quality to be improved.

Objective (s)

To assess the repeatability of CAD/CAM rectifications using template-based and non-template-based methods for three brace designs (Rigo Cheneau, Boston, and Boston Night Shift) and three Lenke curve types (1, 2, and 5).

Study Design

A retrospective secondary analysis of CAD/CAM rectifications was conducted using data from three AIS patients with three Lenke curve types. Each patient underwent rectifications for three brace designs. For each brace design, three template-based and three non-template-based rectifications were performed. This resulted in 24 total rectifications.

Methods

Shape deviations between each rectification and its subsequent 3D scan were analysed using AmpScan software. Maximum shape deviations, total volume, and torso cross-sectional area (CSA) measurements were also compared between repeat rectifications.

Results

Template-based methods demonstrated better repeatability than non-template methods across all braces. For Boston template rectifications, the mean deviation was 25.09 mm (range: 4.07 mm), compared to 29.80 mm (range: 5.77 mm) for non-template methods, showing a 15.8% improvement. For Boston Night Shift rectifications, templates increased repeatability to a range of 0.28 mm compared to 0.77 mm for non-templates. Lenke 5 curves were the most consistent overall, particularly with Boston template rectifications (range: 0.28 mm). Lenke 1 and Lenke 2 curves had lower repeatability, with Lenke 2 showing the largest mean deviation (52.33 mm, range: 9.98 mm). Among braces, Boston templates demonstrated the highest repeatability, while Rigo Cheneau non-template rectifications showed the lowest, particularly for Lenke 1 curves (mean: 45.06 mm, range: 12.08 mm).

Conclusion(s)

Template-based approaches help improve repeatability compared to non-template methods across Rigo Cheneau, Boston, and Boston Night Shift rectifications. Boston templates demonstrated the highest repeatability, while Rigo Cheneau rectifications were less consistent. Lenke 5 curve rectification was more repeatable than Lenke 1 and 2 curves, highlighting an area for orthotists to focus on in the future.

Clinical significance

CAD/CAM rectifications were highly repeatable but varied with templates, curve types, and brace designs. Orthotists should consider these factors to ensure consistent rectification strategies.

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COMPLIANCE AND TREATMENT OUTCOMES OF A NOVEL SEMI-RIGID BRACE FOR ADOLESCENT IDIOPATHIC SCOLIOSIS: MULTICENTER PROSPECTIVE TRIAL WITH A MINIMUM 2-YEAR FOLLOW-UP

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Background

Brace treatment is one of the most effective conservative treatments for adolescent idiopathic scoliosis (AIS). However, patient compliance with brace use is often low. An effective brace that enhances adherence is essential. To address this, we developed a semi-rigid brace for AIS. This brace features a unilateral trunk cuff made of plastic and a fabric pad with a dial-fitting system. It is available in both lumbar and thoracic designs (Figure 1). While mid-term outcomes for correction rates and compliance have been promising (Hirata K, *ISLS* 2023), long-term treatment outcomes have not been thoroughly investigated.

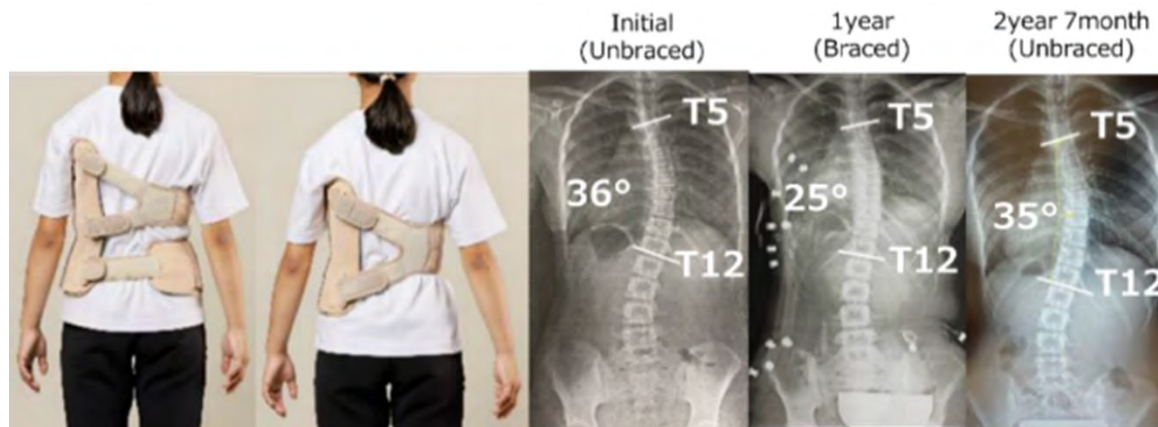


Figure 1. Appearance of the semi-rigid brace (left: Thoracic type; 2nd from left: Lumbar type) and case presentation of a 12-year-old girl (middle: Initial; 2nd from right: 1-year follow-up; right: Final follow-up).

Objective (s)

This study aimed to evaluate compliance and treatment outcomes of the semi-rigid brace for AIS, with a minimum 2-year follow-up.

Study Design

Multicenter prospective observational study.

Methods

Forty-nine AIS patients who completed brace treatment or were followed for at least two years were included. Inclusion criteria: age 10–15 years, Cobb angle of 25 - 40°, Risser sign 0 - 2, pre-menarche or within one year after menarche, and single-curve pattern. A monitoring system embedded in the brace measured wearing time during the first year. Treatment outcomes were categorized as follows:

1.Improved: Cobb angle decreased by $\geq 6^\circ$.

2.Unchanged: $\leq 5^\circ$ change in Cobb angle.

3.Progressed: Cobb angle increased by $\geq 6^\circ$.

The Wilcoxon signed-rank test was used to compare initial and final Cobb angles without the brace.

Results

Forty-nine patients (19 thoracic and 30 lumbar/thoracolumbar curves; Mean age of 12 year old) participated, with a mean follow-up period of 2 years and 9 months. The initial Cobb angle was $30.3^\circ \pm 5.1^\circ$; after bracing, it was $17.2^\circ \pm 7.8^\circ$ (initial correction rate: 43.3%). At the final follow-up without the brace, the mean Cobb angle was $29.8^\circ \pm 11.7^\circ$ ($p=0.148$), indicating maintenance of the curve.

Outcomes were as follows: 13 cases improved, 28 unchanged, and 8 progressed, yielding a success rate of 83.7%. Mean wearing time in the first year was 16.2±6.7 hours/day.

Conclusion(s)

The semi-rigid brace demonstrated high initial correction rates, adequate wearing time, and high adherence, effectively preventing curve progression in AIS patients.

Clinical significance

This study highlights the potential of the semi-rigid brace as a novel treatment option for AIS.

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IMPROVEMENT IN CORONAL AND SAGITTAL BALANCE AND STABILIZATION OF COBB ANGLE IN ADULT DE NOVO DEGENERATIVE SCOLIOSIS USING SCOLIBRACE®. A CASE SERIES

Rosemary Mirenzi (formerly Marchese), Nora-Lee Doueihi, Juan Du Plessis, Jeb McAviney

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Background

Primary degenerative scoliosis represents a new scoliosis developing in patients with no prior history of spinal curvature, and is characterized by asymmetric intervertebral disc and facet joint degeneration. This combination can lead to coronal and sagittal spinal imbalance potentially resulting in severe pain, neurological deficits and impaired function, thus significantly reducing the quality of life. Primary degenerative scoliosis has an average progression rate of 3 degrees per year which can further exacerbate deterioration of spinal balance. This case series investigates the use of ScoliBrace® as a non-surgical treatment approach of adults with primary degenerative scoliosis.

Objective (s)

To report the outcomes of the use of ScoliBrace® in five patients with primary degenerative scoliosis.

Study Design

Case series

Methods

A cohort of 5 patients with progressive primary degenerative scoliosis, aged 64-83 years, were prescribed a full length standard ScoliBrace® (ScoliCare Pty Ltd. Sydney, Australia). The patients were prescribed a part-time bracing regime, averaging between 4-8 hours per day in the ScoliBrace®. Every ScoliBrace® was custom made for the individual by a dedicated design team and Computer-Aided Design and Manufacturer. The treatment approach lasted at least 12 months, with follow-up appointments at the 1 month (in-brace X-ray and fit check), 3 month, 6 month and 12 month mark. Out-of-brace Cobb angles, coronal balance, sagittal balance were measured at the initial, 6 month and 12 month follow-up appointments. These standardised measurements were analysed to determine the effectiveness of the ScoliBrace® in the management of coronal balance, sagittal balance and Cobb angle primary degenerative scoliosis over 12 months.

Results

The Cobb angles were stabilized in all five patients (100%) over the 12 month treatment period. Coronal balance was improved or stabilized in all five (100%) patients. The sagittal balance was improved or stabilized in all 5 (100%) patients. TRACE score improved in 4 out of 5 (80%) patients and with no change in 1 of the 5 patients.

Conclusion(s)

Cobb angle was stabilized, and coronal balance improved in all patients with primary degenerative scoliosis that used the ScoliBrace®. Sagittal balance and TRACE scores were improved in most patients with primary degenerative scoliosis that used the ScoliBrace®.

Clinical significance

The ScoliBrace® may provide a useful treatment option for patients with primary degenerative scoliosis for improving coronal and sagittal balance and stabilization of Cobb angles. This has the potential to reduce pain levels, and improve function and quality of life of patients with primary degenerative scoliosis and should be further investigated in future research.

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TREATMENT AND LONG-TERM FOLLOW-UP OF JUVENILES WITH IDIOPATHIC SCOLIOSIS USING SCOLIBRACE®. A CASE SERIES

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Background

Juvenile Idiopathic Scoliosis (JIS) is characterized by abnormal curvature of the spine in children between the ages of 3 and 9. JIS is a highly progressive condition exacerbated by growth (1). JIS greater than 30 degrees has been shown to increase rapidly and presents a 100% prognosis for surgery (1), emphasising the need for active treatment and management. This case series investigates the use of ScoliBrace® as a non-surgical treatment approach of Juveniles with idiopathic scoliosis.

Objective (s)

To report the long term outcomes of the use of ScoliBrace® in five Juvenile patients with Idiopathic Scoliosis classified as double or triple curves, with a primary right thoracic curve.

Study Design

Case Series

Methods

A cohort of 5 patients with JIS, aged 5-9, were prescribed a ScoliBrace® (ScoliCare Pty Ltd. Sydney, Australia) for the treatment of JIS. All patients in this case series were prescribed a full-time bracing protocol (20-23 hours per day). Over the course of treatment, bracing hours were reduced based on findings regarding individual patient's growth status (Risser sign, hand X-ray, change in height). Every ScoliBrace® was custom made for the individual by a dedicated design team and Computer-Aided Design and Manufacturer. Patients were braced for 3-8.5 years (average = 6.6 years), with follow-up appointments on a 3-monthly basis. Patients were monitored for a minimum of 5 years (5-10 year range). Out-of-brace X-rays, postural images and Angle of Trunk Rotation (ATR) measurements from yearly timestamps have been collected for this case series.

Results

Cobb angle improved in all 5 patients with JIS. The primary right thoracic curves reduced from an average Cobb angle of 32.8 degrees to 14.2 degrees (average 57% reduction). Lumbar curves, either secondary or tertiary in nature, reduced from an average of 22.6 degrees to 6 degrees (73% reduction average). Upper thoracic curves, either secondary or tertiary, were initially present in 2 out of 5 patients. These curves reduced from an average of 27 degrees to 23 degrees (average 15% reduction) and 2 patients developed a mild compensatory upper thoracic curve throughout the treatment. ATR in the primary thoracic region reduced in all five patients from an average of 13.8 degrees to 6.2 degrees (average 55% reduction) in the long term follow-up (minimum 5 years).

Conclusion(s)

Treatment of JIS using the ScoliBrace® resulted in a reduced Cobb angle at all spinal regions. ATR measurements at the level of the primary right thoracic curve was reduced in all patients using the ScoliBrace®.

Clinical significance

The ScoliBrace® may provide a useful treatment option for patients with JIS with double or triple curve classifications. ScoliBrace® treatment has the potential to improve Cobb angles and ATR in Juvenile patients with idiopathic scoliosis. This should be further investigated in future research

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ENHANCED SCOLIOSIS CORRECTION: THE SYNERGISTIC POWER OF PSSE COMBINED WITH AN ASYMMETRIC SCOLIOSIS BRACE IN ADOLESCENCES

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Background

In-brace correction (IBC) is a key predictor of successful bracing outcomes in idiopathic scoliosis, with higher IBC linked to improved out-of-brace Cobb angle correction. Factors limiting IBC include residual curve stiffness, suboptimal brace design, high BMI, non-compliance, and curve characteristics. Physiotherapeutic Scoliosis-Specific Exercises (PSSE) are reported to improve curve flexibility.

Objective (s)

This study investigates the impact of PSSE on IBC.

Study Design

This retrospective study analysed data from 54 patients with complete records over a 3-month period.

Methods

Patients were grouped into those receiving bracing only (n=25) and those receiving bracing combined with PSSE (n=29). All participants met SRS criteria for bracing and were fitted with their first scoliosis brace. All braces were assessed, modelled, and fit by a sole orthotist to ensure consistency. Skeletal correction was assessed using in-brace radiographs, with the primary outcome being the percentage reduction in Cobb angle. PSSE programmes were individually tailored to the patient's curve pattern and delivered by certified therapists, comprising up to 10 hours of face-to-face sessions and home exercises of 30 minutes, 4-5 times per week.

Results

Preliminary analysis showed the bracing plus PSSE group achieved greater IBC compared to the bracing-only group, with mean Cobb angle reductions of 88% and 75%, respectively. The results suggest that PSSE combined with asymmetric bracing enhances spinal flexibility and correction beyond bracing alone. Ongoing research will expand sample size to confirm statistical credibility of these findings and provide a clearer understanding of observed differences.

Conclusion(s)

Both groups benefited from bracing, but the addition of PSSE appeared to yield superior in-brace correction, suggesting PSSE as a valuable adjunct to bracing. This work supports the belief that PSSE may help address residual curve stiffness. Further research involving a larger sample size is required to validate these findings and explore the long-term effects on reduction/management of scoliosis progression.

Clinical significance

The clinical significance of these results lies in the potential to improve treatment outcomes for adolescents with idiopathic scoliosis. The combination of Physiotherapeutic Scoliosis-Specific Exercises (PSSE) with asymmetric bracing demonstrated enhanced in-brace correction (IBC) compared to bracing alone. Higher IBC is a strong predictor of improved long-term outcomes, including better out-of-brace Cobb angle correction and a reduced risk of scoliosis progression. By incorporating PSSE, clinicians may address factors like residual curve stiffness and enhance spinal flexibility, ultimately offering patients a more effective, holistic treatment approach. These findings could inform clinical protocols and encourage the integration of PSSE into standard scoliosis bracing care to optimise outcomes for adolescent patients.

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BRACE TREATMENT FOR IDIOPATHIC SCOLIOSIS IS A COMPLEX MULTIMODAL INTERVENTION: A DELPHI STUDY USING THE COCHRANE REHABILITATION “GUIDE-REHAB” REPORTING GUIDELINE

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Background

Current research indicates considerable variation in the effectiveness of brace treatment. Compliance could be a reason, but few studies focused on methods to increase it (Negrini 2024). Understanding of brace treatment in SOSORT grew through qualitative studies: consensus was absent on biomechanical actions (Rigo 2005), but existed on how to manage patients (Negrini 2009), confirming that factors other than “the brace” play a major role. A

possible way forward could be considering bracing as a complex intervention (UK Medical Research Council 2021). Cochrane Rehabilitation developed the Guideline for Interventions Description in Rehabilitation (GUIDE-Rehab) (Negrini 2024) as a tool to open the so-called “black box” of rehabilitation complex interventions that could offer a framework to describe the bracing practice.

Objective (s)

To describe the brace treatment as a complex intervention using GUIDE-Rehab.

Study Design

This is the first part of a mixed-methods qualitative study within a tertiary-level scoliosis outpatient institute, including Delphi rounds (Part I) and focus groups with final consensus (Part II).

Methods

We inquired all expert physicians, physiotherapists, motor scientists and psychologists working in our Institute (73 potential participants). The whole project includes:

Part I – Delphi Study (December 2024):

- First Round to identify the treatment targets (definition: *“a measurable aspect of the functioning or contextual factors hypothesised to be directly changed by the active ingredients of the intervention”*);
- Second Round to identify the 3 most common targets’ ingredients (definition: *“a constituent of the intervention responsible alone or with other ingredients for the therapeutic action”*).

Part II – Final GUIDE-Rehab description (February 2025):

- Focus Groups to identify all GUIDE-Rehab elements (treatment and components theories; ingredients quantity, tailoring, and quantity changes).
- Consensus Conference.

After each Delphi Round, we grouped the answers through a nominal data analysis and an Artificial Intelligence (AI) analysis using ChatGPT 4.0.

Results

We had 53 (response rate 75%) and 57 (78%) participants in the Delphi Rounds. Both analyses provided the following targets (% of respondents): aesthetic improvement (53%), compliance (40%), psychological well-being and quality of life (36%), scoliosis reduction (23%) and stabilisation (15%). AI analysis added postural control (34%), fitness and functioning (26%),

education and self-consciousness (21%) and therapeutic alliance (25%). The table reports the ingredients we identified for the three most common targets.

Table. Main ingredients of the 3 main targets proposed by participants

Aesthetic improvement				Adherence to treatment			
AI analysis		Nominal analysis		AI analysis		Nominal analysis	
Construction and design of the brace	52%	Strengthening and postural symmetrical exercises	27%	Patient communication and engagement	40%	Shared decision making	
Specific exercises	33%	Body-shaped brace construction	21%	Motivation and emotional support	23%	Motivational talks at each encounter with professionals	
Monitoring	27%	Brace symmetry	19%	Education and information	21%	Brace invisibility and comfort	
Patient education and awareness	27%			Monitoring and progress feedback	15%	Medical brace check for invisibility, comfort and correction	
Use and maintenance of the brace	21%			Team and collaboration	15%	Compliance tools	
Motivation and psychological support	19%						
Effective communication	6%						
Family support	2%						

Conclusion(s)

The targets identified by the experts show that brace treatment is a complex multimodal intervention. Phase II will allow us to describe it completely within our Institute.

Opening the black box of the different brace schools could explain the variety of clinical results with the presence/absence of some treatment components. A similar process with a SOSORT Consensus would define international standards and identify new research areas.

Clinical significance

Although complex, the exercise of identifying targets and ingredients allowed us to better focus clinically on some treatment components rarely described and consequently underestimated.

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A MULTIMODAL NON-SURGICAL APPROACH TO PRIMARY THORACOLUMBAR ADOLESCENT IDIOPATHIC SCOLIOSIS: A CASE SERIES

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Background

Adolescent Idiopathic Scoliosis (AIS) is abnormal curvature of the spine in children aged between 10 and 18. AIS is a progressive condition driven by growth. Adolescents with idiopathic scoliosis may wish to explore treatment options to manage the curve during their growth period to prevent progression to a surgical threshold. This case series investigates the effectiveness of a multimodal, non-surgical approach for the management of double curve scoliosis in adolescents with idiopathic scoliosis with a primary left thoracolumbar and secondary right thoracic curve.

Objective (s)

To report the outcomes of a multimodal, non-surgical approach in 6 AIS double curves, with a primary left thoracolumbar and secondary right thoracic curve.

Study Design

Case series.

Methods

A cohort of 6 adolescents, aged 12-16 years, with idiopathic scoliosis with primary thoracolumbar and secondary thoracic curves, were prescribed the following; Intensive supervised exercise rehabilitation (combination of Scolibrace[®], CLEAR[™] therapy and CLEAR[™] exercises) for 2 weeks prior to brace arrival, 21 hours of brace wear using the Scolibrace[®] and 1 hour of home exercise rehabilitation per day. Every Scolibrace[®] was custom made for the individual by a dedicated design team and Computer-Aided Design and Manufacturer. Patients were re-evaluated 2 weeks after starting the protocol and followed-up on a 3-monthly basis. Intensive exercise protocols were implemented 6-monthly and brace modifications were made as individually required. Patients adhered to the 21 hours of daily brace wear for an average of 21 months and were weaned from treatment when curves stabilised or improved.

Results

Cobb angle improved (>5 degree reduction) in all 6 patients. The primary left thoracolumbar curves reduced from an average Cobb angle of 34.5 degrees to 16 degrees (average 54% reduction). Secondary right thoracic curves reduced from an average of 22.3 degrees to 18 degrees (28.3% reduction average). ATR in the primary thoracolumbar region reduced in all 6 patients from an average of 7.5 degrees to 2.3 degrees (average 69.3% reduction). Overall Trunk Aesthetic Clinical Evaluation (TRACE) scores reduced from an average of 9.7 to 4.5 (average 54% reduction).

Conclusion(s)

Treatment of double curves in adolescents with a primary left thoracolumbar and secondary right thoracic scoliosis using a multimodal, non-surgical approach resulted in reduced Cobb angles. ATR of the primary thoracolumbar curves reduced and TRACE scores improved in all 6 patients.

Clinical significance

This multimodal, non-surgical approach may provide a useful treatment option for patients with AIS with a primary thoracolumbar and secondary right thoracic curve presentation. This approach has the potential to improve Cobb angles, ATR and TRACE scores in adolescent patients with idiopathic scoliosis. Additional research should be conducted to further assess the effectiveness of this protocol.

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ANALYZING THE USE OF CONSERVATIVE TREATMENT IN AIS PATIENTS WHO HAVE LARGE CURVES TO AVOID THE SURGICAL THRESHOLD

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Background

This is the second in a series of independent analyses that evaluate the career-long patient database of a single clinician at a single institution. The second inquiry looks at the effectiveness of bracing in treating Adolescent Idiopathic Scoliosis based on the Cobb angle when bracing is initiated, with specific interest in when the Cobb angle has already reached 40 degrees.

Objective (s)

To compare the effectiveness of the ART brace in controlling or improving Cobb Angle in patients with AIS when starting treatment on curves above and below 40 degrees.

Study Design

This longitudinal analysis of 902 consecutive adolescents treated with the ART brace between 2013 and 2018 includes at least 5 years of treatment and follow up data.

Methods

After IRB approval and de-identification of the patient database, 902 consecutive patients with AIS that were treated with the ART brace were evaluated by an independent team of researchers. Radiographs measured Cobb angle prior to brace treatment. Follow up radiographs measured Cobb angle in brace, during treatment, and 2 years after weaning from the brace. Brace effectiveness was assessed by the Cobb angle at weaning and at 2 year follow up for each patient. Patients were divided into groups based on their initial Cobb angle at the start of treatment.

Results

Thoracic			
Cobb Angle at the Start of Treatment	n	Initial Cobb Angle	
10-19°	8	18.38 ± 1.06°	
20-29°	264	23.88 ± 2.81°	
30-39°	132	33.39 ± 2.84°	
≥40°	89	47.26 ± 6.74°	

Lumbar			
Cobb Angle at the Start of Treatment	n	Initial Cobb	

Conclusion(s)

In this large sample of patients receiving a consistent bracing treatment there was a 100.00% avoidance of reaching the threshold for recommended surgical intervention for all initial Cobb angles under 40 degrees. For initial Cobb angles above 40 degrees, there was a success rate for avoiding the surgical threshold of 89.89% and 90.63% for thoracic and lumbar curvatures respectively. Nevertheless, all groups showed average improvement of Cobb angles.

Clinical significance

There is generally consensus among clinicians that AIS curves that have progressed beyond 50 degrees are candidates for surgery. There is also consensus that conservative treatment is most successful in patients who have a smaller Cobb angle at the time treatment is initiated. This study examined whether conservative treatment is worthwhile in patients who already have large curves. The results show that in about 90% of patients conservative treatments were successful in preventing patients from reaching the recommended threshold for undergoing corrective surgery, indicating conservative treatment is in fact worthwhile in larger Cobb angles.

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AUTOMATED GENERATIVE DESIGN OF FULL-TIME BRACES: TOWARDS A DATA-DRIVEN ALTERNATIVE TO EMPIRICALLY CRAFTED SOLUTIONS

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Background

The brace treatment of adolescent idiopathic scoliosis (AIS) lacks standardization, resulting in variability in reported outcomes. Current brace designs rely on orthotists' expertise and empirical methods, with no comprehensively validated tools to evaluate brace fit or effectiveness prior to delivery. To address these challenges, we previously developed and validated an automated generative brace design algorithm for nighttime braces. However, its application and validation to full-time braces remained unexplored.

Objective (s)

To adapt an automated generative design algorithm for full-time AIS braces and to biomechanically compare the performance of algorithm-generated braces with those designed by expert orthotists.

Study Design

Biomechanical numerical analysis comparing brace design effectiveness

Methods

Thirty-five AIS cases treated with full-time braces between 2013 and 2018 were retrospectively analyzed. For each case, a personalized finite element model (FEM) was created using biplanar radiographs, a torso surface topography scan and a brace digital mesh to simulate immediate in-brace and two-year out-of-brace evolution. Simulated brace correction was compared with actual radiographic measurements to validate the model. Using these validated FEMs, an optimization algorithm generated brace designs to maximize 3D correction and functionality (TEST group). Simulated immediate and two-year corrections for these TEST braces were compared with those of the actual expert-designed braces (CTRL group) worn by patients at same time points.

Results

The FEM simulations predicted correction with an average deviation of $5.8^{\circ} \pm 4.0^{\circ}$ (immediate in-brace) and $4.9^{\circ} \pm 3.4^{\circ}$ (two-year out-of-brace), an accuracy on the same order as the measurements' interoperator reproducibility. Simulated immediate correction for TEST group was $37 \pm 18\%$ ($27 \pm 9\%$ thoracic, $47 \pm 12\%$ lumbar), compared to $33 \pm 14\%$ ($27 \pm 5\%$ thoracic, $38 \pm 13\%$ lumbar) for the CTRL group ($p < 0.01$). At two years, the simulated deformity progressed on average by $1^{\circ} \pm 3^{\circ}$ for the TEST braces and $2^{\circ} \pm 2^{\circ}$ for the CTRL braces ($p < 0.01$). Sagittal curves and axial vertebral rotations showed no significant differences between the groups.

Conclusion(s)

The generative brace design algorithm demonstrated the potential to produce full-time braces achieving corrections comparable to or, in some cases, better than those designed by expert orthotists. This automated approach represents a promising step toward a standardized, data-driven alternative to manual processes.

Clinical significance

By reducing reliance on orthotist expertise, this method shows significant promise for improving treatment consistency and accessibility, laying the groundwork for a more systematic and equitable approach to AIS management.

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CAN NON-OPERATIVE TREATMENT WITH BRACE AND SCOLIOSIS SPECIFIC EXERCISES BE EFFECTIVE FOR SEVERE SCOLIOTIC CURVES EXCEEDING 40o AT PEAK OF GROWTH?

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Background

According to Scoliosis Research Society (SRS) surgical indication for Adolescent Idiopathic Scoliosis (AIS) is above 40°. However, many patients refuse to be operated, trying brace treatment. To date, no strong evidence exists for non-operative treatment in large scoliotic curves.

Objective (s)

Our purpose was to investigate the efficacy of a combined therapy with brace and Physiotherapeutic Scoliosis Specific Exercises (PSSE) in severe scoliosis during growth spurt.

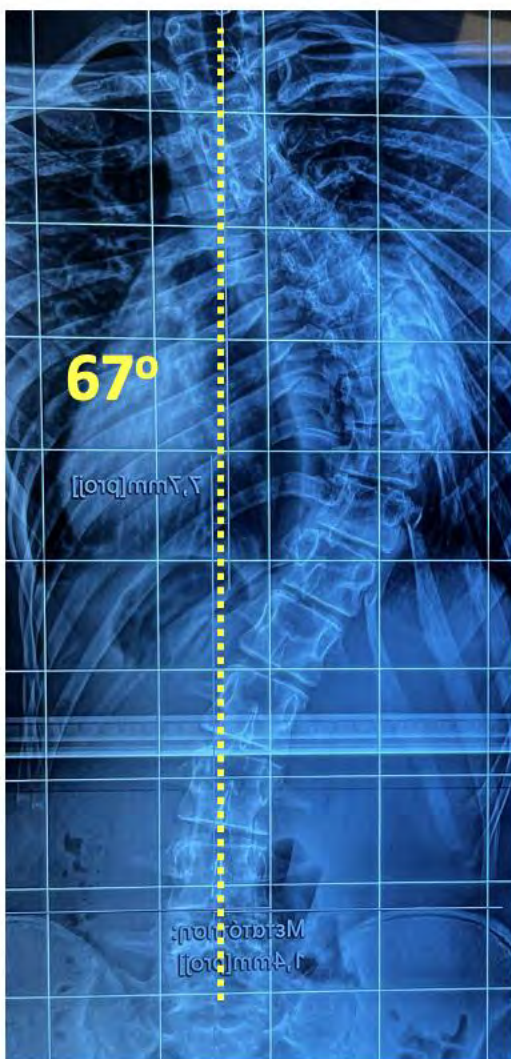
Study Design

Prospective cohort study.

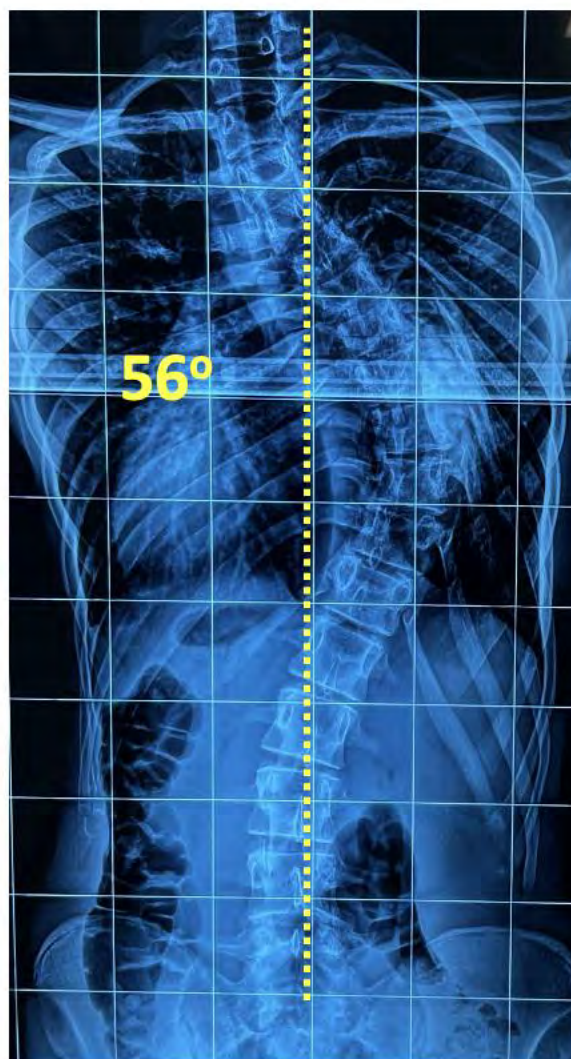
Methods

78 patients (73 females and 5 males) received treatment by 3D corrective brace and PSSE. Our inclusion criteria were at least one structural curve with Cobb angle >40°, Risser 0-2, age > 10 years and less than 1 year after first menstruation. Average Cobb angle was 53.4° for thoracic curves (41° – 99°) and 52.4° (40° – 85°) for lumbar curves, mean Risser 0.6 and age 12.6 years. 18 curves (23.1%) were single (15 thoracic and 3 lumbar) and 60 double (76.9%). Outcome parameters were Cobb angle post-treatment, Angle Trunk Rotation (ATR), Trunk Appearance Clinical Evaluation (TRACE) scale, SRS-22 questionnaire score, and number of patients underwent operation. Mean follow-up was 35.5 months. Statistical analysis performed by Analysis of Variation (ANOVA) and Chi-square tests.

Results



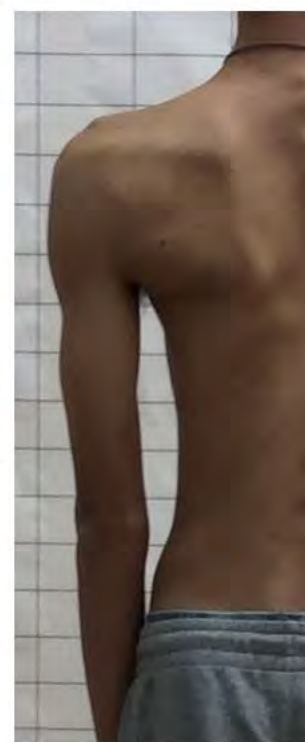
Before treatment



After treatment



Before treatment



After treatment

Totally, 31 (39.7%) subjects remained stable, 24 (30.8%) improved $> 5^\circ$ and 23 (29.5%) progressed $> 5^\circ$. For the improved curves, 12 were thoracic, 7 lumbar and 5 both thoracic and lumbar. For the progressed curves, 15 were thoracic, 3 lumbar and 5 both thoracic and lumbar). Cobb angle post-treatment improved to 52.2° ($p=0.09$) for thoracic and 45.9° , ($p= 0.002$) for lumbar curves.

A statistically significant reduction was reported for ATR, thoracic reduced from 13.2° to 10.4° ($p=0.004$) and lumbar from 11.3° to 8.6° ($p=0.01$). TRACE scale also significantly decreased from 8.3 to 6.4 ($p=0.01$) and SRS-22 total score improved from 73.1 to 80.2 ($p=0.002$). Mean in-brace correction (IBC) was 36.8% for thoracic and 34.8% for lumbar curves. In double curves progression rate was 33.3% and in single curves 16.7% ($p=0.004$). Higher IBC and good compliance with the treatment protocol led to less progression rate. 9 patients (11.5%) underwent spinal fusion.

Conclusion(s)

Conservative treatment achieved a high success rate of 70.5% in a group of scoliotic curves above 40° with a high risk of progression at the peak of growth. A significant improvement was detected for trunk rotation (ATR), body symmetry measured by TRACE scale and quality of life measured by SRS-22 questionnaire. Non-operative treatment by bracing and PSSE can effectively treat severe scoliosis and reduce the need for surgery. The results were significantly better in single than double curves and in subjects with good compliance and IBC.

Clinical significance

Non-operative treatment with brace and PSSE can be an effective alternative option for severe AIS patients that refused operation, during growth spurt.

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FACTORS THAT INFLUENCE SHORT TERM OUTCOME OF BRACING FOR IDIOPATHIC SCOLIOSIS: HOW IMPORTANT IS COMPLIANCE?

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Background

Bracing has been proven to significantly reduce the progression of idiopathic scoliosis (IS) with compliance being one of the most influential factors for a positive outcome. However, the evidence of

objective compliance monitoring with thermal sensors is limited, especially considering daily wearing patterns and consistency.

Objective (s)

To determine the role of adherence and consistent brace use in predicting the changes of the Cobb angle in IS patients during growth.

Study Design

Retrospective cohort study.

Methods

We included all IS patients prescribed a first brace with applied thermal sensor from our database. The patients were divided into groups according to age, adherence to treatment, compliance and short-term outcome. We calculated a „Consistency index," (CI) as the interquartile range of daily brace wear time recorded by the thermal sensor. Patients with $CI \leq 1$ were classified as consistent and patients with $CI > 1$ as inconsistent. We defined „Adherence" as the ratio of the average daily brace wear time to the recommended daily wear time (in hours). We compared the Cobb angles at baseline with those in-brace and at 6 months follow-up. Progression and improvement were defined as a Cobb angle changes $> 5^\circ$ between two out-of-brace radiographs. We calculated the mean, median or percentage according to the variables and their distribution. Various tests (t-test, Mann-Whitney, Fisher's Exact, Kruskal Wallis) were applied to compare the groups. A multivariate logistic regression with adjustment for factors usually associated with progression risk was applied.

Results

We included 114 patients with IS (100 with AIS, 14 with JIS), 95 females and 19 males, age 12.7 ± 2.4 years and initial Cobb angle $30.8 \pm 10.4^\circ$. In the consistent group there were 22 patients and in the inconsistent group 92 patients. We found no statistically significant differences between consistent and inconsistent group in terms of age, gender, scoliosis type and clinical and radiological parameters. A statistically significant difference was observed between the consistent and inconsistent groups for all brace-wearing parameters. AIS patients with consistent brace wear had 1.52 times higher odds of achieving improvement (OR = 1.52, CI 95% 0.51-4.55). In AIS patients with high level of compliance, the odds of achieving improvement were 1.7 times higher (OR = 1.70, CI 95% 0.76-3.78) compared to the others. The regression analysis didn't show any significant influence of initial Cobb angle, age and Risser on the outcome.

Conclusion(s)

Our findings underscore the importance of adherence and consistent brace use in effectively managing IS. A consistent brace-wearing significantly increases the likelihood of scoliosis improvement, emphasizing the need for objective compliance tracking and tailored patient education. These findings support a more personalized approach to treatment, reinforcing the critical role of patient collaboration in optimizing therapeutic outcomes.

Clinical significance

By focusing on adherence monitoring, patient education and tailored interventions, we can enhance treatment efficacy, patient engagement, and long-term adherence, ultimately improving clinical outcomes in scoliosis care.

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GROWTH MODULATION IN SCOLIOSIS: FACT OR FICTION? PRELIMINARY RESULTS OF RIGO CONCEPT BRACE FROM A RETROSPECTIVE ANALYSIS.

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Background

Idiopathic scoliosis (IS) affects 3% of the population. Bracing has been shown to effectively reduce the risk of curve progression and thus surgery. Outcomes data on bracing protocols, including duration, materials, and brace type, are needed to further optimize patient outcomes.

Objective (s)

This study aimed to explore the growth modulation effect observed during and after bracing in a cohort of subjects with IS treated by an orthotist group fabricating custom braces using Rigo-Cheneau principles of three-dimensional correction.

Study Design

Longitudinal retrospective review of prospectively collected clinical data from a single orthotist group.

Methods

IS patients who received brace treatment from January 2015 to November 2023 and who had complete data from treatment start and a minimum of 2 follow-up visits have been included. Descriptive statistics included mean and standard deviation for normally distributed continuous variables. Proportion and rates have been used to describe categorical binary and multilevel variables. A logistic model was employed to evaluate the role of age, Cobb angle at start and time in brace on the following binary outcome variables: reaching 30 Cobb at follow up, having a correction >10 Cobb from baseline or reaching the surgical threshold (50 Cobb). Statistical analyses were performed using STATA 17.0 MP—Parallel Edition for Windows (Copyright 1985-2021 StataCorp LLC).

Results

The data of 87 patients were included; 92% were females. 35 reached brace discharge, 52 reached US Risser 2 during follow-up. Mean age at baseline was 11.9+-2.4, and mean time of follow-up was 3.3+-2.1 years; 21 patients dropped out before 2 years of follow-up, and 35 had 4 to 12 years of follow-up. All patients received a Rigo Concept brace, and the average self-reported brace time was 20.6+-1.5. At baseline, the thoracic Cobb was 29.1+-9.9; at the last assessment, it was 29.0+-11.7. Baseline thoracolumbar and lumbar Cobb was 28.9+-9.0; at the end mean Cobb was 24.7+-8.6. We found gradual correction over time with curves corrected of more than 10 Cobb degrees in 32% of the subjects, while 72% reached the last follow-up with curves below 35 Cobb degrees. 8% of patients showed progression to the surgical threshold (50 degrees) The logistic regression model revealed that the odds of reaching a curve below 35 degrees are increased by 15% as brace time increases and by 19% with a smaller Cobb angle at baseline.

```
Logistic regression                                Number of obs =   116
                                                    LR chi2(4)      =  61.53
                                                    Prob > chi2     =  0.0000
Log likelihood = -39.404567                        Pseudo R2      =  0.4384
```

healthy	Odds ratio	Std. err.	z	P> z	[95% conf. interval]	
age_at_xray	1.353988	.259547	1.58	0.114	.929924	1.971435
gender	1.968433	3.124661	0.43	0.670	.0876872	44.18809
THCobb	.7756694	.040806	-4.83	0.000	.6996762	.8599162
braceweartime	1.142935	.0739927	2.06	0.039	1.006735	1.29756
_cons	3.588123	11.72235	0.39	0.696	.005943	2166.362

Note: _cons estimates baseline odds.

Conclusion(s)

This preliminary analysis showed the Rigo concept brace, provided good patient outcomes, which corroborates previously published studies evaluating the effectiveness of brace. This work provides a foundation for future large-scale studies comparing different braces and finding determinants of the best outcomes.

Clinical significance

This evaluation reports patient outcomes with Rigo Concept bracing treatment and factors associated with successful treatment outcomes.

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GEOGRAPHIC, PERSONAL AND CLINICAL DETERMINANTS OF BRACE-WEARING TIME IN ADOLESCENTS WITH IDIOPATHIC SCOLIOSIS

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Background

Bracing is an effective treatment for adolescents with moderate-degree idiopathic scoliosis (AIS). Some studies have investigated adherence determinants through sensors, but many factors, such living in specific areas (e.g., mountains vs. seaside, town vs. countryside), or family income, have not yet been explored.

Objective (s)

The study was aimed to verify the influence of geographic, personal and clinical variables routinely registered by physicians on adherence to brace treatment in a large cohort of consecutive AIS patients.

Study Design

Retrospective cross-sectional study with prospectively collected data.

Methods

We consecutively recruited participants at a tertiary referral institute from December 2009 to October 2022. Inclusion criteria were AIS, start of brace therapy, one-year follow-up, and use of an iButton thermal sensor to systematically collect brace-wearing time. To ensure high adherence, patients and parents received a cognitive-behavioural intervention.

The outcome variable was binary: adherence $>$ or $<75\%$. The tested predictors were age, brace prescription time, living in the North, Centre, or South of Italy, gender, Risser, Cobb at baseline; curves type, ATR, TRACE, brace type, back pain, income, city size, distance from the sea, and height above sea level.

The categorical nature of most variables determined the need for non-parametric tests for descriptive statistics. The χ^2 test was used to preliminary investigate the association between the categories and the level of adherence. The logistic regression model tested the predictors of adherence. The alpha level of significance was set at 0.05. For the analysis, we used STATA 17.0 MP.

Results

We included 1904 adolescents, age 13.8 ± 1.6 , with the major scoliosis curve of $35 \pm 11^\circ$ Cobb. The prevalence of good compliers was 90%.

Factors associated with higher adherence were: geography (people from the North of Italy are better compliant than people from the South of the country [χ^2 11.4 $p=0.003$]), prescription >20 hours per day ($\chi^2=7.07$ $p=0.008$), female gender ($\chi^2=7.07$ $p=0.008$), and younger age and lower Risser sign (age 10 to 13: $\chi^2=16.6$ $p=0.000$; Risser 0-1: $\chi^2=8.7$ $p=0.013$). All the other tested factors showed no association with adherence. The binary logistic model highlighted that younger subjects with a full-time prescription living in northern Italy had 71% higher odds of wearing the brace with good adherence.

Conclusion(s)

Geographic factors possibly linked to climate or social aspects were associated with better adherence. Also, a prescription >20 hours, female gender, younger age, and lower Risser sign increased adherence. This information came from a highly compliant population, and results could be different in other settings or countries.

Clinical significance

Adherence is a crucial factor in bracing therapy for improving results. Understanding that factors such as living in warmer areas, male gender, older age, and higher Risser sign may reduce adherence allows for identifying patients who may benefit from specific adherence-enhancing interventions.

Final category: 5 Pre- and Post-operative Care

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PREOPERATIVE CHARACTERISTICS AND POSTOPERATIVE PAIN PATTERNS IN SCOLIOSIS SURGERY: A RETROSPECTIVE ANALYSIS

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Background

Scoliosis, a complex spinal deformity defined by lateral curvature and axial rotation, significantly impacts patient quality of life. Surgical correction remains a critical intervention for severe cases. Understanding the interplay between preoperative characteristics and postoperative outcomes is essential for optimizing care. This study explores the relationship between surgical type, fusion levels, and postoperative pain in scoliosis patients.

Objective (s)

To analyze the preoperative characteristics and postoperative pain patterns of scoliosis patients undergoing surgery, focusing on the influence of surgical type and fusion levels on pain distribution and severity

Study Design

Retrospective cohort study

Methods

A retrospective analysis of 25 scoliosis surgery patients at a single institution was conducted. Data included demographics, preoperative Cobb angles, fusion levels, time from surgery, main areas of postoperative pain, and trunk balance. Comparative and correlation analyses were performed to evaluate the relationship between surgical approach, fusion extent, and pain outcomes

Results

The cohort included 25 patients aged 14–63 years. Preoperative Cobb angles ranged from 50°–60°, with fusion levels spanning thoracic to thoracolumbar regions. Key findings include:

- **Pain Distribution by Surgical Type:**
 - Lumbar pain was more prevalent in anterior fusion procedures ($p < 0.05$).
 - Thoracic pain was associated with posterior fusion ($p < 0.05$).
- **Extent of Fusion and Pain Severity:**
 - A positive correlation was identified between fusion extent and pain severity ($r = 0.45$, $p < 0.01$).
- **Fusion Area and Pain Location:**
 - Patients with thoracic fusions reported thoracic pain, while lumbar fusion patients reported lumbar pain.

Table 2: Postoperative Pain Patterns by Surgical Type

Main Area of Pain	Surgical Type	Fusion Levels	Mean Time from Fusion (years)	Mean Pre-op Cobb Angle
Lumbar	Anterior	T1-L1	4.5	53
Thoracic	Posterior	T2-L2	13	55

Conclusion(s)

Surgical approach and fusion extent significantly influence postoperative pain patterns in scoliosis patients. Anterior fusions are associated with increased lumbar pain, while posterior fusions result in thoracic pain. Greater fusion extents correlate with higher pain severity.

Clinical significance

These findings emphasize the importance of tailored surgical planning and comprehensive pain management to improve outcomes in scoliosis patients. Understanding these relationships aids clinicians in anticipating postoperative challenges and optimizing recovery.

Final category: 6 Imaging and Other Diagnostic or Assessment Tools

3

HOUNSFIELD UNIT FOR ASSESSING ASYMMETRICAL LOSS OF VERTEBRAL BONE MINERAL DENSITY AND ITS CORRELATION WITH CURVE SEVERITY IN ADOLESCENT IDIOPATHIC SCOLIOSIS

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Background

Low bone mass concomitantly occurs in patients with adolescent idiopathic scoliosis (AIS) and can persist until skeletal maturity.

Objective (s)

The purpose of this study was to assess the asymmetrical loss of vertebral bone mineral density (vBMD) and its correlation with curve severity in patients with AIS using Hounsfield unit (HU) values measured from computed tomography scans.

Study Design

A retrospective cohort study

Methods

A total of 93 AIS patients were retrospectively recruited. The HU values of the vertebral body (VB-HU) and pedicle screw trajectory (PST-HU) were measured from four vertebrae above (Apex – 4) to four below (Apex + 4) the apical vertebra (Apex) of the major curve. The VB-HU and PST-HU at the upper end vertebra, Apex, and lower end vertebra within the concave and convex sides of the major and minor curves and stable vertebrae were obtained.

Results

A significant correlation was found between the Cobb angle and VB-HU at the periapical levels of the major curve. VB-HU and PST-HU at periapical levels were significantly greater within the concavity than the convexity of both major and minor curves. The asymmetric ratios of VB-HU and PST-HU were significantly correlated with the major curve Cobb angle, peaked at the apex, and gradually diminished from the apex to the end vertebrae. The asymmetrical loss of vBMD aggravated with the progression of curve severity, presenting as VB-HU, significantly decreased within the convexity and insignificantly decreased within the concavity of the major curve.

Conclusion(s)

The asymmetrical loss of vBMD was associated with the progression of curve severity in AIS. For patients with severe AIS, the distraction of the pedicle screws at the concave side should be a priority in correcting the major curve, and supplemental anchors and larger-sized screws should be placed within the convex side around the apex of the major curve to reduce the risk of screw loosening after surgery.

Clinical significance

This study reveals the clinical importance of asymmetrical (vBMD) loss in AIS and its association with curve severity, offering key insights for surgical practice. The higher vBMD on the concave side and lower density on the convex side, especially at the apex, suggest the need for customized screw placement strategies. Surgeons should focus on distraction on the concave side, where bone density is greater, and use larger screws or additional anchors on the convex side to reduce the risk of screw

loosening in severe curves. Preoperative CT-based Hounsfield unit (HU) assessments can help tailor fixation methods, ensuring optimal correction and postoperative stability, while also highlighting the importance of monitoring bone health to support long-term surgical success in AIS patients.

8

CORRELATION BETWEEN COCCYGEAL BONE MORPHOLOGY CLASSIFICATION AND PREDICTION OF PROGRESSION OF ADOLESCENT IDIOPATHIC SCOLIOSIS

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Background

Adolescent Idiopathic Scoliosis (AIS) is a common spinal deformity affecting 0.47–5.4 % of adolescents. While the etiology of AIS remains unclear, recent studies highlight the potential role of anatomical factors. For instance, Haoyang Zhang et al. (2024) identified specific coccygeal shapes more prevalent in AIS patients.

The intercoccygeal angle serves as a radiological measure to classify coccygeal morphology and assess distortion. Using midline sagittal imaging, the angle is determined by intersecting straight lines bisecting the first and last coccygeal segments,(figure 1) .

Coccygeal morphology is classified using the Postacchini-Massoprio system, which describes four distinct types of coccyx shapes :

- Type I: Curved slightly forward
- Type II: More marked curve, straight forward
- Type III: Sharply angled anteriorly
- Type IV: Subluxation of sacrococcygeal or intercoccygeal joints

Type I is the most common in non-scoliotic, asymptomatic individuals, with an average intercoccygeal angle of $36.4^{\circ} \pm 10.56^{\circ}$ (33.29° for females, 40.05° for males) .

Despite these findings, there is no established research linking coccygeal morphology classification and AIS progression. The coccyx, as part of the spine, warrants further investigation in this context.

This study aims to explore the relationship between coccygeal morphology classification, particularly Types II and III, and the progression of AIS.

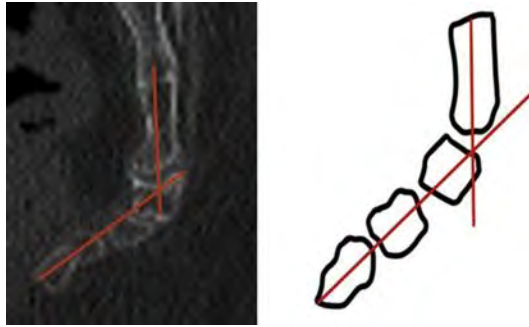


figure 1 : The intercoccygeal angle measurement

Objective (s)

The main aim objective of this study is to investigate the correlation between coccygeal bone morphology classification (Postacchini - Massoprio classification) ,and the progression of adolescent idiopathic scoliosis.

The hypothesis is that specific morphological characteristics

(Postacchini - Massoprio classification type II and type III) of the coccygeal bone can predict the progression of Idiopathic scoliosis.

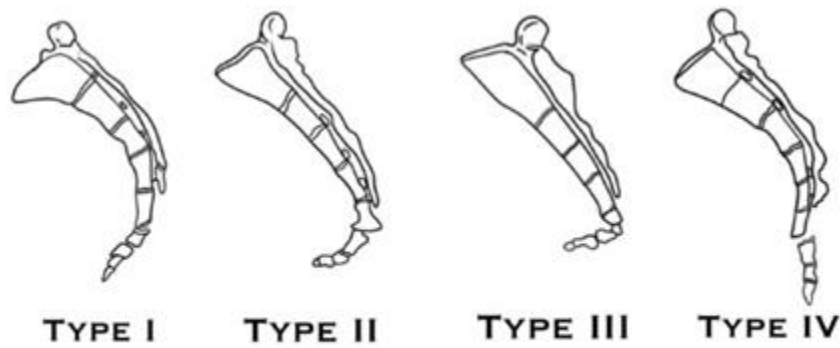
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Study Design

Retrospective case series Study

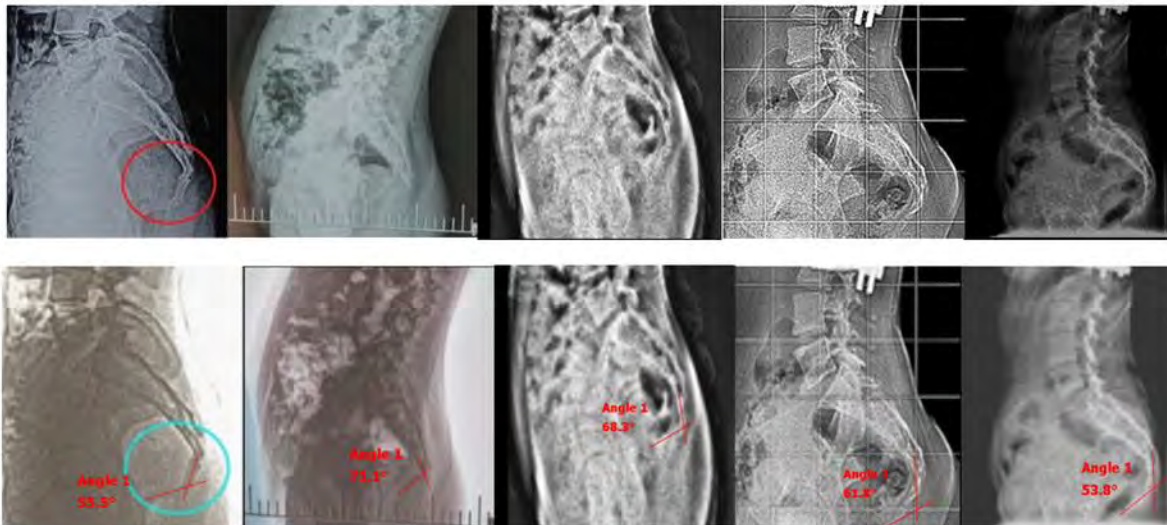
Methods

This retrospective study reviewed data from 2019 to 2024. Intercoccygeal angles were measured on lateral radiographs for all cases. The coccyx was classified according to the Postacchini-Massoprio (Types I–IV). Patients with rapid progression, uncommon patterns, or those reaching the surgical threshold (Cobb angle $\geq 45^\circ$) were identified. we noticed that the common radiological sign was an increase in the intercoccygeal angle specifically Types II and III, The study compared coccygeal types, with the progression of AIS to assess any potential correlation.



Results

The study included 200 adolescents aged 11–18 years, with an equal representation of both genders and Cobb angles ranging from 25 to 40 degrees, 18% of AIS cases progressed to surgery and were classified as Type II or Type III based on coccygeal morphology. In contrast, the remaining cases were classified as Type I.



Conclusion(s)

This study underscores the importance of coccygeal morphology classification in management of AIS.

The significant correlation between coccygeal shape, AIS progression, suggests that coccygeal morphology can aid in predicting scoliosis development.

Clinical significance

Radiographic evaluation of coccygeal morphology could provide guiding differential diagnosis, and informing intensive follow-up protocols.

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COMPARATIVE ANALYSIS OF A MANUAL AND AN AUTOMATED 3D LANDMARK DIGITIZATION METHOD OF THE HUMAN TORSO

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Background

Adolescents with idiopathic scoliosis (AIS) are concerned about the physical appearance of their spine. Therefore, monitoring the shape changes of the torso during the condition is relevant for them. In recent years, efforts have been made to measure 3D torso asymmetry using different surface topography (ST) approaches. Methods based on manual landmarks are the gold standard, but some limitations arise, especially related to the dependence on expert skills and excessive time consuming during landmark digitization.

Objective (s)

1) To develop an automated method and 2) To measure the agreement with the gold standard.

Study Design

Retrospective validation study of cross-sectional data.

Methods

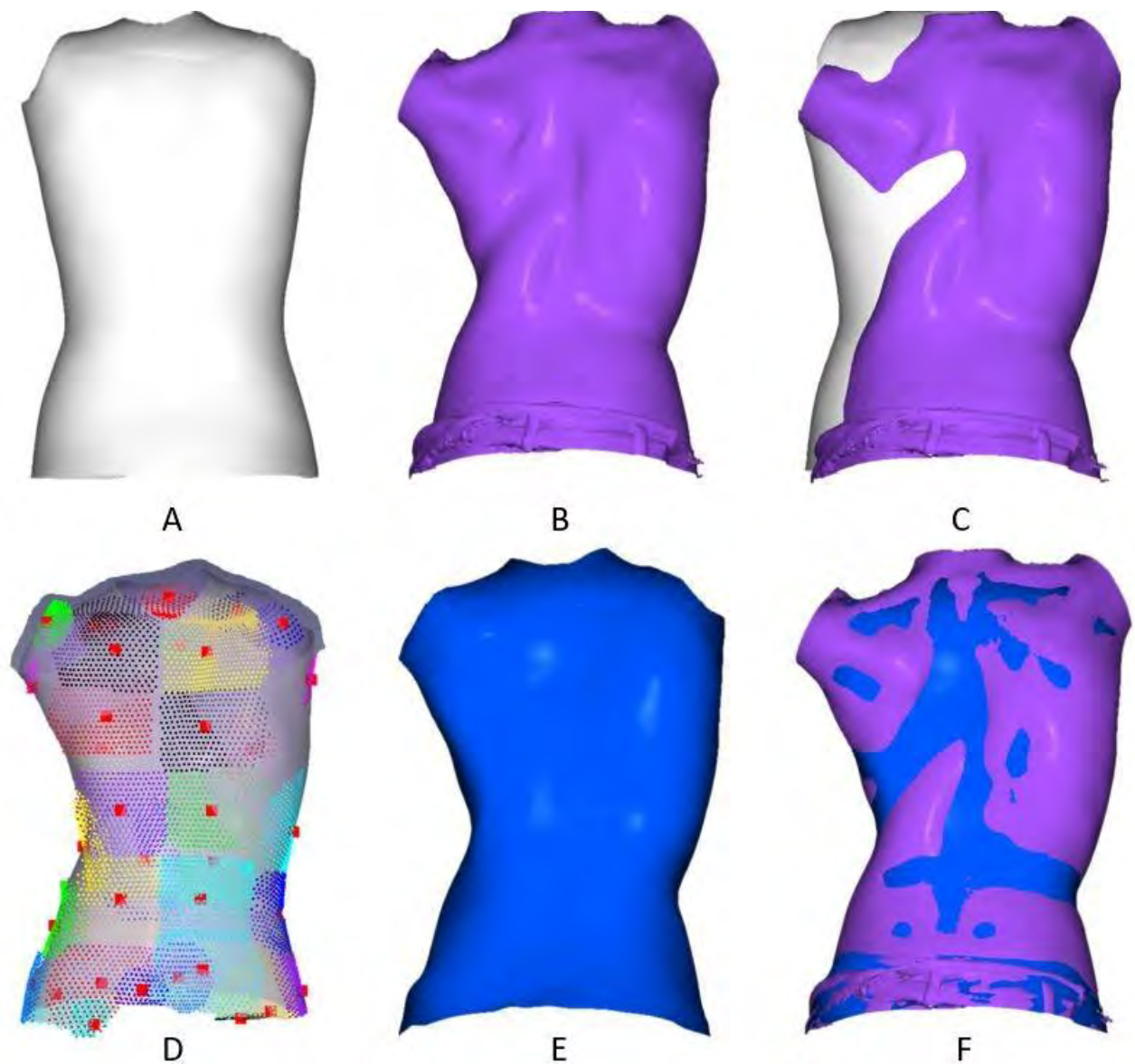


Figure 1. Automated workflow. A female reference mesh (A) and a female patient with AIS (B) are subjected to a Rigid Global Alignment (C). Then, the Rigid Local Alignment shows the 34 landmarks (red dots) with their corresponding Voronoi cells (D). Finally, the Elastic Mesh Registration step produces an automatically estimated mesh of the patient (E). A superposition of the patient's original torso (B) and the estimated torso (E) is shown in F.

The sample consisted of 33 non-scoliotic torsos with a mean age of 11.94 years ($SD = 2.09$) and 83 AIS torsos with a mean age of 13.43 years ($SD = 1.96$), and a mean Cobb of 30.92° ($SD = 11.76^\circ$). 1) The automated method consists of the following steps: C) Rigid Global Alignment of the patient's torso with a symmetric reference torso, D) Rigid Local Alignment that projects 34 landmarks onto the patient's torso with Voronoi cells to create a preliminary surface mesh, E) Elastic Mesh Registration that outputs a final mesh and the 34 landmark coordinates. This workflow is summarized in Figure 1. 2) Inter-method agreement evaluation for shape and size was performed using Procrustes methods and Principal Component Analysis (PCA) of the automated and manual coordinates extracted from a previous study.

Intra-class correlation (ICC) was calculated for PC1 and PC2. Finally, a Pearson correlation between size (measured as centroid size) was calculated.

Results

PCA shape variability captured by both methods shows high agreement for PC1 (ICC=0.94, CI95%=0.90, 0.96) and good agreement for PC2 (ICC=0.85, CI95%=0.78, 0.90). The correlation between size measured by both methods is very strong ($r=0.95$, $p\text{-value}<0.001$).

Conclusion(s)

The automated method presented in this study showed excellent agreement with the gold standard in capturing shape and size features of the human torso. Future studies may consider automatic landmarks as a basis for the development of statistical shape modeling (SSM) of the scoliotic torso.

Clinical significance

Integrating this method with topographic measurements of the torso can help track changes in shape over time and detect different scoliotic patterns for diagnosis, classification, and developing predictive models of shape.

25

VALIDATION OF BACK HEIGHT DIFFERENCE MEASURED BY 3D DEPTH SENSING AS A NON-INVASIVE ASSESSMENT TOOL FOR ADOLESCENT IDIOPATHIC SCOLIOSIS

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Background

Adolescent idiopathic scoliosis (AIS) is a common spinal deformity affecting the health of adolescents. Accurate assessment of AIS are of great significance to prevent disease progression. Traditional methods, such as measuring trunk rotation Angle (ATR) with a spinometer, have certain limitations, especially in terms of sensitivity and

accuracy. With the advancement of medical imaging technology, the use of three-dimensional imaging technology for the evaluation of AIS has become a research hotspot.

Objective (s)

The aim of this study is to introduce a new depth camera-based back height difference (BHD) measurement method to verify the effectiveness of BHD in the diagnosis and efficacy evaluation of AIS by comparing with ATR. This method has the advantages of non-invasiveness, no radiation, and simple operation, which can provide a more accurate and objective evaluation method for clinical practice.

Study Design

Cross sectional studies

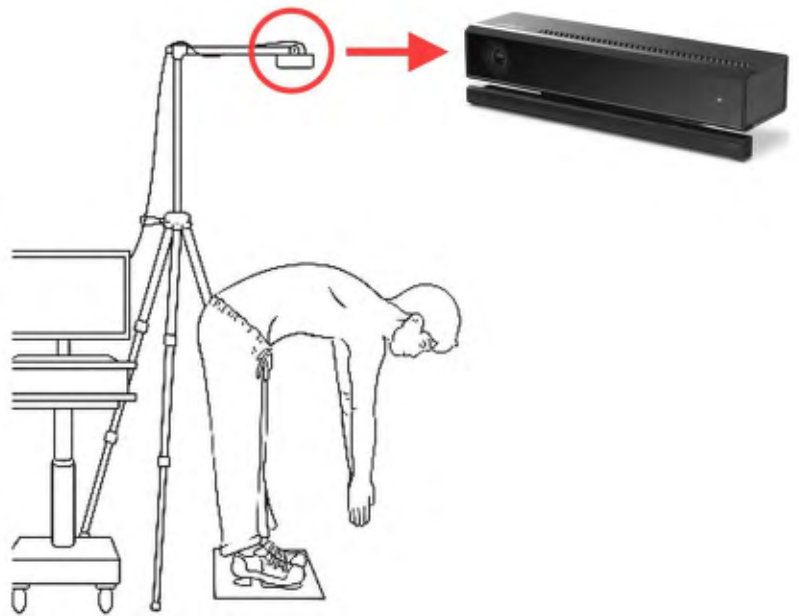
Methods

Participants were patients with AIS. Utilizes a consumer-grade 3D depth sensor and a laptop, both integrated into the ROS framework. The height difference (HD), height group difference (HGD), Cobb Angle and ATR of AIS patients were scanned and measured. The BHD measurement time is about 1-2 minute. Using pearson correlation coefficient, evaluate the correlation between HD, HGD, ATR and Cobb angle. Subgroup analysis was performed according to Cobb angle ($\leq 20^\circ$; $20^\circ-40^\circ$, $> 40^\circ$) and location of the major curve (thoracic, thoracolumbar, lumbar). The statistical significance level was set at $P < 0.05$.

Results

The study included 164 participants (132 women and 32 men; mean [SD] age, 13.77 [2.17] years; major curve Cobb angle, 24.65 [11.39] °; ATR, 8.22 [3.65] °. Validity evaluations revealed a pronounced linear correlation between the HD ($R = 0.747$, $P < 0.001$), HGD ($R = 0.713$, $P < 0.001$) with ATR. Subgroup analysis showed that when Cobb $> 40^\circ$ (HD, $R = 0.747$, $P < 0.001$; HGD, $R = 0.770$, $P < 0.001$) and thoracic curve (HD, $R = 0.909$, $P < 0.001$; HGD, $R = 0.828$, $P < 0.001$) showed a better correlation with ATR. In the meantime, validity evaluations revealed a pronounced linear correlation between the HD ($R = 0.618$, $P < 0.001$), HGD ($R = 0.541$, $P < 0.001$) with Cobb, although the correlation was lower than ATR ($R = 0.629$, $P < 0.001$). Subgroup analysis showed that when thoracic curve (HD, $R = 0.709$, $P < 0.001$; HGD, $R = 0.632$, $P < 0.001$) showed a better correlation with Cobb.

3D depth sensor



3D point cloud acquisition

Conclusion(s)

This study confirmed a strong correlation between BHD and ATR, especially in the Cobb $> 40^\circ$ and thoracic curve. Depth camera provides a new option for clinical efficacy evaluation and has great potential.

Clinical significance

Depth camera shows promise as a safe diagnostic tool for monitoring conservative treatments in the future.

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DEVELOPING AND VALIDATING A CODE-FREE DEEP LEARNING MODEL FOR AN AUTOMATED DIAGNOSTIC AND SCREENING SYSTEM FOR ADOLESCENT IDIOPATHIC SCOLIOSIS USING ONLY SIMPLE BACK IMAGES

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Background

Adolescent idiopathic scoliosis (AIS) is a three-dimensional spinal deformity affecting up to 2.2% of boys and 4.8% of girls, with a significant risk of progression during puberty that can diminish quality of life and lead to health issues in adulthood. Early detection and intervention are essential. Since 1995, Hong Kong has implemented a school screening program for AIS, but interruptions like the COVID-19 pandemic highlight the need for accessible, out-of-hospital assessments.

Current AIS detection relies heavily on clinician expertise, including physical exams and radiographs, which can be subjective and require further imaging to accurately assess malformation severity. While deep learning can automate Cobb angle calculations from stereoradiography, repeated imaging raises concerns about radiation exposure.

Radiation-free detection methods include Moiré topography and standardized back photographs. However, using simple photos for automated AIS detection poses challenges due to variability in image quality and differences in individual spinal deformities. Code-free deep learning (CFDL) offers a solution by allowing non-experts, like clinicians, to create AI models

without extensive coding knowledge, making it a cost-effective screening option suitable for resource-limited communities.

Objective (s)

The main aim was to showcase the reliability and diagnostic accuracy of the CFDL model in identifying patients with AIS using basic back images.

Study Design

Retrospective original study

Methods

The dataset consisted of 156 labeled bareback images sourced from two public datasets. To enhance model generalizability, data augmentation techniques like zooming and horizontal flipping were applied. The final dataset comprised 1,024 images, categorized into 'normal' and 'scoliosis' classes. These images were resized, normalized, and divided into training, internal validation, and external validation sets in an 80:10:10 ratio for model training and evaluation.

The CFDL model was built using the Google Console Vertex AI platform. A single-label multi-class classification training mode was trained, and the model training was conducted in the U.S. East region with default settings, including automatic early stopping to minimize costs. The area under the receiver operating characteristic curve (AUROC), precision, recall, and F1-score were used to evaluate the diagnostic accuracy and reliability of the scoliosis screening model.

Results

During internal validation, the CFDL model attained an AUROC of 99.6%, an F1 score of 99.3%, precision of 98.7%, and recall of 98.0% at a 0.5 confidence threshold. However, upon external validation, there was a slight decline in performance, with AUROC, F1 score, precision, and recall at 84.3%, 83.1%, 82.0%, and 82.1%, respectively. This reduction may have resulted from demographic bias in the dataset, despite data augmentation, making the performance drop acceptable.

Conclusion(s)

Our CFDL algorithm allows orthopaedists without coding skills to conduct efficient scoliosis screenings.

Clinical significance

The scarcity of orthopedic specialists complicates scoliosis screening in underserved areas, indicating a significant opportunity for orthopedists to adopt CFDL platforms to develop automated tools that improve detection and accessibility.

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INFLUENCING FACTORS OF RESPIRATORY MUSCLE FUNCTION IN PATIENTS WITH ADOLESCENT IDIOPATHIC SCOLIOSIS

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Background

Scoliosis is prevalent among adolescents and children. Thoracic malformation leads to functional alterations in respiratory muscle groups. For patients with a 45° curvature undergoing conservative treatment, it is particularly essential to explore the inspiratory muscle strength and its influencing factors in AIS patients.

Objective (s)

To investigate the inspiratory muscle strength and its influencing factors in adolescent idiopathic scoliosis (AIS) patients.

Study Design

The study was approved by the hospital medical ethics committee. All the subjects were patients with idiopathic scoliosis diagnosed by whole spine DR and other examinations. The inclusion criteria, exclusion criteria, and dropout criteria were strictly adhered to. The study encompassed the collection of basic information, the test of inspiratory muscle strength, the measurement of inspiratory diaphragm thickness and excursion. Finally, SPSS 22.0 software was utilized for statistical analysis, including univariate and multivariate analyses of inspiratory muscle strength, and the results were discussed to arrive at the final conclusion.

Methods

A total of 66 patients with adolescent idiopathic scoliosis admitted to the Rehabilitation Medical Center of the Affiliated Taian City Central Hospital of Qingdao University from April 2021 to April 2024 were selected. Basic data were collected, including age, gender, disease course, location of the apical vertebra, whether to learn dance, whether to like sports, BMI, Cobb Angle, rotation Angle, etc. The inspiratory muscle strength was tested by an inspiratory muscle training instrument, and the thickness and mobility of the diaphragm were measured by a color Doppler ultrasound diagnostic system. SPSS 22.0 software was employed for data statistical analysis. $P < 0.05$ was regarded as statistically significant.

Results

Only 29.22% of adolescent idiopathic scoliosis patients had good inspiratory muscle function. Univariate analysis showed that there was no significant difference in gender, age, location, course of disease, BMI, rotation Angle and other factors among different inspiratory muscle strength groups ($P>0.05$). However, there were significant differences between the two groups in whether to learn dance, whether to exercise regularly and Cobb Angle ($P<0.05$). Taking the inspiratory muscle strength as the dependent variable, and taking whether to learn dance, whether to exercise regularly, Cobb Angle and diaphragm mobility as the independent variables with $P<0.15$ in univariate analysis, multivariate Logistic regression analysis showed that Cobb Angle and diaphragm mobility were independent influencing factors of respiratory muscle strength ($P<0.05$).

Conclusion(s)

Patients with adolescent idiopathic scoliosis have inspiratory muscle dysfunction, and Cobb Angle and diaphragm ROM are independent influencing factors of respiratory muscle strength.

Clinical significance

To provide a reference for developing personalized respiratory rehabilitation programs and improving the overall rehabilitation effect of patients with scoliosis.

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INVESTIGATING NEUROMUSCULAR DYSFUNCTION IN ADOLESCENT IDIOPATHIC SCOLIOSIS: INSIGHTS INTO SCAPULA STABILIZER ACTIVATION PATTERNS

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Background

It is a consensus that scoliosis can cause neuromuscular control disorders. Several studies have primarily focused on neuromuscular control deficits around the scapula stabilizers in adolescents with idiopathic scoliosis (AIS). A thorough understanding of the neuromuscular control mechanisms of the scapula stabilizers in AIS populations is essential to modify disease progression and develop effective rehabilitation interventions, but there is a lack of research in this area.

Objective (s)

The purpose of this study is to explore the neuromuscular characteristics of scapula stabilizers in adolescent idiopathic scoliosis (AIS) through anticipatory muscle activations (AMAs).

Study Design

Case-sectional study.

Methods

17 AIS subjects and 19 age-matched healthy subjects were recruited into this study. Both the AIS and healthy groups performed right and left upper limb reaching tasks at three different heights while surface electromyography monitored the activity of scapular stabilizers. The bilateral infraspinatus (IS) muscles, upper trapezius (UT) muscles, lower trapezius (LT) muscles, serratus anterior (SA) muscles, latissimus dorsi (LD) muscles and the anterior deltoid (AD) on the motor side were recorded. Then compared the AMAs incidence, onset latencies and AMAs amplitudes of scapula stabilizers.

Results

For AMA incidence, ipsilateral UT (iUT) and ipsilateral IS (iIS) exhibited the highest, 72.59% and 70.06% respectively. But there was a significantly decline in the concave side of the thoracic in AIS group, iUT (55.63 ± 14.74 vs. 45.21 ± 19.92 , $t = 2.330$, $p = 0.034$) and iIS (59.38 ± 20.16 vs. 48.13 ± 22.11 , $t = 2.316$, $P = 0.035$). Concerning the onset latencies, there was a delay in the ipsilateral LT ($F = 3.586$, $P < 0.05$, $\eta^2_p = 0.006$) and advance in the contralateral UT ($F = 7.753$, $P < 0.001$, $\eta^2_p = 0.027$), contralateral IS (cIS) ($F = 6.554$, $P < 0.01$, $\eta^2_p = 0.024$) on concave side compared to the healthy. Additionally, almost all scapula stabilizers in AIS group exhibited reduction of AMAs amplitude compared to the healthy group.

Conclusion(s)

This preliminary study suggests potential neuromotor control impairments in the AIS population, as indicated by observed trends in the incidence, amplitude, and timing of AMAs in scapular stabilizers.

Clinical significance

Insights from this study may offer valuable recommendations to the design of future bracing and physiotherapeutic scoliosis-specific exercise interventions targeting the neurodevelopmental during adolescence.

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DIFFERENCES IN LOWER LIMB BIOMECHANICS BETWEEN ADOLESCENT IDIOPATHIC SCOLIOSIS AND HEALTHY ADOLESCENTS: A RETROSPECTIVE STUDY

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Background

Spinal and pelvic biomechanics in adolescent idiopathic scoliosis (AIS) patients have been a hot topic in previous research on the etiology of AIS, and there are few studies related to lower extremity biomechanics in AIS patients.

Objective (s)

This study aimed to investigate the differences in lower limb biomechanics between AIS patients and healthy adolescents.

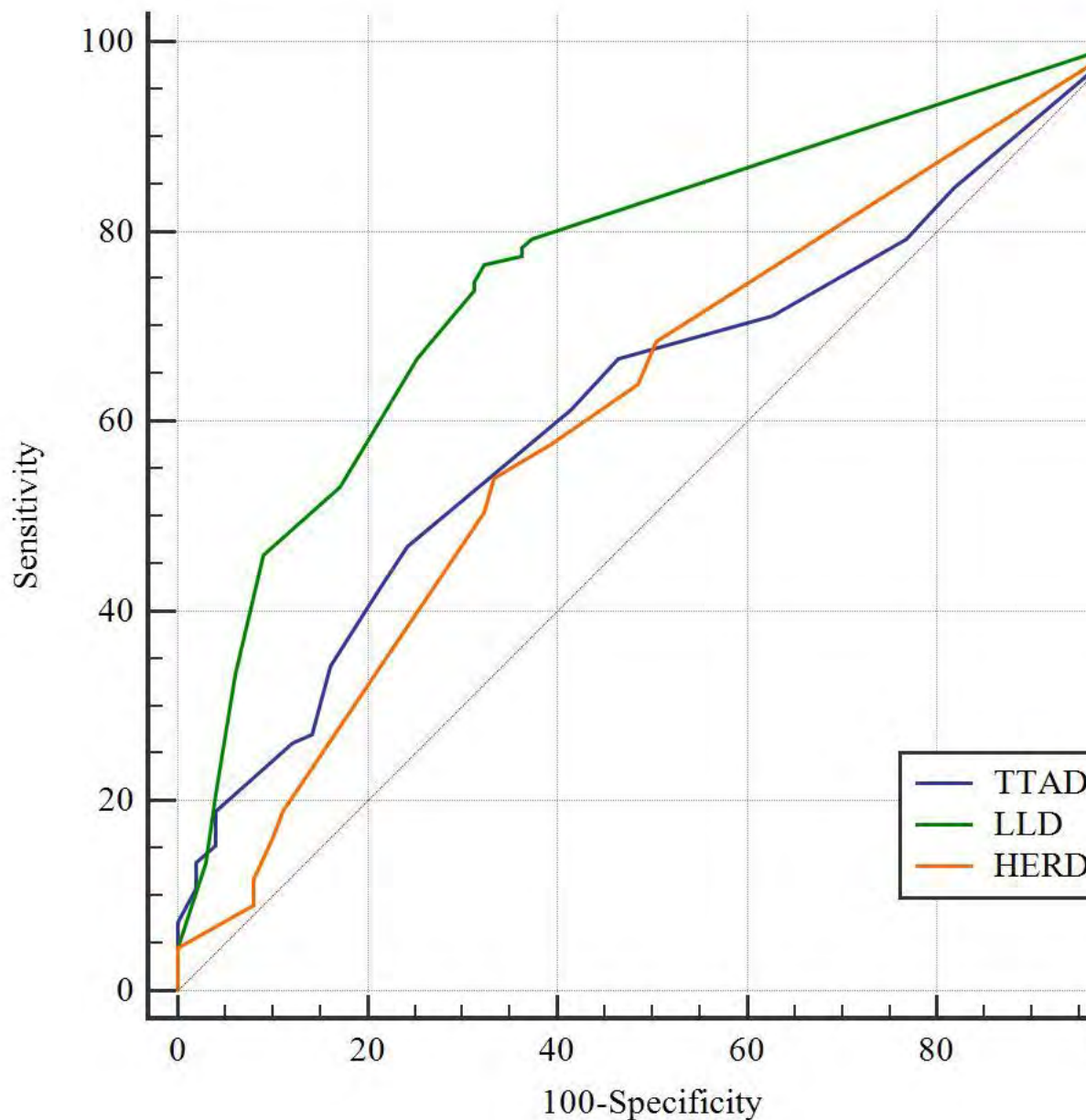
Study Design

This is a single-center retrospective study.

Methods

This study selected 111 AIS patients who met the inclusion criteria from 2018 to 2024 and 99 healthy adolescents during the same period as the control group. Measurements were recorded for both groups of patients on bilateral lower limb resting calcaneal stance position difference (RCSPD), neutral calcaneus stance position difference (NCSPD), tibial torsion angle difference (TTAD), hip internal rotation difference (HIRD), hip external rotation difference (HERD), forefoot-rearfoot angle discrepancy (FRAD), and leg length discrepancy (LLD), followed by comparative analysis, logistic regression analysis, and ROC analysis. Additionally, the AIS group was subdivided based on severity levels (mild, moderate) and different types of leg alignment (varus, valgus) for subgroup analysis.

Results



AIS group had higher TTAD, HERD, and LLD than the control group ($P < 0.05$). Through logistic regression analysis, HERD [$P < 0.05$, constant (B)=0.112, odds ratio (OR)=1.118] indicated that each 1° increase in HERD increased the risk of AIS by 11.8%. LLD ($P < 0.001$, B=0.276, OR=1.317) indicated that each 1 mm increase in LLD increased the risk of AIS by 31.7%. ROC analysis revealed that LLD (AUC=0.761) had the best capability to distinguish between AIS and the control group, followed by TTAD (AUC=0.620), and lastly HERD (AUC=0.608). In

analyzing different severity levels of AIS, gender ($P<0.01$, $B=1.368$, $OR=3.926$) was a risk factor, with females having a 3.926 times higher risk of suffering from moderate AIS compared to males. HERD ($P<0.05$, $B=-0.123$, $OR=0.884$) indicates that for each 1° decrease in HERD, the risk of moderate AIS is reduced by 11.6% compared to mild AIS. In the analysis of AIS with different leg types, FRAD ($P<0.05$, $B=0.536$, $OR=1.710$) indicates that each 1° increase in FRAD, compared to a normal leg type, increases the risk of knee valgus by 71%. LLD ($P<0.05$, $B=0.222$, $OR=1.248$) indicates that each 1 mm increase in LLD increases the risk of knee valgus by 24.8% relative to a normal leg type.

Conclusion(s)

AIS patients show significant differences in TTAD, HERD, and LLD compared to healthy adolescents, with increases in HERD and LLD potentially elevating the risk of developing AIS. LLD demonstrates high diagnostic efficacy when diagnosing AIS. Females and those with greater HERD are at higher risk for moderate AIS, while increases in LLD and FRAD elevate the risk of AIS with knee valgus.

Clinical significance

Lower limb biomechanical measurements can provide valuable reference for AIS diagnosis, assessment, and treatment plan formulation.

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RESEARCH ON THE CHARACTERISTICS OF PLANTAR PRESSURE DISTRIBUTION IN BOTH LOWER LIMBS DURING WALKING IN ADOLESCENTS WITH IDIOPATHIC SCOLIOSIS

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Background

Adolescent idiopathic scoliosis (AIS) is a three-dimensional spinal deformity that not only affects patients' posture control and motor balance but may also alter plantar pressure distribution patterns, subjecting patients to asymmetrical loads during walking, resulting in imbalanced plantar pressure and abnormal center of pressure trajectories. This, in turn, exacerbates impairments in gait neural control, induces back pain, and accelerates spinal curvature. However, due to limitations in data acquisition and processing techniques in the past, few studies have compared and analyzed the pressure distribution in different regions of both feet during walking in AIS patients.

Objective (s)

This study aims to compare and analyze dynamic plantar pressure distribution in AIS patients during walking, providing a scientific basis for quantitative gait analysis as an auxiliary assessment and diagnostic tool. It also seeks to offer a new perspective for clinical treatment planning, with the goal of establishing precise risk stratification indicators and optimizing treatment strategies.

Study Design

A retrospective study.

Methods

This study enrolled 30 adolescent idiopathic scoliosis patients. A plantar pressure testing system was used to collect indicators related to pressure distribution (the peak pressure and time-pressure integral values in various zones of the plantar region) during walking, and paired-sample t-tests were conducted for bilateral foot comparisons.

Results

This study included 30 AIS patients (20 females, 10 males; age: 11.68 ± 1.29 years; Cobb angle: $15.11 \pm 2.49^\circ$; Risser grade: 1.58 ± 0.96 grade). The peak pressure analysis showed significantly lower pressure in the left M1 ($t = -2.344$, $P = 0.031$) and M4 zones ($t = -2.264$, $P = 0.036$) compared to the right, while the left M5 zone ($t = 2.328$, $P = 0.032$) had higher pressure. For time-pressure integrals, the left FA ($t = -2.141$, $P = 0.046$), T1 ($t = -0.287$, $P = 0.035$), and M1 zones ($t = -2.242$, $P = 0.038$) had lower values than the right, whereas the left M5 zone ($t = 3.251$, $P = 0.004$) had a significantly higher value.

Conclusion(s)

This study revealed significant left-right asymmetry in plantar pressure distribution among scoliosis patients, particularly in the AF, M1, M4, and M5 zones. This asymmetry may closely correlate with pelvic obliquity, altered lower limb alignment, and changes in plantar muscle and ligament tension due to scoliosis.

Clinical significance

Therefore, for AIS patients, conducting plantar pressure analysis and implementing targeted interventions (e.g., customized insoles, orthotics) based on the results can help improve plantar pressure distribution, alleviate related symptoms, and prevent complications. Additionally, this study's

findings offer valuable insights into the impact of scoliosis on plantar pressure distribution, guiding future clinical research and treatment with new ideas and directions.

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CORRELATION OF TORSOBAROGRAPHIC SYMMETRY INDICES WITH SURFACE TOPOGRAPHIC INDICES OF ADOLESCENT IDIOPATHIC SCOLIOSIS

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Background

Surface topography (ST) has demonstrated its potential for use in screening and progression evaluation of adolescent idiopathic scoliosis (AIS), reducing the number of radiographic examinations. ST systems measure in a standing position and require complete undressing of the torso, which reduces compliance, particularly among adolescent girls. The novel ST method of torsobarography offers a solution by analyzing the back surface based on the pressure distribution in a supine position on a dressed subject.

Objective (s)

The aim of the study was to determine the correlation between symmetry indices of torsobarography and established indices of an ST reference system to evaluate the potential of torsobarography for radiation-free spinal assessment in mild ($10^{\circ} \leq \text{Cobb angle} < 20^{\circ}$) and moderate scoliosis ($20^{\circ} \leq \text{Cobb angle} < 40^{\circ}$).

Study Design

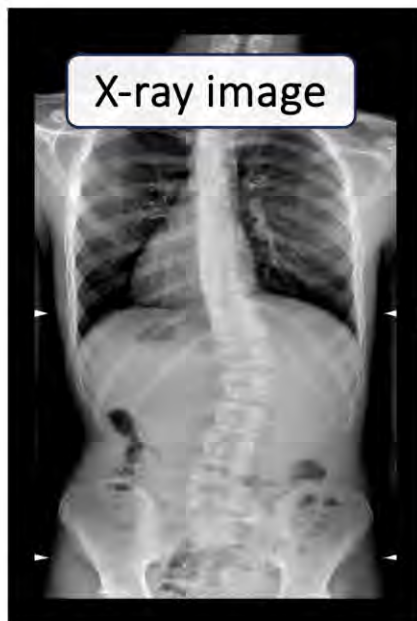
Retrospective correlational study

Methods

A total of 71 subjects were included and divided into a mild scoliosis group (Cobb angle: $13.9 \pm 2.8^{\circ}$; 47 subjects; age: 13.7 ± 2.7 years) and a moderate scoliosis group (Cobb angle: $26.5 \pm 6.0^{\circ}$; 24 subjects; age: 14.2 ± 2.3 years). The torsobarography measurement was conducted using a pressure sensor array (LX100:100.160.05, XENSOR) attached to a soft pad. The subjects were measured in a standardized position: knees bent (100°), arms spread apart, palms facing downwards, and looking upwards. From the pressure image, the following indices were extracted: the absolute difference between the left and right pressure maximum in the thoracic region (T1) and the ratio between the summed pressure values of the left and right thoracic region (T2). The DIERS Formetric 4D served as the ST reference system and the following indices were selected: scoliosis angle (F1), lateral deviation RMS (F2) and surface rotation RMS (F3). The correlation between the torsobarographic indices and Formetric 4D indices was evaluated using the Spearman correlation coefficient ρ .

Results

Significant correlations of $\rho=0.47$ (T2-F3) to $\rho=0.75$ (T1-F1) were achieved for moderate scoliosis. Especially the index T1 showed good positive correlations to the reference system for T1-F1 ($\rho=0.75$) and T1-F3 ($\rho=0.62$). Additionally, the index T2 provided positive moderate correlations of $\rho=0.49$ (T2-F2) to $\rho=0.49$ (T2-F1) for the moderate scoliosis group. For the mild scoliosis group, a significant positive correlation was only found between T1-F3 ($\rho=0.43$). All further correlation coefficients determined for the mild scoliosis group were not significant.



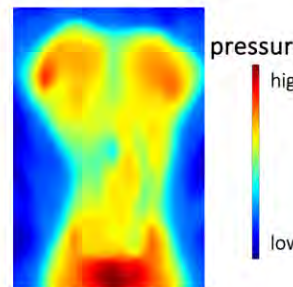
divide data according to curve magnitude

mild scoliosis

moderate scoliosis

Spearman correlation

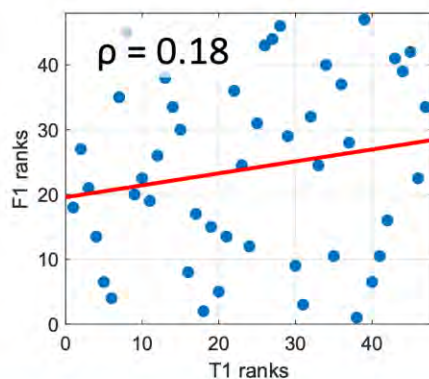
Torsobarography



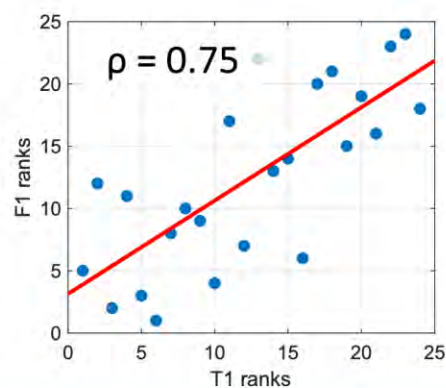
- T1: absolute pressure symmetry
- T2: relative pressure symmetry

scattering of ranks

mild scoliosis



moderate scoliosis



mild scoliosis	
ρ	
T1	0.18
T2	0.18

moderate scoliosis	
ρ	
T1	0.75
T2	0.75

*: p-value < 0.05

Conclusion(s)

This study demonstrated that torsobarographic indices correlate with established ST indices for spinal non-radiographic assessment of moderate scoliosis. In contrast, the effective assessment of mild scoliosis currently appears to be a challenge for torsobarography.

Clinical significance

The investigations showed that the pressure distribution in the supine position provides interpretable information related to ST data in the standing position for AIS. Therefore, torsobarography has the potential to become an ST method with high compliance and improved suitability for diverse populations (e.g., individuals with physical impairments, such as wheelchair users).

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THE CLINICAL APPLICATION OF PRO-KIN BALANCE TEST SYSTEM IN THE EVALUATION OF ADOLESCENT IDIOPATHIC SCOLIOSIS

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Background

To determine whether there is a correlation between lateral bending Angle and balance function in AIS patients, and to provide objective basis and dynamic monitoring indicators for further guidance of balance function training in AIS patients.

Objective (s)

The Pro-kin balance test system was used to assess balance function in adolescents with idiopathic scoliosis (AIS).

Study Design

The balance function of lower limbs corresponding to the convex and concave sides of the main curvature of AIS patients was evaluated by the Pro-kin balance test system in eligible AIS patients.

Methods

21 AIS patients who met the inclusion criteria, aged 10-17 years and Cobb degrees 21-35, were selected as the study objects. The Pro-kin balance test system is selected as an evaluation instrument to evaluate the static and dynamic balance functions. The evaluation indexes of the subjects were Romberg rate (area ratio and length ratio of the swing of the center of gravity of the closed/open eyes), Average Track Error (ATE%), Stability Index (SI) of the front and rear axis, left and right axis, circumference, and Limit Of stability (LOS), etc. Quantitatively assess the balance function of AIS patients, compare the difference in the balance function indexes of lower limbs corresponding to the convex and concave sides of the main curvature of AIS patients, and determine whether there is a correlation between the main curvature Angle of AIS patients and the balance function indexes.

Results

There were significant differences among the static and dynamic balance function indexes ATE%, anterior and posterior axis SI, left and right axis SI, and circumferent SI measured on the convex and concave sides of the main curved line of AIS patients, with statistical significance ($P < 0.05$). Correlation analysis between Cobb Angle and static and dynamic balance function indicators in AIS patients: Cobb Angle was correlated with Romberg rate (ratio of area of center of gravity to area of center of gravity to length of center of gravity to open and closed eyes), ATE%, and SI of anterior and posterior axes, with statistical significance ($P < 0.05$).

Conclusion(s)

The static and dynamic balance deviation indexes of the lower limbs corresponding to the convex side of the main bending line in AIS patients are lower than those measured by the concave side, and the balance function of the lower limbs corresponding to the concave side is worse than that of the lower limbs corresponding to the convex side. The Romberg rate, average trajectory error and stability index of front and rear axes in static and dynamic balance of AIS patients were related to the Cobb Angle of the main bend, The others have nothing to do with the Cobb Angle.

Clinical significance

The clinical content of conservative treatment of scoliosis is enriched, and the treatment is more targeted.

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BACK-FORWARD BENDING CT: A NOVEL IMAGING TECHNIQUE TO EVALUATE THE SAGITTAL FLEXIBILITY OF KYPHOSIS SECONDARY TO ELDERLY DELAYED OSTEOPOROTIC THORACOLUMBAR FRACTURE

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Background

Bending radiographs, an essential tool of assessing scoliotic curve flexibility, is indispensable and widely used for planning surgical treatment in spinal scoliosis. By contrast, the concept of flexibility of kyphosis and the bending image method for assessing sagittal flexibility has not been documented, and the imaging technique to evaluate kyphotic curve flexibility is lacking. The degree of kyphosis changes along with the curve magnitude in different postures. Such phenomenon is worthy of further study.

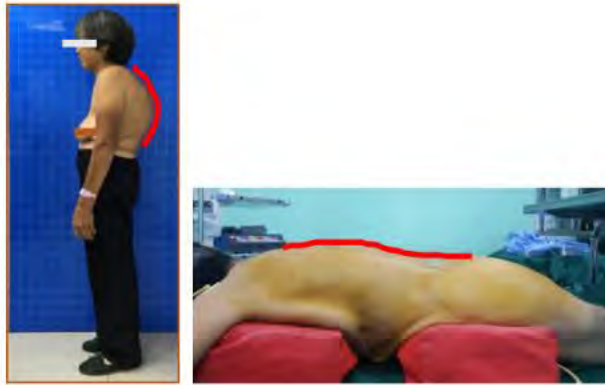


Fig 1. Female, 74y, kyphosis secondary to ed-OTLF. The round kyphotic back in standing position changed to almost normal curve in prone position before operation.

Objective (s)

This study aims to introduce back-forward bending CT (BFB-CT), a novel imaging technique to evaluate the sagittal flexibility of kyphosis secondary to elderly delayed osteoporotic thoracolumbar fracture (ed-OTLF).

Study Design

Cohort Study Design

Methods

1. The conventional standing lateral full-spine X-ray (SLFSX) and BFB-CT image with simulated surgical prone position were obtained for patients with ed-OTLF in a single medical center.
2. Before the scout view of BFB-CT performed, the upper limbs are naturally flexed and placed on both sides of the head and neck. Two special soft pads are placed at the level of the patients' proximal chest and iliac spine to keep the distal chest and the whole abdomen almost suspended. The kyphotic back is pulled to bend forward, drooped naturally under the help gravity suspension, and the degree of kyphosis decreased spontaneously. CT scout image scanning was performed from the skull to the pelvis including the whole spine.
3. The thoracic kyphosis (TK), thoracolumbar kyphosis (TLK), local kyphosis of injured vertebrae (LKIV), lumbar lordosis (LL), and sagittal vertical axis (SVA) were measured and compared based on the two kinds of images. Curve flexibilities were then calculated respectively. Correlations of

sagittal parameters between SLFSX and BFB-CT were determined by Pearson correlation

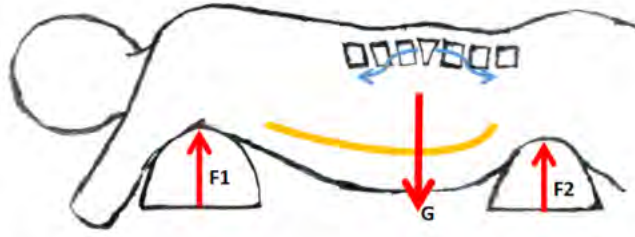


Fig 2. The illustration of an ed-OTLF-related kyphotic patient preparing for BFB-CT examination. Two soft pads are placed on the proximal chest and ilium. Kyphosis is restored by pulling the chest and abdomen forward with gravity. coefficient.

Results

28 patients with an average age of 69.5 ± 8.5 years were included. Comparison of the parameters between SLFSX and BFB-CT, TK decreased from $43.9 \pm 17.0^\circ$ to $30.1 \pm 14.3^\circ$ with a flexibility of 34.1%, TLK decreased from $47.4 \pm 11.4^\circ$ to $30.1 \pm 9.7^\circ$ with a flexibility of 36.2%, LKIV decreased from $32.7 \pm 9.4^\circ$ to $19.9 \pm 8.0^\circ$ with a flexibility of 39.3% and SVA decreased from 5.3 ± 5.2 cm to 2.1 ± 2.5 cm, with significant positive correlations and differences (all, $p < 0.0001$). LL increased from $-40.4 \pm 21.1^\circ$ to $-42.4 \pm 19.7^\circ$ ($p > 0.05$).

Table 1. Demographics of all the 28 patients.	
Characteristic	Value
Age (y)	69.5 ± 8.5 (56-92)
Gender	
Men, n (%)	6 (27.3%)
Women, n (%)	22 (62.7%)
Fracture location	
T11	5
T12	6
L1	10
L2	1
T12, L1	5
T12, L1, L2	1
Fracture non-union	
Yes	17
No	11
Course of disease (month)	9.1 ± 9.8 (0.8-36)

Conclusion(s)

BFB-CT technique is feasible and reliable method for obtaining sagittal bending image and evaluating the flexibility of the kyphosis secondary to ed-OTLF.

Clinical significance

This study is the first to propose the concept of flexibility of spinal kyphosis and use BFB-CT as the bending image to evaluate sagittal flexibility.

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THE EFFECT OF VISION ON PLANTAR PRESSURE CHARACTERISTICS DURING STATIC BALANCE IN ADOLESCENTS WITH IDIOPATHIC SCOLIOSIS

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Background

Adolescent idiopathic scoliosis (AIS), a common three-dimensional structural deformity of the spine, exhibits a complex pathogenesis. Due to the shift in the body's center of mass, it is often considered to significantly impact patients' balance function and postural stability. Although preliminary studies have revealed the postural characteristics of AIS patients, there remains a lack of in-depth and systematic research on the specific mechanisms of the visual system in regulating static balance and plantar pressure distribution in these patients.

Objective (s)

To reveal the potential role of visual factors in balance control among patients with scoliosis by comparing and analyzing the plantar pressure distribution characteristics of adolescent idiopathic scoliosis (AIS) patients under normal visual conditions and visual deprivation conditions.

Study Design

A retrospective study.

Methods

This study enrolled 30 AIS patients. A plantar pressure testing system was used to record the total sway path length, envelope area, ellipse curvature and the center of gravity swing in four directions during static standing under open-eye and closed-eye conditions. Paired-sample t-tests were conducted to compare and analyze the plantar pressure and center of gravity swing characteristic parameters between the two conditions.

Results

This study included 30 AIS patients (20 females, 10 males; age: 11.68 ± 1.29 years; Cobb angle: $15.11 \pm 2.49^\circ$; Risser grade: 1.58 ± 0.96 grade). The analysis showed that the total sway path length ($t=3.022$, $P=0.007$), envelope area ($t=2.860$, $P=0.010$), and ellipse curvature ($t=3.236$, $P=0.004$) of AIS patients were significantly greater during open-eye conditions compared to closed-eye conditions. However, no significant differences were found in the left-right foot pressure ratio, anterior-posterior foot pressure ratio, and center of gravity sway amplitude in the lateral and anterior-posterior directions ($P>0.05$).

Conclusion(s)

AIS patients exhibited larger balance indices such as total sway path length, envelope area, and ellipse curvature during open-eye conditions compared to closed-eye conditions, indicating poorer balance performance. This may be related to visual interference in balance, imbalance in vestibular function and proprioceptive senses, and the direct impact of scoliosis on balance ability. To improve the balance ability of scoliosis patients, targeted rehabilitation training measures can be implemented, such as strengthening core muscle groups and improving vestibular function and proprioceptive functions. Additionally, incorporating balance exercises under closed-eye conditions during training can enhance patients' internal balance mechanisms.

Clinical significance

By comparing and analyzing the plantar pressure distribution characteristics of AIS patients under normal visual conditions and visual deprivation conditions, this study aims to reveal the potential role of visual factors in balance control among scoliosis patients, reduce the risk of falls and prevent secondary injuries. This contributes to establishing a more comprehensive balance control model and provides more effective strategies and methods for rehabilitation treatment of scoliosis patients.

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GAIT CHARACTERISATIONS IN ADOLESCENT IDIOPATHIC SCOLIOSIS PATIENTS WITH RIGO A

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Background

Adolescent idiopathic scoliosis (AIS) is one of the most common scoliosis abnormalities, with a prevalence of 1% to 3%. AIS affects the biomechanics of the lower limbs, resulting in altered gait patterns. In turn, abnormal gait characteristics may lead to increased asymmetric load on the spine and contribute to the progression of AIS. Previous studies have shown that patients with Rigo type A have significant spinal coronal parameter imbalances, but the characteristics of gait have rarely been reported.

Objective (s)

The aim of this study was to compare the gait characteristics and trunk force characteristics of Rigo type A AIS patients with healthy controls. The results may provide reference for clinical intervention.

Study Design

A cross-sectional design was adopted in this study. The study protocol was registered with the Chinese Clinical Trial Registry (Number: ChCTR1800018310) and the Human Subject Committee of Guangzhou Sport University (Number: 2023LCLL-10).

Methods

10 Rigo type A AIS patients (aged 10-16 years) and an equal number of healthy age and sex matched teenagers (normal group). We used a 3D motion capture system to analyze the spatiotemporal parameters of the gait of the two groups of participants. Firstly, the German Zebris FDM gait analysis system was used to collect the gait parameters of the subjects at normal speed. Secondly, Vicon motion capture system combined with AMTI force platform was used to analyze the dynamic parameters of gait at constant speed and calculate the force of trunk by reverse equation. Participants were measured three times and averaged for statistical analysis. All experimental data were statistically processed and

analysed using SPSS 26.0 software, with independent samples t-test for data that conformed to normal distribution, and rank sum test for data that did not conform to normal distribution, and the statistical results were expressed as mean $\pm$ standard deviation.

Results

Compared to the normal group, the double stance phase is longer ($25.43 \pm 1.77\%$ vs. $22.98 \pm 2.90\%$). In addition, in patients with Rigo type A AIS, the force in the vertical direction of the trunk reached a maximum in the early phase of the right stance in the complete gait cycle.

Conclusion(s)

Compared with healthy controls, patients in this group had a larger proportion of bistationary gait cycles, suggesting that they may improve physical stability while walking by increasing bistationary compensation. This group of patients experienced the greatest vertical force on the trunk at the early stage of the right stance phase, which may be related to the right-facing coronal imbalance of the spine shown by the right thoracic curve.

Clinical significance

The results will inform clinical rehabilitation strategies and help set goals for corrective and aesthetic modifications.

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THREE-DIMENSIONAL SPINAL AND PELVIC PARAMETERS, GAIT ANALYSIS, AND THE CORRELATION WITH LOWER LIMB BIOMECHANICS IN ADOLESCENTS WITH IDIOPATHIC SCOLIOSIS

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Background

Adolescent Idiopathic Scoliosis (AIS) is the most prevalent spinal deformity in adolescents, potentially resulting from asymmetric spinal development and an imbalance in spinal-pelvic mechanics. Load pattern alteration may contribute to gait abnormalities and disruptions in lower limb biomechanics in AIS patients.

Objective (s)

This study explores the relationship between gait analysis parameters, lower limb biomechanical factors, and three-dimensional spinal-pelvic parameters in AIS patients.

Study Design

A single-center, cross-sectional observational design

Methods

This study involved 40 AIS patients who met the inclusion criteria. Full spine and bilateral lower limb weight-bearing lateral radiographs were used to measure coronal parameters, including the Cobb angle, Coronal Vertical Axis (CVA), Apical Vertebral Translation (AVT), T1 Tilt Angle, and the coronal sacral tilt (CSS). Sagittal parameters included the Cervical Vertebra Cobb Angle (CVCA), Thoracic Cobb Angle (TCA), Lumbar Cobb Angle (LCA), Sagittal Vertical Axis (SVA), Sacral Slope (SS), pelvic Tilt (PT), and Pelvic Incidence (PI). The trunk rotation angle (ATR) was measured using Adam's Forward Bend Test and the Scoliometer. The patient's gait pattern was assessed using the Tecnobody digital gait analysis system. Lower limb biomechanical parameters, including the Calcaneal Deviation Angle (CDA), Tibial Torsion Angle (TTA), Hip Internal Rotation Range (HIR), Hip External Rotation Range (HER), Forefoot-Rearfoot Angle (FRA) were measured as well. Stepwise multiple linear regression analysis was performed to determine the relationship between gait analysis, lower limb biomechanical, and radiographic parameters.

Results

The body weight ($B=0.022$, $p=0.001$) and CSS ($B=0.052$, $p=0.006$) were significant positive predictors of center of mass vertical displacement, while T1 Tilt Angle ($B=-0.054$, $p=0.002$) and LCA ($B=-0.012$, $p=0.035$) were negative predictors. These factors explained 41.95% of the variance. Age ($B=2.647$, $p<0.001$) and CVCA ($B=2.647$, $p=0.022$) were positive predictors of stride length on the main curve side (44.6% variance). Age ($B=-0.707$, $p=0.003$) and CVCA ($B=-0.095$, $p=0.006$) were negative predictors of the coefficient of variation (CV) on the main curve side (36.1% variance) and non-main curve side ($B=-0.727$, $p=0.002$; $B=-0.08$, $p=0.018$, 34.1% variance). For lower limb biomechanics, age ($B=-0.506$, $p=0.015$) and CSS ($B=-0.228$, $p=0.027$) were negative predictors of CDA on the main curve side (30.9% variance). CSS ($B=0.487$, $p=0.046$) was a positive predictor of TTA on the main curve side, while TCA ($B=-0.222$, $p=0.035$) and PT ($B=-0.191$) were negative predictors. ATR ($B=1.359$) was a positive predictor of TTA on the non-main curve side, while Cobb angle ($B=-0.348$) and TCA ($B=-0.244$) were negative predictors. PT ($B=0.445$) was a positive predictor of FRA on the main curve, while CVA ($B=-0.104$) negatively predicted FRA.

Conclusion(s)

The imaging parameters of the spine and pelvis, along with ATR, significantly influence and predict gait analysis parameters and lower limb biomechanical factors.

Clinical significance

This offers a theoretical foundation for correcting spinal and pelvic imaging imbalances to enhance gait patterns and lower limb biomechanical alignment in AIS patients.

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CORRELATION ANALYSIS BETWEEN THREE-DIMENSIONAL SPINAL AND PELVIC PARAMETERS AND SURFACE ELECTROMYOGRAPHY OF PARASPINAL AND LUMBAR MUSCLES IN ADOLESCENT IDIOPATHIC SCOLIOSIS

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Background

Background: Adolescent idiopathic scoliosis (AIS) is the most common spinal deformity and may result from asymmetric development of the spine and pelvic mechanical imbalance. Changes in load patterns can lead to imbalances in the surface electromyography (SEMG) parameters of paraspinal muscles.

Objective (s)

This study aims to explore the relationship between SEMG parameters of the paraspinal muscles and quadratus lumborum (QL) muscles and three-dimensional spinal-pelvic parameters in AIS patients.

Study Design

This was a single-center cross-sectional observational study.

Methods

This study including 40 AIS patients meeting the inclusion criteria. Full-spine and weight-bearing lateral radiographs were taken to measure coronal parameters, including Cobb angle, Coronal Vertical Axis (CVA), Apical Vertebral Translation (AVT), T1 Tilt Angle, and Coronal Sacral Slope (CSS). Sagittal parameters measured included Cervical Vertebra Cobb Angle (CVCA), Thoracic Cobb Angle (TCA), Lumbar Cobb Angle (LCA), Sagittal Vertical Axis (SVA), Sacral Slope (SS), Pelvic Tilt (PT), and Pelvic Incidence (PI). Trunk rotation angle (ATR) was measured using the Adam's forward bending test and Scoliometer. SEMG values, including the average electromyography (AEMG), root mean square (RMS), median frequency (MF), and mean power frequency (MPF) of the paraspinal and QL muscles on the main and non-main curve sides, were measured using the UM1-SE-1 SEMG analysis system. A stepwise multiple linear regression analysis was performed to identify the relationships between SEMG parameters and radiographic parameters.

Results

Disease duration ($B=-1.025, p=0.015$) and LCA ($B=-0.551, p<0.001$) were significant negative predictors of MF in the non-main curve side paraspinal muscles, explaining 40% of its variance. PI ($B=0.528, p=0.047$) significantly predicted MPF in the main curve side paraspinal muscles, while age ($B=-5.039, p=0.001$) significantly predicted MPF, explaining 35.6% of the variance in MPF. Age ($B=-2.370, p=0.047$), disease duration ($B=-1.064, p=0.041$), LCA ($B=-0.585, p=0.003$), and T1 Tilt Angle ($B=-1.075, p=0.037$) were significant negative predictors of MPF in the non-main curve side paraspinal muscles, explaining 54.3% of the variance. PT ($B=3.616, p=0.026$) and SS ($B=7.892, p=0.003$) significantly predicted AEMG in the main curve side paraspinal muscles, explaining 31.4% of the variance. SS ($B=8.393, p=0.001$) significantly predicted AEMG in the non-main curve side paraspinal muscles, while weight ($B=-2.348, p=0.016$) significantly negatively predicted AEMG, explaining 35.5% of its variance. Weight ($B=-0.457, p=0.032$) and CVA ($B=-0.595, p=0.022$) were significant negative predictors of MF in the main curve side QL muscles, explaining 22.6% of its variance. Age ($B=9.137, p=0.014$) significantly predicted AEMG in the main curve side QL muscles, while weight ($B=-2.407, p=0.001$) significantly negatively predicted AEMG, explaining 38.8% of its variance.

Conclusion(s)

The coronal and sagittal radiographic parameters of the spine and pelvis, along with the ATR, significantly influence and predict SEMG parameters of the paraspinal and QL muscles in AIS patients.

Clinical significance

These findings provide theoretical support for correcting spinal and pelvic imbalances in clinical practice to improve neuromuscular function in the paraspinal and QL muscles of AIS patients.

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VALIDATION OF THE DECISION SUPPORT SYSTEM FOR DETERMINING THE SEVERITY OF SCOLIOTIC SPINAL DEFORMITY BY THE ANALYSIS OF RADIOGRAPHS

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Background

The **Cobb angle**, a widely recognized metric, serves as the gold standard for quantifying the severity of spinal curvature. Accurate measurement of the Cobb angle is critical for diagnosing scoliosis, planning treatment, and monitoring its progression. However, manual measurement of the Cobb angle on radiographs is subject to inter- and intra-observer variability, which may affect consistency and reliability in clinical decision-making. Decision Support Systems (DSS) equipped with machine learning algorithms have demonstrated potential for improving the efficiency and accuracy of scoliosis evaluation. In 2020 the computer program “The Decision Support System for determining the severity of scoliotic spinal deformity by the analysis of radiographs” was developed. These systems aim to reduce human error, provide consistent results, and offer standardized approaches to estimate Cobb angle.

Objective (s)

The main goal of study was to prove the possibility of using in clinical practice the DSS computer program for Cobb angle determination by means of comparative analysis of the obtained automated data with the data of manual measurement by specialists.

Study Design

Applied validation study (diagnostic accuracy study)

Methods

A total of 411 digital spinal radiographs of children and adolescents with idiopathic scoliosis (II-III degree), treated with CAD/CAM-modeled Rigo-Chêneau braces, were analyzed. Measurements were performed by a certified radiologist with extensive vertebrology experience (gold standard - R-Etalon), a radiologist without deep experience in vertebrology (R-Beginner), and the computer program in its initial (KP1) and retrained (KP2) versions. The study assessed Mean Absolute Percentage Error (MAPE) and Mean Absolute Deviation (MAD) across different curve types and sizes, with reliability evaluated using Intraclass Correlation Coefficients (ICC) and Pearson correlation coefficients.

Results

After add-on training, the DSS computer program improved the accuracy of measurement in general for curves and types of scoliosis, exceeding the R-beginner by almost two times in the MARE indicator. The previously identified issue of measuring the value of the lumbar (lumbosacral curve) was eliminated in the program. KP2 data have the highest correlation with the reference ($R=0,94$). The excellent level of reliability of the program ($ICC=0,95$ when counting on the main curve and $0,97$ when counting on all curves), comparable with foreign analogues, was proved. It is also confirmed that the average absolute deviation of $\pm 3,2^\circ$ and $\pm 4,0^\circ$ on the main curve corresponds to data from other researchers groups..

Conclusion(s)

It is possible to conclude about the possibility of validation of the DSS computer program as it is proved that the current algorithm of the computer program gives accuracy in comparison with the reference measurement above the level of a radiologist with no experience in vertebrology and is comparable with analogues

Clinical significance

The DSS program allow specialists from different clinics work with the same data, that increase quality of clinical decisions especially from specialists not deep involved in IS.

COMPARING SURFACE TOPOGRAPHIC RANGE OF MOTION IN PEDIATRIC PATIENTS WITH SCHEUERMANN'S KYPHOSIS TO HEALTHY CONTROLS

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Background

Scheuermann's kyphosis (SK) is a structural deformity of the thoracic spine, identified as three or more adjacent vertebrae with at least five degrees of anterior wedging per level. Though SK is typically recognized by spinal curvature in the sagittal plane, it can have concomitant coronal and axial deformities, which can alter a patient's range of motion (ROM).

Objective (s)

This study compares the ROM of patients with SK to healthy controls using surface topographic (ST) scanning.

Study Design

Case-Control Study

Methods

This retrospective IRB approved study included SK patients and healthy controls between 11-21 years of age. Patients with prior chest or spine surgery or those unable to follow ST scan instructions were excluded. ST scans were conducted while patients were asked to bend forward maximally (sagittal ROM), twist their torso left and right maximally (axial ROM), and bend their torso left and right maximally (coronal ROM). PSIS, vertebral prominence and jugular notch landmarks were tracked to calculate ROM. An analysis of covariance controlling for age, sex, and body mass index (BMI) was used to determine significant differences in the ROM (coronal, axial, and sagittal) and asymmetry (coronal and axial) of SK patients versus controls.

Results

23 patients with SK and 98 controls were analyzed. In the SK group, 78.3% were male, average age of 16.4 ± 2.3 years, and BMI of 24.1 ± 6.1 kg/m². The average thoracic kyphosis angle was $75.0^\circ \pm 16.3^\circ$. The control group was 55.1% male, average age of 13.9 ± 2.0 years, BMI of 20.9 ± 3.7 kg/m². Compared to

the controls, patients with SK had 18.0° less ROM in the sagittal plane, 12.0° less ROM in the coronal plane, and 15.5° less ROM in the axial plane (Table 1). SK patients had 30.2% greater axial plane asymmetry than the control group (Table 1), but no observable difference in coronal asymmetry.

Table 1: Surface Topographic Results

Surface Topography Values	SK Patients Results
Sagittal Plane ROM, average $\pm$ SD (range), degrees	85.7 $\pm$ 19.0 (52.4-118.9)
Coronal Plane ROM, average $\pm$ SD (range), degrees	59.6 $\pm$ 13.2 (31.5-82.4)
Axial Plane ROM, average $\pm$ SD (range), degrees	57.9 $\pm$ 20.1 (29.6-96.4)
Coronal Asymmetry, average $\pm$ SD (range), %	13.1 $\pm$ 11.2 (1.6-35.5)
Axial Plane Asymmetry Index, average $\pm$ SD (range), %	48.7 $\pm$ 53.6 (3.3-193.1)

SK: Scheuermann's Kyphosis; ROM: range of motion; SD: S

Conclusion(s)

Spinal ROM measured by ST scanning proved to be more limited in SK patients than in controls in all three planes. Prior literature has mostly shown deficits in ROM in the sagittal plane, but our results show similar deficits in ROM in the axial plane. Larger cohorts of SK patients should be studied to understand the differences in ROM compared to healthy controls and patients with other spinal deformities.

Clinical significance

This study highlights ST scanning as a radiation-free method for assessing spinal ROM, and the limited ROM in SK patients across all planes compared to healthy controls.

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IS IT NECESSITY OF LEG LENGTH DISCREPANCY EXAMINATION BEFORE BRACING FOR SCOLIOSIS?

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Background

Leg length discrepancy (LLD) is commonly referred to as functional scoliosis. When LLD persists over an extended period, it may lead to permanent changes in spinal biomechanics. Therefore, early identification and intervention of leg length discrepancy (LLD) are of crucial importance. However, few studies were reported on the necessity of leg length discrepancy examination before bracing for scoliosis for children and adolescents.

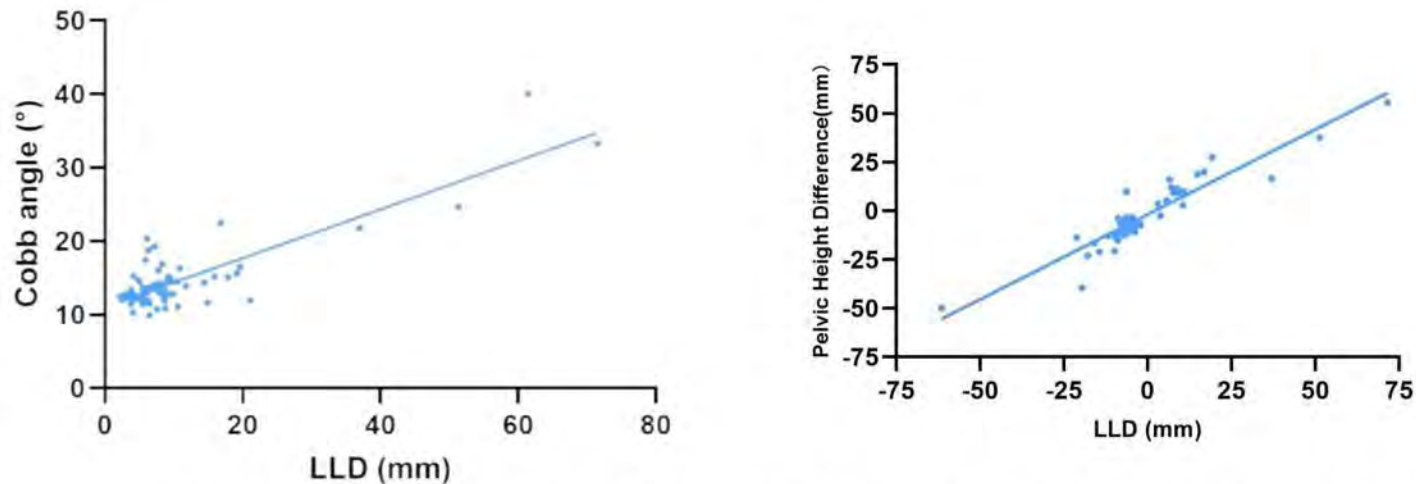


Figure. A. The Cobb angle had a significant positive correlation with the severity of LLD ($R=0.440$, $p<0.01$). B. The LLD had a significant positive correlation with Pelvic Height Difference ($R=0.874$, $p<0.01$). LLD, leg-length discrepancy.

Objective (s)

The purpose of this study is: 1.the impacts of the existence and severity of leg-length discrepancy (LLD) on scoliosis in children and adolescents; 2.the consistency between lower limb length discrepancy and pelvic height difference.

Study Design

A retrospective study following prospective data collection

Methods

Sixty-three patients with idiopathic scoliosis associated with leg length discrepancy (LLD) were included. The patients were treated in our hospital from March 2021 to July 2024. Inclusion criteria: (1) Patients are children or adolescents and have idiopathic scoliosis complicated with leg length discrepancy (LLD); (2) The type of scoliosis is thoracolumbar/lumbar curve; (3) The bilateral acetabular dome line is parallel to the superior endplate of the sacrum. Whole spine posteroanterior standing radiographs and whole lower limb radiographs of the patients were collected. Data were recorded for age, sex, LLD, major curve Cobb angle and pelvic height difference. Correlation analysis method was used to evaluate the relationship between LLD, LLDR and the Cobb angle of scoliosis, as well as the relationship between LLD and the consistency of pelvic height difference.

Results

Among the 63 patients, the convex side of all scoliosis was towards the short leg side. Female patients were accounting for 66.7%. The patients had a mean age of 11.79 ± 3.52 years (range: 4 to 18 years). The average Cobb angle was $14.78 \pm 4.99^\circ$, the average leg length discrepancy (LLD) was 11.22 ± 12.74 mm, and the average pelvic height difference was 12.41 ± 10.32 mm. Significant correlation exists between LLD and the Cobb angle ($R = 0.440$, $P < 0.01$), and a significant correlation also exists between

LLDR and the Cobb angle ($R = 0.445$, $P < 0.01$). A strong positive correlation is shown between LLD and the pelvic height difference ($R = 0.874$, $P < 0.01$), which indicates that there is good consistency between the pelvic height difference and leg length discrepancy.

Conclusion(s)

In children and adolescent patients with scoliosis complicated with LLD, the Cobb angle was significantly related to the LLD and LLDR. There is good consistency between the pelvic height difference and the leg length discrepancy. It is necessity of leg length discrepancy examination before bracing for scoliosis.

Clinical significance

Cobb angle was significantly related to the LLD in patients with scoliosis. It is necessity of leg length discrepancy examination before bracing for scoliosis.

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NOVEL AI MODEL FOR THE RIGO CLASSIFICATION SYSTEM

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Background

The Rigo classification system (RCS) uses several radiographic parameters to determine a classification and resulting treatment plan for adolescent idiopathic scoliosis (AIS) patients. Clinicians must take time to measure and interpret these parameters. Several studies have shown this introduces inter- and intra-observer variability to the RCS and resulting treatments. Although AI models have been developed to assist in scoliosis classification, such as applying the Lenke classification or measuring the Cobb angle, none have been developed for the RCS.

Objective (s)

1) Develop an AI model applying the RCS to X-ray images. 2) Design an AI model to measure RCS parameters, including apex and transition point (TP) levels, Cobb angles, L3-5 tilt, T1 offset, and TP offset, and compare them with human-based measurements. 3) Compare the time taken for the AI model output to human observers. 4) Compare the accuracy of the AI model to human observers.

Study Design

Retrospective, blinded study in which an AI model and three investigators measured the RCS.

Methods

Twenty non-in-brace, non-surgical AIS X-rays were chosen from a SpineWeb public dataset. An open source AI model was previously developed by Scoliosis Tools to segment vertebral bodies into binary masks. Then, code developed in-house calculated relevant parameters from the masks to determine the Rigo classification (Figure 1). The final AI-based RCS model then classified the twenty PA-view X-ray's, while being timed. Three human observers independently classified the same X-ray's using the RCS, which was also timed. Once this was complete, the observers discussed and decided on the most accurate RCS classification for each X-ray. Two observers measured RCS parameters for each X-ray. A descriptive analysis was performed for timing, accuracy, and radiographic parameters. $P < 0.05$ was considered significant.

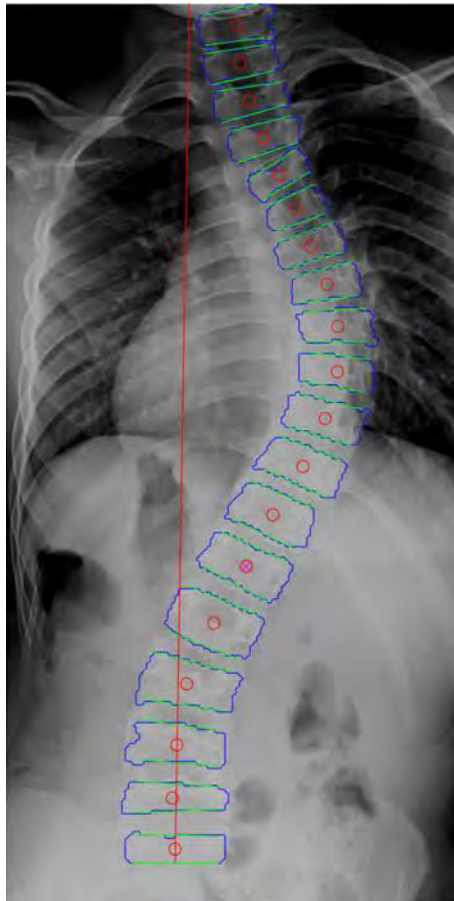


Figure 1. AI model output of X-ray image, with RCS-specific parameters visualized

Results

There were no significant differences between RCS measurements done by the AI model and humans ($P > 0.05$). The mean time to determine each RCS classification was 14.6 ± 5.4 seconds for the AI model, and 35.1 ± 10.7 seconds for human observers ($P < 0.0001$). The AI model had 60.0% accuracy, while the average human observer accuracy was 75.0%.

Conclusion(s)

The primary AI model has been successfully developed, with no significant differences between its parameter measurements and that of human observers. The model offers quantified parameters for an observer to solidify their RCS classification and significantly saves time. The model's accuracy is limited by its inability to interpret pelvic shift, an important criteria used by human observers to determine the RCS classification. Future versions of the AI model could include improved parameter cut-off values and measurement of pelvic shift.

Clinical significance

The AI model will reduce clinician time load for the RCS, which will play an important role in enhancing efficiency of physiotherapeutic scoliosis specific exercise and bracing design.

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A STUDY ON THE CORRELATION BETWEEN ADOLESCENT IDIOPATHIC SCOLIOSIS AND SENSORY FUNCTION

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Background

Adolescent Idiopathic Scoliosis (AIS) is the most common type of scoliosis, characterized by three-dimensional spinal deformity, and may be associated with genetic factors, hormone levels, and neural regulation. This study aims to explore the correlation between AIS and sensory dysfunction, providing a basis for clinical assessment and intervention.

Objective (s)

The main objective of this study is to evaluate the differences in sensory integration indicators, including visual, proprioceptive, vestibular, and tactile functions, between healthy adolescents and those with AIS under dynamic and static conditions. Additionally, we investigate the relationship between the sensory integration system of AIS patients and balance disorders as well as the severity of scoliosis to evaluate how these dysfunctions may increase the risk of scoliosis progression.

Study Design

The study was approved by the medical ethics committee of the hospital and implemented strictly in accordance with the inclusion criteria, exclusion criteria, and dropout criteria. The subjects were adolescents with AIS and were compared with healthy controls. The Pro-kin balance test system was employed to assess the static and dynamic balance functions. The evaluation indices included Romberg rate, average trajectory error (ATE%), stability index (SI), and limit of stability (LOS). Independent sample

t tests and correlation analysis were utilized to compare the differences between the two groups and to explore the relationship between Cobb Angle and sensory integration indicators.

Methods

The study included 45 adolescents with AIS and 33 healthy peers. The Pro-kin balance testing system was used to assess both static and dynamic balance functions, with evaluation metrics including Romberg rate, average trajectory error (ATE%), stability index (SI), and limits of stability (LOS). Independent-samples t-tests and correlation analyses were employed to compare the differences between the two groups and to investigate the relationship between the Cobb angle and sensory integration indicators.

Results

Results indicated that the AIS group showed significantly higher Romberg rates, average trajectory errors, and stability indices under both eyes-open and eyes-closed conditions compared to the control group ($P < 0.05$). Furthermore, a significant correlation was found between the Cobb angle and sensory integration indicators within the AIS group, further confirming the relationship between scoliosis and sensory function.

Conclusion(s)

This study emphasizes the importance of actively recognizing sensory dysfunction in adolescents with AIS. Understanding these sensory integration challenges can assist clinicians in developing more effective rehabilitation plans, especially concerning sensory training. This approach may help improve sensory function in AIS patients and mitigate the progression of scoliosis, thus enhancing the quality of life.

Clinical significance

This study aims to explore the correlation between AIS and sensory dysfunction, providing a basis for clinical assessment and intervention.

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OBSERVATION STUDY ON THE EFFECTS OF CORONAL IMBALANCE ON GAIT IN ADOLESCENT IDIOPATHIC SCOLIOSIS (AIS) PATIENTS

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Background

Adolescent Idiopathic Scoliosis (AIS) is a common spinal deformity in adolescents, characterized by lateral curvature and vertebral rotation. Studies have shown that AIS impacts not only spinal structure

and function but also overall gait patterns. Coronal imbalance, a deviation of the trunk from the midline, may significantly influence gait asymmetry. Gait analysis has become a critical tool in understanding these effects and guiding rehabilitation strategies.

Objective (s)

This study aims to investigate the impact of coronal imbalance on gait in AIS patients compared to healthy adolescents, providing insights for targeted rehabilitation.

Study Design

This retrospective observational study included AIS patients and healthy controls.

Methods

Population: The study analyzed 28 AIS patients (Cobb angle $>10^\circ$, Risser grade ≤ 4) and 28 age-, gender-, and anthropometrically matched healthy adolescents treated from October 2022 to December 2024.

Measurements: Full-spine X-rays were taken to measure the Cobb angle and coronal imbalance distance, calculated as the deviation of the C7 plumb line (C7PL) from the central sacral vertical line (CSVL). A TecnoBody gait analysis system assessed spatiotemporal parameters and joint kinematics during free-speed adaptive walking.

Outcomes: Primary outcomes included weight-bearing asymmetry and trunk lateral displacement. Secondary outcomes were hip and knee joint angle differences. Correlation analyses were conducted to examine the relationship between coronal imbalance and gait parameters.

Results

AIS patients exhibited significantly greater asymmetry in weight-bearing ($P < 0.001$) and step length differences ($P < 0.05$) compared to controls. Trunk lateral displacement was markedly higher ($P < 0.05$), correlating positively with coronal imbalance distance ($r = 0.63$, $P < 0.001$). Although no significant differences in hip and knee flexion-extension range of motion were found ($P > 0.05$), AIS patients showed increased differences in maximum extension and flexion angles between sides ($P < 0.05$).

Conclusion(s)

Coronal imbalance in AIS patients contributes to asymmetrical gait patterns and uneven weight distribution, affecting daily activities and quality of life. Rehabilitation strategies should prioritize improving trunk and joint coordination.

Clinical significance

This study underscores the importance of addressing coronal imbalance in AIS rehabilitation to optimize functional mobility and prevent long-term complications.

ASYMMETRY IN OXYGEN DYNAMICS IN PARASPINAL MUSCLES DURING ISOMETRIC LOADING USING NEAR-INFRARED SPECTROSCOPY IN TEENAGERS WITH ADOLESCENT IDIOPATHIC SCOLIOSIS.

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Background

Adolescent idiopathic scoliosis (AIS) is characterised by 3-dimensional spinal structural changes affecting teenagers. While paraspinal muscle imbalances are well-documented in AIS, research on their metabolic characteristics, including oxygen dynamics, is limited. Understanding these changes could inform assessment and treatment strategies.

Objective (s)

The study quantified asymmetry in oxygen dynamics in the paraspinal muscles of teenagers with AIS compared to age-matched non-AIS controls during isometric back extension. It also explored correlations between muscle oxygen dynamics asymmetry and spinal curvature severity.

Study Design

Cross-sectional study

Methods

Fifty-one teenagers with right thoracic curves (Lenke I-III) (11 males, 40 females; 13.5±1.7 years) were recruited alongside 51 age-matched non-AIS controls (18 males, 33 females; 13.2±1.7 years) matched within a ±1.5-year window. Participants performed three trials of isometric trunk extensions in the prone position, using Moxly muscle monitors to assess paraspinal muscle oxygenation. Four sensors were placed at T9 and L3, 2cm lateral to the spinous process bilaterally. Participants were instructed to lift the suprasternal notch 10 cm from the plinth until fatigue or for up to 1 minute, with 2-minute rest intervals between tests. Primary outcomes were recovery time (Tr), measured as the duration to reach 63.2% of the exponential constant for full recovery post-exertion, and between-side differences in recovery times (TrAsy) for deoxyhaemoglobin in paraspinal muscles. Between-group differences were evaluated by independent t-tests, and multiple linear regression identified correlations with curvature severity.

Results

Individuals with AIS exhibited curves from 12° to 45° (mean 22.8°±6.8°), with T8 as the primary curvature apex (41.2%). Nine cases were identified as Lenke I, 28 as Lenke II, and 14 as Lenke III. In the AIS group, recovery was

slower on the convex ($77.8 \pm 16.1s$) than the concave side ($67.8 \pm 18.8s$) at T9 ($p < 0.005$), while controls showed no significant between-side differences. The AIS group exhibited significantly larger TrAsy at T9 ($10.04 \pm 24.3s$) ($p = 0.03$) and smaller TrAsy at L3 ($3.8 \pm 24.9s$) ($p = 0.01$) compared to controls ($0.3 \pm 24.0s$ at T9 and $7.5 \pm 18.8s$ at L3). Only TrAsy at T9 was retained in the model predicting curvature severity ($\beta = 0.51$, $p = 0.002$), which was statistically significant ($F = 4.46$, $R^2 = 0.40$, $p < 0.003$).

Conclusion(s)

This study is the first to reveal distinct metabolic characteristics of paraspinal muscles in AIS, suggesting that TrAsy related to curve severity. Addressing fatigability imbalance is crucial. Further studies are warranted to investigate the causal relationship between asymmetrical muscle metabolic response and curve severity.

Clinical significance

TrAsy may be a target for assessing or treating paraspinal muscle dysfunction in AIS, potentially enhancing risk identification and treatment, warranting further investigation of this hypothesis.

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CLINICAL PROBLEM SOLVING WITH A DIGITAL TWIN FOR THE ANALOG SCOLIOMETER

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Background

In scoliosis care, a spine specialist will measure the lateral curvature of the spine from a radiograph and measure the trunk rotation non-radiographically with an analog scoliometer directly on the patient at every surveillance appointment. While radiographs can be taken at any imaging centre and transferred to the treating spine clinic, the patient must visit in person for monitoring the progression of structural rotation. Regular lengthy travel to these clinics places significant temporal, financial and emotional stress on rural, remote and regional (RRR) patients, in addition to the costs incurred by the health service.

Objective (s)

Until now, distance measurement of the Angle of Trunk Rotation (ATR) has not been possible as no “virtual” scoliometer exists. We describe the first development and clinical validation of a digital twin for

the analog scoliometer using generative 3D modelling. We investigate the reliability, accuracy, sensitivity and specificity of the tool, and its potential for future clinical use in telehealth initiatives.

Study Design

Retrospective Cross-Sectional Study

Methods

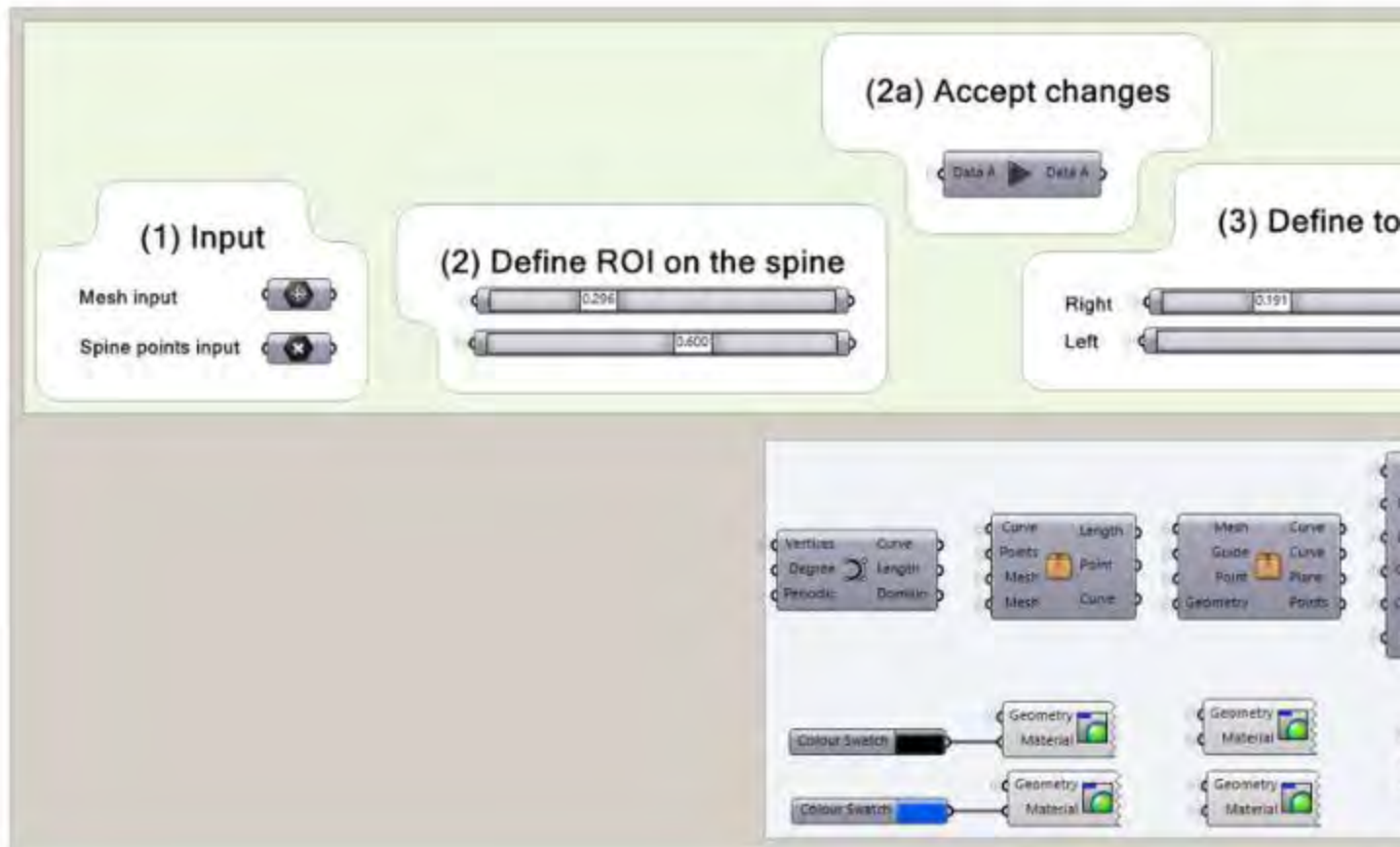
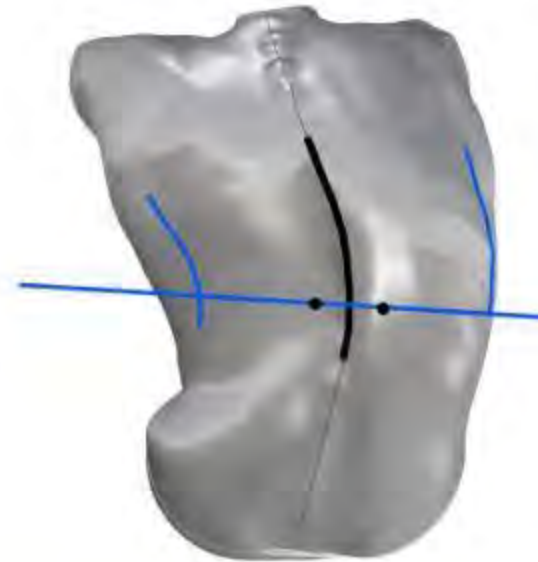
A robust semi-automated algorithm of generative design which measures ATR from surface topography was developed (Rhinoceros-Grasshopper Vsn7, Robert McNeel and Associates, USA). With an operating time of just a few seconds, it provides quick and reliable ATR measurements from simple parametric user inputs. 150 calibrated 3D virtual models of Adolescent Idiopathic Scoliosis (AIS) patients treated at the Queensland Children's Hospital Spine Clinic (QCHSC) obtained from our existing database of 3D surface scans (3DSS) and healthy non-scoliotic controls recruited for this study were used to validate the digital scoliometer tool. Dataset usage and user information is shown in Figure 1.

	Dataset 1 (Healthy) n=39	Dataset 2 (AIS first presentation) n=41	Dataset 3 (AIS surgical) preop n=35 postop n=35	
Data usage for analyses				Total number of participants
 Absolute difference	✓	✓	✓	n=150
 Reliability			✓	n=70
 Accuracy	✓	✓	✓	n=150
 Sensitivity and Specificity	✓	✓		n=80
User info and measurement attempts				Total number of measurements
 A – Engineering student <i>(limited familiarity with the algorithm; limited knowledge about scoliosis)</i>	x1	x1	x3	n=290
 B – Research fellow <i>(expert in algorithm usage; knowledgeable about scoliosis)</i>	-	-	x3	n=210
 C – Training Spine Fellow and Orthopaedic Surgeon at the QCHSC <i>(not familiar with 3D digital tools; expert in scoliosis)</i>	-	-	x3	n=210
 D – Training Spine Fellow and Orthopaedic Surgeon at the QCHSC <i>(not familiar with 3D digital tools; expert in scoliosis)</i>	-	-	x1	n=70

Intra- and inter-user reliability of the tool was assessed using Interclass Correlation (ICC) and accuracy was assessed using Spearman's Correlation Coefficient and Bland Altman plots. Sensitivity and specificity were calculated at 5, 6 and 7 degrees ATR cut-off.

Results

A scoliometer digital twin was successfully developed (Figure 2). Scoli MP is the same width as the analog device and Scoli MP Ext with a larger width to span the full trunk.



The tool showed excellent intra-user (<0.95) and inter-user (<0.95) reliability. The digital values had a high positive correlation (0.897) and agreement (92.7%) with the analog ATR measurements made clinically. At 6° cut-off, the tool showed a high sensitivity of 90.24% and specificity of 92.31%. Larger device width was not shown to be an advantage.

Conclusion(s)

The scoliometer digital twin is fast, reliable, accurate, sensitive, specific, not limited by gravity, can measure angles higher than 30°, and is not affected by parallax errors, and can measure the ATR even if the patient is unable to bend fully.

Clinical significance

The development of this virtual tool will enable the remote measurement of the ATR from 3D models and is significant for telehealth implementation in paediatric spine deformity management.

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EXPLORING PREDICTIVE MODELS OF COBB ANGLE IN ADOLESCENTS WITH IDIOPATHIC SCOLIOSIS (AIS), A CROSS-SECTIONAL STUDY BASED ON SURFACE TOPOGRAPHY (ST) AND CLINICAL PARAMETERS

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Background

Clinical decisions in AIS, regardless of severity, are typically based on the Cobb angle. Therefore, frequent radiographs are indicated to monitor progression. Some adverse effects have been associated with such an excessive number of radiographs. Non-ionizing imaging techniques, such as ST, have shown potential as predictors of AIS incidence and severity. There is a lack of consensus on which ST parameters may be the best predictors, and a combined clinical and ST predictive approach remains to be explored.

Objective (s)

1) To explore combined predictive models using clinical and ST parameters 2) To validate and compare the models.

Study Design

Multi-center, cross-sectional study of 52 AIS

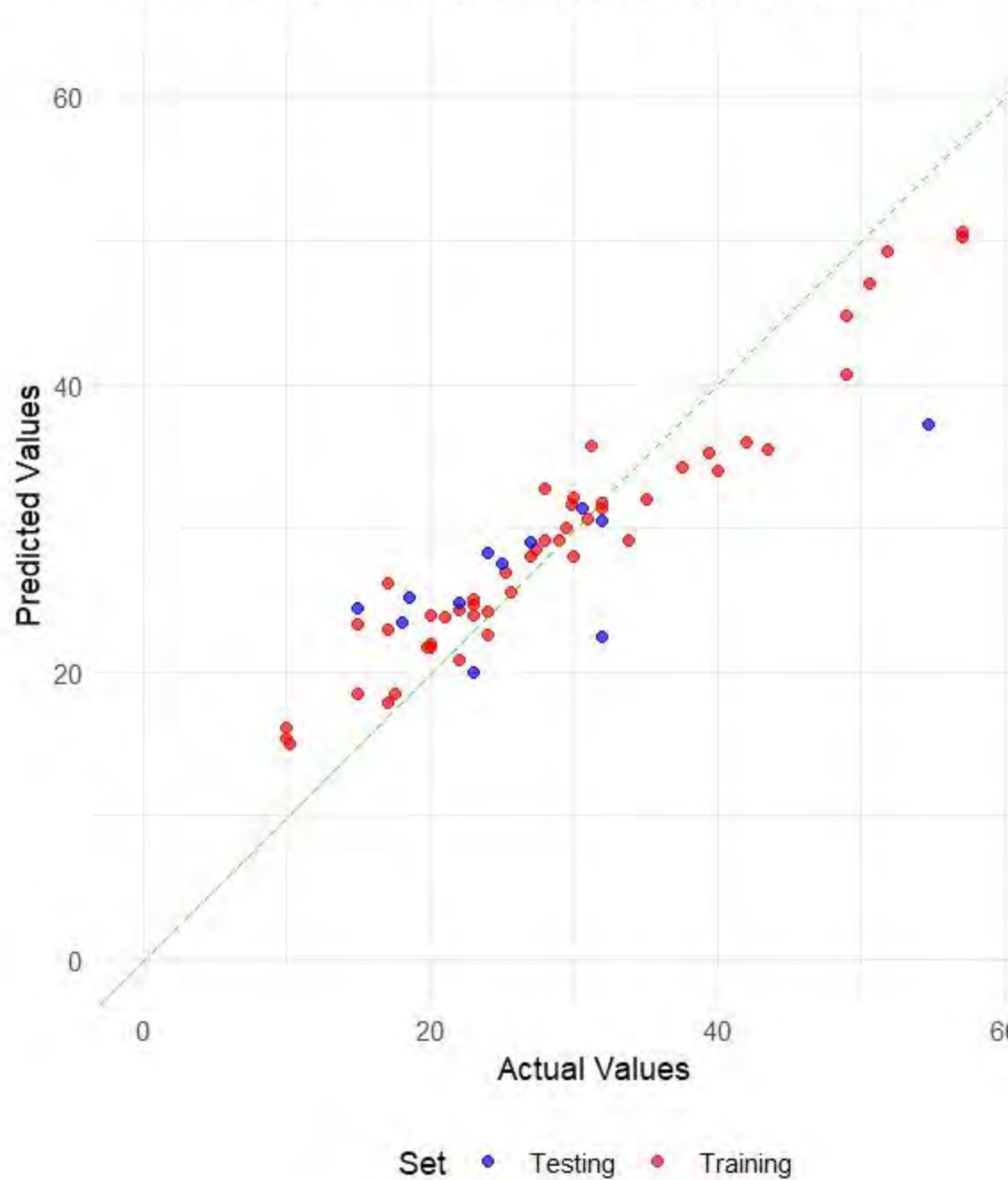
Methods

Of the 52 AIS, 42 thoracic and 20 lumbar curves had a corresponding radiographic ST asymmetry and were finally included in the study. The mean Cobb was $30.22^{\circ} \pm 13.31^{\circ}$ (thoracic) and $26.35^{\circ} \pm 9.64^{\circ}$ (lumbar). Five ST parameters, and trunk rotation angle measured by the scoliometer, were used as predictors of Cobb. Two prediction models were tested: Linear Regression (LR) and Machine Learning (ML). The validity of the models was tested using a 5-fold cross-validation with $n=50$ for training and $n=12$ for testing. Performance metrics were calculated to compare the models.

Results

The LR shows a Root Mean Square Error (RMSE)= 7.68° , Mean Standard Error (MAE)= 6.16° and Coefficient of Determination (R^2)= 0.58 in training; RMSE= 7.93° , MAE= 6.22° and R^2 = 0.32 in testing. For ML, RMSE= 4.06° , MAE= 3.23° and R^2 = 0.95 in training; RMSE= 7.13° , MAE= 5.47° and R^2 = 0.58 in testing. The ML model outperformed the LR in both the training and test sets, with higher differences in the training set. Predicted Cobb for testing and training sets using ML are shown in Figure 1.

Predicted vs Actual Values (Training and Testing)



Conclusion(s)

The best predictions of Cobb were obtained with ML, but the differences between training and testing were higher than with LR, suggesting possible overfitting that may require further investigation. Results on unseen data (n=12) are promising and close to the acceptable clinical error threshold ($\pm 5^\circ$), with 58%

of Cobb variance explained by this model. Despite the limited sample size, which is a potential limitation for ML, our predictive model is a promising tool to predict Cobb in AIS.

Clinical significance

The combination of clinical and topographic predictors of Cobb integrated into a ML model may contribute to the state of the art in Cobb angle prediction by reducing prediction error below the clinical threshold.

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WHICH IS BETTER FOR PREDICTING SPINAL SAGITTAL SEQUENCE? AL VS PI

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Background

Pelvic Incidence (PI) is a key parameter for understanding the three-dimensional regulation of spinal sagittal curves, and it has been strongly correlated with other spinal alignment parameters such as sacral slope (SS), pelvic tilt (PT), and lumbar lordosis (LL). Despite its utility in surgical planning, PI has limitations, as it is a simplistic graphical angle that provides minimal information about the pelvic sequence and neglects potentially crucial aspects of pelvic morphology. This inadequacy makes PI insufficient for accurately predicting spinal alignment parameters, which is critical for surgical design requirements. To address these limitations, the study introduces an AI-based method that utilizes a sequence-to-sequence (Seq2Seq) framework to model the spatial correlation between pelvic and spinal key points. This innovative approach aims to improve the precision of predicting sagittal spinal alignments beyond the capabilities of traditional PI-based methods.

Objective (s)

To develop and validate an AI-based system to model the spatial correlation between pelvic and spinal key points, with the aim of improving the accuracy of predicting sagittal spinal alignment parameters such as SS, PT, and LL. This system is intended to overcome the limitations of the traditional PI-based method, offering a more precise tool for surgical planning and spinal alignment assessment in spinal surgery.

Study Design

Randomized trial

Methods

We created an AI system using a Seq2Seq framework to model the spatial relationships between pelvic and spinal key points. The system was trained on 337 cases and evaluated on 51 cases from multiple centers. To account for pelvic rotation, we introduced an Angle Correlation Network. We compared the AI system's performance with the traditional PI-based method, using Mean Absolute Error and Pearson correlation coefficient (R value) as metrics.

Results

The AI-based method showed superior Pearson correlation coefficients compared to the PI-based method (0.80 vs. 0.67 for SS, 0.73 vs. 0.52 for PT, and 0.76 vs. 0.48 for LL), indicating a stronger linear relationship between predictions and actual values. Additionally, the AI system achieved lower MAE for LL (5.52 vs. 6.69), highlighting improved prediction accuracy.

Conclusion(s)

The AI-based system, incorporating a Seq2Seq framework and Angle Correlation Network, demonstrated enhanced precision in predicting sagittal spinal alignment compared to the PI-based method. These findings support the use of AI in spinal surgery planning, improving accuracy in evaluating and managing sagittal alignment and advancing personalized approaches in surgical procedures.

Clinical significance

- 1.Enhanced Surgical Precision: Enhances the accuracy of predicting spinal alignment parameters, facilitating more precise surgical planning and reducing the risk of postoperative complications.
- 2.Personalized Medicine: By offering detailed, personalized predictions of spinal alignment, the system aids in crafting individualized treatment plans and tailoring surgical interventions.
- 3.Optimized Clinical Outcomes: Improved accuracy in spinal alignment predictions is expected to enhance surgical outcomes, potentially leading to better functional results, decreased pain, and higher patient satisfaction.

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CONSERVATIVE TREATMENT OF SCOLIOSIS USING ONLY EXERCISES. ARE THE CURVES ONLY STABILIZED? A REASSESSMENT OF TREATMENT OUTCOME RATES IN A GROUP OF 580 PATIENTS

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Background

Conservative treatment of scoliosis is performed with the application of braces or teaching specific exercises.

The fundamental objective of the exercises is the stabilization of the curves, that is, to prevent worsening. As indicated in the guidelines, Improvement is not considered a usual objective.

Objective (s)

To verify whether treatment with only exercises is adequate to simply slow their evolution or whether reductions of the curves can also be obtained.

Study Design

Descriptive study

Methods

From a group of 11.234 patients, who were visited in a specialized center for the treatment of idiopathic scoliosis, 982 cases with a diagnosis of scoliosis were selected and given different treatment prescriptions depending on the severity of the curve and the risk of progression.

From this group, 580 patients were selected who began treatment with the prescription of only specific exercises and who finished the treatment without the prescription being modified.

The group consisted of 454 (78.1%) female patients with a mean Cobb of 19.6 and 126 (21.9%) male patients with a mean Cobb of 19.8.

Results

All patients finished treatment at Risser 4 (454 pts – 77.7%) or Risser 5 (129 pts – 22.3%).

After treatment that lasted an average of 31 months, the results of the changes in the Cobb degrees of the main curve are listed in the following tables. The patients were divided into males and females to verify any differences.

The definition of improvement or worsening assumes that curves can be defined as changed with a variation of at least 5 Cobb degrees.

Females	
327(72%)	Stable
72 (15.8)	Worsened
55 (12.2)	Improved
454	

Male	
83 (65.9)	Stable
25 (19.8)	Worsened
18 (14.3)	Improved
126	

Conclusion(s)

The conservative treatment of scoliosis based on the execution of specific exercises throughout the maturation period of the skeleton allows to stabilize the curves in about 70% of cases (72% males - 66% females). The remainder is divided into worsened (15.8 females and 19.8 males) and improved (12.2 females and 14.3 males) with a variation greater than 5 degrees.

Clinical significance

An interesting reflection can be made on the rule of 5 degrees that we follow in practice.

If for the improved and worsened we also include the curves that have increased or worsened by 5 degrees precisely, the tables change significantly.

Female

274 (60%) Stable

Male

70 (55,5%) Stable

98 (21,4%) Worsened

33 (26,1%) Worsened

82 (18.6%) Improved

23 (18,4%) Improved

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SCOLIOSIS SCREENING ACCURACY OF A ST AND AI-BASED SYSTEM VERSUS X-RAY IN A SCREENING PROGRAM IN BRAZIL: PRELIMINARY RESULTS

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Background

Idiopathic scoliosis (IS) is a three-dimensional spinal deformity affecting 0.5%-5.2% of children. Screening, traditionally based on the ADAM test and trunk rotation angle (TRA) via scoliometer, helps detecting cases in its early stages, potentially reducing severity progression and the need for surgery, but shows high false positive rates. Emerging 3D technologies, including ST-based systems, allow for torso asymmetry analysis to screen IS and offer a cost-effective and accurate alternative for early detection.

Objective (s)

To test the screening accuracy of a ST-based software and TRA in a sample of healthy adolescents enrolled in a military school.

Study Design

Diagnostic validation study

Methods

Students aged 10 to 17 years were included, and those with more than a 1.5 cm difference in lower limb length, neurological or musculoskeletal diseases that could interfere with their balance, or a history of spinal surgery were excluded. A Brunel scoliometer was used for TRA, and a ST-based system to scan and analyse the torsos. Participants stood in a relaxed posture with the shoulders in

an abduction and flexion of 45° and the hands holding a stick to improve stability. Panoramic posterior-anterior X-rays were taken within one week after the TRA and 3D scans. Cobb angle $\geq 10^\circ$ and a TRA $\geq 5^\circ$ were considered positive for scoliosis.

Results

83 students completed the scans and 60 the x-rays, 30 boys (14 $\pm$ 1.6 years old) and 30 girls (14.4 $\pm$ 2.0 years old). 8 girls and 4 boys were positive for scoliosis with a mean Cobb of 19.9 $\pm$ 4.16 and 11.3 $\pm$ 0.85 respectively. Table 1 shows the comparison of the ST-based software and TRA. A prevalence of 3% was used to calculations. The 2 false negatives for ST presented a Cobb angle of 10.2° and 10.8°.

	TOTAL		Boys		Girls	
	ST	TRA	ST	TRA	ST	TRA
True Positive	10	9	2	3	8	6
True Negative	48	42	26	24	22	18
False Positive	0	6	0	2	0	4
False Negative	2	3	2	1	0	2
Sensitivity	83.33%	75.00%	50.00%	75.00%	100.00%	75.00%
Specificity	100.00%	87.50%	100.00%	92.31%	100.00%	81.82%
Accuracy	99.50%	87.12%	98.50%	91.79%	100.00%	81.61%
PPV	100.00%	15.65%	100.00%	23.17%	100.00%	11.31%
NPV	99.49%	99.12%	98.48%	99.17%	100.00%	99.06%
LR ⁺		6.00		9.75		4.13
LR ⁻	0.17	0.29	0.5	0.27	0	0.31

Conclusion(s)

ST showed better results than TRA in this sample. The combination of sensitivity and specificity overcomes the TRA screening performance, especially in girls, achieving a 100% in all metrics. As a limitation, the sensibility in boys is below the recommended (70%). If we consider both false negatives for ST as negligible (10.2° and 10.8°), the sensibility improves to 100%.

Clinical significance

The ST-based software presented here is a valid tool that may contribute to early detection and reduction of false positives rate during IS screening.

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Background

Planning treatments for scoliosis requires assessing spine flexibility using potentially harmful x-rays. Radiation-free 3D ultrasound imaging (3DUS) and robotic indentation can assess spinal flexibility and vertebral level stiffness, respectively. Data from healthy participants can help interpret these measurements. If a strong relationship exists, a single method could be used or spinal indentation may complement ultrasound imaging by identifying levels responsible for flexibility limitations.

Objective (s)

This study aimed to determine the correlation between spinal stiffness obtained using spinal indentation and side-bending flexibility measured using 3DUS in healthy young adults.

Study Design

Cross-sectional correlation study

Methods

Thirty healthy participants aged 18-30 were recruited using email and poster ads. Participants were healthy, non-pregnant with no back pain or open back wounds. A clinical exam recorded age, height and weight. Side-bending flexibility was obtained using 3DUS recording the difference between maximal right and left prone SB angles. Spinal stiffness was measured using a smoothed force-displacement curve from robotic indentation which progressively applied 100N at T4, T6, T8, T10, T12, L2 and L4 (3 trials each). Pearson correlations and a multiple regression model were used to determine if spine side-bending flexibility could be predicted from a combination of patient characteristics and indenter measurements.

Results

Thirty participants were recruited with a mean age of 23.7 ± 3.2 years, height of 173.5 ± 9.3 cm and weight of 72.3 ± 14.3 kg. Three participants were excluded as they did not tolerate full indentation pressure. Two outliers were excluded.

Stiffness measurements at all thoracic vertebrae correlated significantly with thoracic side-bending flexibility (range: $r = -0.41$ to -0.67). (Fig 1) Stiffness measurements at lumbar vertebrae did not significantly correlate with lumbar side-bending flexibility ($r = -0.29$, -0.39). The stiffness measurements of all tested vertebral levels except T4 correlated significantly with the full spine side-bending flexibility. (range: $r = -0.38$ to -0.67).

Fig. 1: Pearson's correlations between spinal stiffness and side-ben

	Full spine flexibility	Lumbar flexibility	Thoracic flexibility	Stifness T4	Stifness T6	Stifness T8	Stifness T10	Stifness T12
Full spine flexibility	1							
Lumbar flexibility	.624**	1						
Thoracic flexibility	.867**	0.174	1					
Stifness T4	-0.375	-0.123	-.455*	1				
Stifness T6	-.446*	-0.148	-.527**	.799**	1			
Stifness T8	-.569**	-0.242	-.592**	.738**	.856**	1		
Stifness t10	-.671**	-0.238	-.673**	.486*	.664**	.771**	1	
Stifness T12	-.433*	-0.171	-.412*	0.239	.532**	.612**	.808**	1
Stifness L2	-.558**	-0.291	-.504*	.475*	.630**	.623**	.779**	.705**
Stifness L4	-.535**	-0.389	-.396*	0.251	0.379	0.377	.561**	.506**

Correlation is significant at the 0.01** or 0.05* level (2-tailed).

Stiffness averaged over all tested levels was significantly correlated with full spine side-bending flexibility ($r=-0.63$). Maximum stiffness measurements over all spine levels presented a higher significantly correlation with the full spine side-bending flexibility than minimum stiffness ($r=-0.74$, -0.46 , respectively).

Fifty-six percent of the variance in full spine side-bending flexibility was predicted by the average stiffness over all levels when controlling for age and height. Full spine side-bending flexibility(degrees) = $101.00-0.98age+0.44height-16.99stiffness_max$.

Conclusion(s)

Moderate to strong correlations exist between spinal stiffness and side-bending flexibility both over the full spine and per level. The larger correlations observed in the thoracic spine and with maximum stiffness values relating to lower side-bending flexibility illustrate that the stiffest regions of the spine may be key limiting factors in side-bending flexibility. However, other factors need to be considered as only about half of the variance in the spine side-bending flexibility was explained by indenter measurements.

Clinical significance

While correlations between stiffness measured by indentation and side-bending flexibility exists, the measurements are not interchangeable.

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Background

Surface topography has been shown to be a reliable alternative to x-ray during the surveillance of scoliosis progression. Using newer, less expensive technology would help bring this surveillance capacity to more clinicians, or even to the patient's home. Using more affordable hardware is only beneficial, however, if it still delivers a reliable measurement of the 3D scoliosis curve.

Objective (s)

To compare a new, low-cost infrared scanning device to the well-known raster stereography device using the same mathematical algorithm to calculate 3D measurements.

Study Design

Healthy volunteer subjects were measured with two spine scanning devices that both use the same mathematical algorithm to calculate 3D spine measurements. A raster stereography measurement was taken as the gold standard, and then three infrared scans were taken for comparison.

Methods

After IRB approval, 65 healthy volunteers consented to be measured. The average age was 26.6yrs (SD 2.8 yrs) and 53% were female. Each stood in their normal posture and were scanned with a raster stereography device, and then three times with a new infrared device that uses time-of-flight to calculate surface topography. Both devices create a point cloud of data that used the same mathematical algorithm to calculate 3D measurements. The measurements were then compared between the two hardware devices, and between the three infrared measurements to evaluate reliability.

Results

Seven spinal measurement parameters were used for comparison. The following correlations were found between hardware devices:

Parameter	Correlation between Hardware Devices	P value	Average Difference between Measurements
Sagittal Imbalance	0.82	<0.05	1.2 deg
Coronal Imbalance	0.75	<0.05	0.5 deg
Pelvic Obliquity	0.80	<0.05	0.9 deg
Thoracic Kyphosis	0.83	<0.05	3.0 deg

Lumbar Lordosis	0.79	<0.05	4.8 deg
Apical Deviation	0.73	<0.05	6.7 mm
Surface Rotation	0.42	<0.05	5.3 deg

The 3 repeated measurements using the infrared scanner had an overall Kappa value of 0.84 showing good repeatability of the hardware's measuring capacity.

Conclusion(s)

For most of the measurements, the correlation between the low-cost infrared scanner and the gold standard raster stereography scanner was between 0.7 and 0.8. This is acceptable, but demonstrates that the point cloud acquisition with the low cost equipment is not as accurate. The measurements of Surface Rotation had poor correlations, and are not accurate when compared to the gold standard. The repeatability of the low-cost infrared scanner was good.

Clinical significance

When using non-radiographic methods in the surveillance of scoliosis to reduce, the method of surface topography must be reliable enough to make good clinical decisions. Developing less expensive hardware will make scoliosis surveillance available to more clinicians. This study tested equipment that was much less expensive than the gold standard, and showed that it was somewhat less accurate. The benefit of making it more widely available may offset the disadvantage of its accuracy in some situations.

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TRUNK AESTHETICS DIFFERS FROM THE CURVE TYPE AND SEVERITY OF THE UNDERLYING SCOLIOSIS IN ADOLESCENTS

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Background

Trunk aesthetics is an important goal of adolescent idiopathic scoliosis (AIS) treatment (Negrini 2018). Currently, subjective experience (questionnaires: e.g. Scoliosis Research Society 22 – SRS-22 and Trunk Appearance Perception Scale – TAPS) is explored more than objective data (symmetry indexes: e.g. Trunk Aesthetic Clinical Evaluation – TRACE and Posterior Trunk Symmetry Index – POTS). Non-invasive imaging techniques, like rasterstereography (RST), have been studied for years to reduce the burden of radiographies for children with AIS.

However, they miss good correlations with Cobb degrees (Minotti 2023). Nevertheless, they could contribute to aesthetic evaluations by providing detailed trunk shape information.

Objective (s)

To develop automated RST aesthetic evaluations (aRSTa) and check their correlations with TRACE (Zaina 2009, Negrini 2020) and scoliosis radiographic characteristics.

Study Design

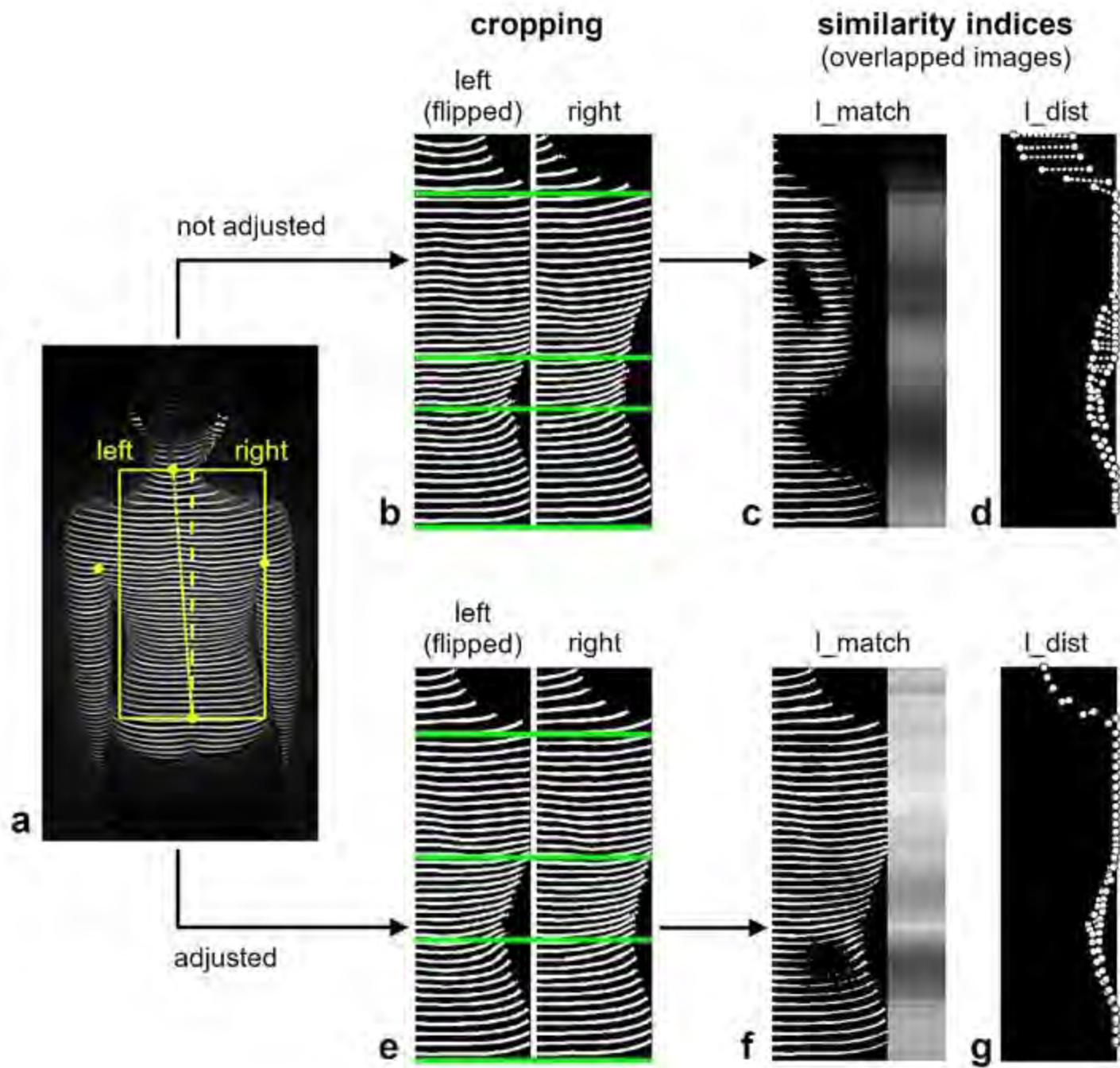
Cross-sectional observational controlled diagnostic study.

Methods

We included consecutive participants with trunk RST scan and standing radiograph/EOS within 2 months.

We developed two aRSTa (I_match and I_dist) following the TRACE principles (total score and shoulders, scapulae, hemithorax and waist sub-scores). We assessed TRACE on all RST images (RST TRACE) because the camera has a perspective from above the shoulders that differs from the clinical one. We checked the intra- and inter-rater test-retest reliability of photographic and RST TRACE in a subset of 28 randomly selected participants.

We checked the correlations among photographic and RST TRACE, aRSTa, scoliosis severity ($^{\circ}$ Cobb), and curve type using Kendall and Spearman tests and permutation distribution for statistical significance.



Results

We included 675 participants, age 13 ± 2 , curves 10 – 45° . Photographic and RST TRACE showed strong to very strong reliability: 0.73 – 0.96 intra-rater and 0.61 – 0.74 inter-rater.

We found absent to weak correlations between the aesthetic measures:

- photographic and RST TRACE (0.3), and sub-scores (0.02-0.4);
- RST TRACE and aRSTa (0.27-0.28), and sub-scores (0.06-0.29).

We found weak to moderate correlations between radiographic and aesthetic evaluations:

- RST TRACE (0.35-0.42);
- photographic TRACE (0.35-0.53), lumbar curves excluded;
- I_match aRSTa (-0.19/-0.44), thoracolumbar curves excluded;
- I_dist aRSTa (0.24-0.49), thoracolumbar and double curves excluded.

For TRACE evaluations, we obtained the best results for the waist sub-score in thoracic and thoracolumbar curves (0.44-0.46 and 0.54-0.56, respectively) and no correlations for shoulders and scapulae. For aRSTa, the best and worst results were for thoracic and thoracolumbar curves, respectively.

Conclusion(s)

The tested aesthetic evaluations differ, and none show a clear superiority. Without a gold standard, the choice shall rely on reliability, validity, responsiveness, and clinical utility.

Aesthetic and radiographic evaluations were weakly correlated. Nevertheless, each couple of evaluations (TRACE and aRSTa) showed coherent correlations (direction and quantity) between trunk areas and curve types/quantity, confirming that scoliosis is one of many underlying factors of aesthetics that we should explore in the future.

Clinical significance

While waiting to develop strong tools to measure aesthetics beyond radiography, TRACE remains a reliable and not expensive instrument for everyday use.

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CHANGES TO RIGID ASYMMETRICAL BRACE DESIGN AFTER THE ADDITION OF 3D MODELS GENERATED FROM EOS IMAGING IN PATIENTS WITH IDIOPATHIC SCOLIOSIS.

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Background

Rigid brace design has traditionally used 2D coronal x-rays to create spinal orthoses. 3D models from bi-planar EOS x-rays provide measurements of the spine in 3 spinal planes from a rotationally neutral pelvis alongside low radiation exposure.

Objective (s)

This study aims to assess whether the addition of 3D spinal models from EOS imaging will change the design of current over-corrective asymmetrical rigid braces.

Study Design

Retrospective observational study.

Methods

Eleven patients with idiopathic scoliosis were retrospectively reviewed. Patients followed normal clinical care with in-brace bi-planar x-ray at 6 weeks. Patients pre-brace and in-brace x-rays were retrospectively modelled using sterEOS “full spine” software. All discussions took place as anonymous round table discussions with a clinical orthotist team. Pre-brace 2D bi-planar x-rays were first shown and a brace design was suggested by orthotists. 3D EOS models were then revealed, and the orthotist team were asked to either change, adjust or keep the brace design. These 2 steps were repeated for the 6 week in-brace review. X-ray measures and 3D EOS measures were compared in all three planes to determine significant differences.

Results

Brace classification at the initial design stage was changed in 6 of the 11 patients when 3D modelling was revealed. This would necessitate the design of 6 new braces. In-brace, 3 previous design changes were picked up on 2D x-ray, with 2 further changes made after 3D modelling reveal. All changes were significantly related to the quantification in the transverse plane of the lumbar spine. Measurement of the apical vertebral rotation and judgement of the neutrally rotated vertebra for both structural and non-structural curves significantly differed between x-ray and EOS.

Conclusion(s)

The addition of 3D EOS models suggest that 6 braces would be re-designed initially, 3 would be re-designed in-brace and 2 would potentially be in the wrong brace longer term. Quantification of the transverse plane accounting for the magnitude of pelvic rotation may have large orthotic benefit.

Clinical significance

This study highlights the potential to refine brace design more accurately using 3D models, potentially reducing the risk of incorrect brace design. The significant difference between 2D x-rays and 3D EOS models suggest that traditional imaging may neglect transverse plane deformities, not adequately accounting for pelvic rotation.

RISSEr STAGING OR TANNER-WHITEHOUSE (TW3): WHICH PROVIDES GREATER ACCURACY AND SAFETY IN PREDICTING CHRONOLOGICAL AND BONE AGE IN IDIOPATHIC SCOLIOSIS?

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Background

Radiographic markers of skeletal maturity play a crucial role in predicting curve progression, determining brace treatment cessation, and guiding surgical management. Traditionally, the assessment of skeletal maturity has been based on the categorical Risser staging. However, with the advent of new scanning technology, an automated method for determining bone age (BA) using hand and wrist (H&W) x-rays is now available. The optimal choice among Risser staging and automated methods is currently undecided.

Objective (s)

To determine the optimal method for assessing skeletal maturity in idiopathic scoliosis by comparing Risser staging with automated paediatric bone age assessment using Tanner-Whitehouse (TW3).

Study Design

Retrospective cohort study of all patients with idiopathic scoliosis undergoing skeletal assessment.

Methods

This retrospective review focused on idiopathic scoliosis patients with both hand and wrist (H&W) x-rays interpreted through automated bone age assessment and documented Risser staging. Scans were excluded if maximum values were reached for TW3 due to a known ceiling effect. Statistical analysis was performed using a one-way ANOVA with Tukey's post-hoc testing between groups, paired t-tests, and descriptive statistics.

Results

132 patients x-rays and Risser scores were included. Radiation dose of H&W x-rays was DR <0.1μSv (standard DR PA whole spine=67.5μSv, EOS microdose PA whole spine=2.6μSv). No adjacent Risser scores showed a statistically significant difference from their neighbouring scores ($p > 0.05$), and this trend persisted in the second reading. In females, 7% reached a TW3 age of 14.5 years old with a Risser of three or less. In contrary, 31% of Risser 4 or 5 females are less than 14.5 years of age according to

TW3. In males, 6% reach 16 years old on TW3 with a Risser of 4 or less whereas 5% of Risser 5 males are less than 16 years old on TW3.

Conclusion(s)

Risser scores showed no significant differences between adjacent values, indicating inconsistency in assessments. In contrast, TW3 scores provide greater confidence in determining whether a female patient has reached skeletal maturity compared to Risser staging. These findings suggest that using TW3 to estimate bone age is a safer and more reliable option than Risser staging in female adolescents with a small trend extending into males.

Clinical significance

Using TW3 to estimate bone age offers greater reliability and clinical confidence in assessing skeletal maturity, particularly in female adolescents, compared to more subjective and inconsistent Risser staging.

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A COMPARISON OF SURFACE TOPOGRAPHY SCANNING TECHNIQUES USING RASTER STEREOGRAPHY AND A CELL PHONE BASED DEVICE

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Background

Surface topography using raster stereography has been shown to be a reliable alternative to x-ray during the surveillance for scoliosis curve progression. Scanning with a cell phone allows patients to be scanned at home, making surveillance more convenient. The phone-based system also uses artificial intelligence to predict spinal measurements.

Objective (s)

To compare a new phone-based scanning device using artificial intelligence to a known raster stereography device in order to assess the accuracy of this new technology.

Study Design

Healthy volunteer subjects were measured with two spine scanning devices to produce 3D spine measurements for comparison.

Methods

After IRB approval, 42 healthy volunteers consented to be measured with both spine scanners. The average age was 25.5 yrs (SD 3.6) and 71% were female. Each stood in normal posture and were scanned twice with a raster stereography device (DIERS Formetric), and then with a new phone-based scanner that sends its images to the cloud for AI analysis (Momentum Health). Measurements were then compared between the two devices, and between the two scans with the same device.

Results

Four spinal measurement parameters were used for comparison: Shoulder asymmetry, Trunk Shift, Coronal Imbalance, and Cobb Angle. The following comparisons were found between hardware devices:

Parameter	Correlation (Pearson r) between Devices	Average Difference Measurement D
Shoulder Asymmetry	<u>0.267</u> (p = 0.14)	2.4 degree
Trunk Shift	<u>0.032</u> (p = 0.78)	7.4 mm
Coronal Imbalance	<u>0.313</u> (p = 0.001)	7.0 mm
Cobb Angle	<u>0.650</u> (p = 0.001)	7.5 degree

When comparing the Cobb Angle prediction between devices, they matched 28/34 times in curves <10°, 4/6 times in curves 10-20°, 1/1 time in curves 20-30°, and 1/1 time in curves >30°.

Conclusion(s)

When comparing the phone-based predictions to raster stereography measurements, the values do not match closely, with weak correlations between them. The two devices have larger differences between them than would be expected by repeated measurements alone. However, the predicted Cobb Angle given by the phone-based device was able to identify the insignificant curves (<10°) and the small curves (10-20°) 80% of the time, and identified the larger curves in both subjects who had them.

Clinical significance

Having software that a patient's family could use at home would make surveillance much more convenient. If the goal of home scanning is to identify when there has been a significant change in the Cobb angle to send the patient back to the clinician for a more definitive measurement, then this system was successful. In this experiment, artificial intelligence delivered predictions that correctly identified

insignificant from significant curves reasonably well. It did not demonstrate accuracy that would allow it to be a substitute for a clinical assessment. More accurate and reliable measuring devices such as raster stereography or x-ray should still be used in the office when medical decision making is needed.

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EVALUATION OF AXIAL SURFACE ROTATION IN ADOLESCENT IDIOPATHIC SCOLIOSIS DURING STANDING AND WALKING

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Background

Studies utilizing surface topography (ST) and motion analysis system (MAS) have identified significant trunk kinematic differences in adolescent idiopathic scoliosis (AIS) patients during gait. Reduced global axial rotation suggests thoracic rigidity. However, the reliance on complex kinematic model with multiple retroreflective marks is time-consuming and MAS has limited assessment of axial vertebral rotation (AVR) at individual spinal levels during the gait cycle (GC).

Objective (s)

1) Compare differences between static and dynamic axial surface rotation (ASR) during the GC of both the convex and concave sides of the major curve from T1 to L4; 2) Assess the correlation and differences between maximal static ASR and maximal dynamic ASR; 3) Determine the correlation between scoliotic angle and maximal static and dynamic ASR.

Study Design

Retrospective Case Series

Methods

This study was approved by IRB committee. Patients were included if they were between the ages of 8-18-year-old with known diagnoses with IS or spinal asymmetry. Static data was evaluated by DIERS formetric 4D. Dynamic data was collected with DIERS Pedogait system at the speed of 2 to 2.5 km/hr and frequency of 60 Hz after the patients began comfortably walking on the treadmill for approximately 6 seconds. The gait cycle was evaluated from the heel strike on the convex side of major curve to the heel strike on the concave side of major curve. Pearson's correlation coefficient and paired T-test were performed with $p < 0.05$ determined to be statistically significant.

Results

38 children met inclusion criteria. Average age was 13.8 (SD=1.6) with 27 (71%) females. Average clinical follow up was 15.5 months (SD=16.8). Average dynamic ASR was greater than static ASR ($1.42^\circ \pm 7.32^\circ$) at pre-swing on the concave side gait and terminal swing on both sides gait ($P<0.05$). Strong correlation throughout the spine was found between maximal static ASR and maximal dynamic ASR ranging from 0.73 to 0.87 for both the concave and convex sides GC ($p<0.001$). Additionally, both maximal static ASR and dynamic ASR throughout the GC showed moderate correlation with static ST measured scoliotic angle ranging from 0.49 to 0.57 ($p<0.001$).

Conclusion(s)

Our study found that peak dynamic ASR ranged from T9/T10 to L1/L2 as a function of GC, which may suggest increased flexibility or compensatory motion around the thoracolumbar region. Additionally, our study indicated that larger curves may result in an increased motion in the transversal plane during the gait cycle.

Clinical significance

The study provides reassurance that the surface topography measurements in the dynamic state correlate well with the static assessments but also offers additional gait related information beneficial to the clinicians in the determination of relative ASR at various spinal level in AIS.

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CORRELATION BETWEEN FOOT PRESSURE DISTRIBUTION AND CURVE PATTERN IN ADOLESCENT IDIOPATHIC SCOLIOSIS

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Background

Adolescent idiopathic scoliosis (AIS) is a complex three-dimensional spinal deformity, Studies have shown that individuals with AIS often exhibit altered foot pressure distribution compared to healthy individuals. This can lead to compensatory mechanisms in posture. Park et al. discovered a correlation between severity of scoliosis and disparity in foot pressure between left and right feet. Another study found that regional plantar foot pressure was significantly higher in AIS compared to healthy individuals. Coronal misalignment impacts how body weight is distributed onto the feet.

Objective (s)

To investigate relationship between different curve patterns in AIS and the distribution of foot pressure. Hypothesis: There will be no correlation between curve pattern and foot pressure percentage in coronal and sagittal planes.

Study Design

Cross-sectional observational design.

Methods

86 moderate AIS(60 females-26 males) were recruited through referrals. allocated into two groups based on curve pattern from July-December 2024.

Primary Outcome: Foot Pressure Distribution: Measured using Baropodometry during static standing in frontal and coronal planes. Secondary Outcomes: Curve Pattern Classification: measure Cobb's angle and Central Sacral Vertical Line and Plumb Line.

Results

Group A consists of 43 patients with Mean Age (13.7 ± 1.4), Height (151.2 ± 5.9), Weight (50.5 ± 5.8), Body Mass Index (22 ± 1.3) and Major Thoracic Curve Cobb Angle (38.7 ± 2.8). Group B consists of 43 patients with Mean Age (13.8 ± 1.4), Height (150.7 ± 5.2), Weight (49 ± 4.2), Body Mass Index (21.6 ± 1.1) and Major Lumbar Curve Cobb Angle (38.1 ± 2.5). both groups have positive coronal imbalance (shifted to the major curve). In Group A, The mean foot pressure on Forefoot (concave side) was 45.47 ± 5.1 and Rearfoot was 54.53 ± 5.1

while in Group B, Forefoot was 46 ± 3.5 and Rearfoot was 54 ± 3.5

In Group A, The mean foot pressure on left foot (concave side) was 54.9 ± 2.4 and right foot was 45.1 ± 2.4 while in Group B, left foot was 47.5 ± 2.1 and right foot (concave side) was 52.5 ± 2.1 .

Conclusion(s)

There was a significant difference between both groups in foot pressure percentage between Right and left foot ($R=0.0001$) more on concave side of the major curve. There was no significant difference between both groups in foot pressure percentage between forefoot and rear foot ($R=0.547$). Using Pearson Correlation; There was no correlation in sagittal plane between curve pattern and forefoot/Rearfoot pressure distribution ($R=0.064$). There was a very strong correlation in coronal plane between curve pattern and Right/Left foot distribution ($R=0.853$).

Clinical significance

Understanding the correlation between curve patterns and foot pressure distribution in AIS is essential for several reasons:

- can improve clinical assessment and monitoring of AIS progression.
- aid in designing more effective treatment plans, including orthosis and exercises.
- help in developing preventive measures to mitigate secondary complications.

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THE IMPORTANCE OF NUCLEAR MEDICINE APPLICATIONS IN PATIENTS WITH SCOLIOSIS; A DESCRIPTIVE ANALYSIS FOR FUTURE RESEARCHES

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Background

Since current nuclear medicine can perform functional and hybrid imaging using different radiopharmaceuticals and imaging techniques, it can be used to evaluate tissue and organ functions affected by scoliosis.

Objective (s)

The aim of the study is to analyze the studies using nuclear medicine applications in patients with scoliosis and to evaluate the possible contributions of nuclear medicine tests to patients with scoliosis.

Study Design

The terms nuclear medicine and scoliosis were searched in Pubmed. Among the published literature, studies using nuclear medicine scans in scoliosis patients were recorded.

Methods

Among a total of one hundred and sixty-two record, twenty-two study were included according to the inclusion criteria and evaluated.

Results

It was noted that nuclear medicine tests have been used in the evaluation of patients with scoliosis since the 1970s. 50% of the studies (n=11) were focused on pulmonary perfusion and/or ventilation scintigraphy in relation to pulmonary functions affected in scoliosis. 13.63% of the studies (n=3) were based on examining the spine using bone scintigraphy. 18.18% of the studies (n=4) were focused on investigating brain glucose metabolism in patients with scoliosis and detecting post-surgery infections using F-18 FDG PET/CT. The others were related to nuclear medicine studies performed rarely in the past.

Conclusion(s)

The impact of scoliosis on lung function varies depending on its severity, and it is common for existing studies to primarily examine this association. The utilization of bone scintigraphy with SPECT/CT in future studies can enhance anatomical detail and specificity. Although abnormalities in brain glucose metabolism were detected in congenital scoliosis, the number of patients in the compared groups needs to be increased. As a suggestion, F-18 FDG PET/CT derived metabolic PET and CT parameters and segmentation of different body components may contribute investigation of scoliosis.

Clinical significance

The use of nuclear medicine for scoliosis patients from past to present and future perspective

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**REVISITING RIGO CONCEPT CLASSIFICATION. RADIOLOGICAL CRITERIA
RELIABILITY**

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Background

Rigo Concept classification differentiates 4 basic clinical types (A, B, C and E) with a modifier for the presence of a proximal thoracic structural curve (D). There is a good correspondence between clinical types and radiological curve patterns. The two main criteria to confirm the observed clinical type are the Transitional Point/Central Sacral line (CSL) Offset (Alfa angle) and curve pattern compatibility (using SRS terminology). In a previous study, Alfa angle has been shown to be a good parameter to discriminate between the different clinical types.

Objective (s)

Investigating intra- and inter- observer reliability in measuring the alfa angle (and other parameters related to the global coronal plane balance).

Study Design

Intra-and inter-observer reliability

Methods

The Cobb angle (proximal thoracic, main thoracic, lumbar/ThL), Alfa angle, upper junction/CSL offset or Beta angle and T1/CSL offset, L3 tilting, L4 tilting and L4L5 counter-tilting, have been measured by 4 different observers in two different occasions (separated for a minimum of one week) in AP radiographies from 60 non-nontreated consecutive AIS patients. Observer 1 was the reference (manual measurements); Observers 2, 3, and 4 used digital/Weasis. Intra- and Inter-observer correlation (Pearson, Spearman and ICC) has been investigated (R-software).

Results

Intra-observer Pearson coefficient: Proximal Th Cobb (Ob1: 0.92; Ob2:0.80; Ob 3: 0.98; Ob 4: 0.93 all $p<0.001$); Main Th Cobb (1; 1; 1; 1 all $p<0.001$); Lumbar/ThL Cobb (0.96; 0.95; 0.99; 0.98 all $p<0.001$); Alfa (0.95; 0.87; 0.99; 0.90 all $p<0.001$); Beta (0.90; 0.86; 0.99; 0.92 $p<0.001$); T1(0.71; 0.68; 0.98; 0.95 $p<0.001$); L3 Tilt (0.91; 0.98; 0.99; 0.99); L4Tilt (0.93; 0.97; 0.99; 0.98 $p<0.001$); L4L5 Counter-tilting (0.87;

0.95; 0.96; 0.88 $p < 0.001$). Inter-Observer Pearson for Proximal Th Cobb; Main Th Cobb Th; Lumbar/Thl Cobb; Alfa; Beta; T1; L3; L4 and L4L5 were, respectively: Ob 1 vs 2: 0.78, 0.96, 0.95, 0.91, 0.92, 0.81, 0.90, 0.87, 0.77; Ob 1 vs 3: 0.93, 0.98, 0.97, 0.96, 0.97, 0.92, 0.97, 0.94, 0.95; Ob 1 vs 4: 0.93, 0.98, 0.97, 0.95, 0.95, 0.91, 0.96, 0.94, 0.87 all $p < 0.001$). Inter-observer Spearman and ICC are presented in Table 1.

Inter-observ		1 vs 2		1 vs 3		1 vs 4	
Spearman	coef.	p-value	coef.	p-value	coef.	p-value	
Cobb Prox.	0,762	<0.001	0,896	<0.001	0,885	<0.001	
Cobb Main	0,958	<0.001	0,981	<0.001	0,982	<0.001	
Cobb.L/THL	0,937	<0.001	0,963	<0.001	0,971	<0.001	
Alfa	0,906	<0.001	0,965	<0.001	0,950	<0.001	
Beta	0,907	<0.001	0,970	<0.001	0,953	<0.001	
T1	0,825	<0.001	0,920	<0.001	0,904	<0.001	
L3Tilt	0,921	<0.001	0,963	<0.001	0,963	<0.001	
L4Tilt	0,901	<0.001	0,962	<0.001	0,961	<0.001	
L4L5Counter	0,757	<0.001	0,946	<0.001	0,875	<0.001	

Comparing the mean of the two measurements of the each observer

Inter-observ		1 vs 2		1 vs 3		1 vs 4	
ICC	coef.	p-value	coef.	p-value	coef.	p-value	
Cobb Prox.	0,765	<0.001	0,914	<0.001	0,930	<0.001	
Cobb Main	0,963	<0.001	0,973	<0.001	0,977	<0.001	
Cobb.L/THL	0,943	<0.001	0,960	<0.001	0,973	<0.001	
Alfa	0,891	<0.001	0,966	<0.001	0,957	<0.001	
Beta	0,918	<0.001	0,972	<0.001	0,956	<0.001	
T1	0,806	<0.001	0,923	<0.001	0,913	<0.001	
L3Tilt	0,904	<0.001	0,966	<0.001	0,969	<0.001	
L4Tilt	0,862	<0.001	0,943	<0.001	0,950	<0.001	
L4L5Counter	0,755	<0.001	0,948	<0.001	0,878	<0.001	

Comparing the mean of the two measurements of each observer

Conclusion(s)

Intra- and Inter-observer reliability of the Alfa angle, as the main radiological criterion in Rigo Concept Classification is excellent. No relevant differences between manual and digital measurements. Other radiological parameters used to confirm a good correspondence between clinical types (A, B, C and E) and radiological curve patterns showed also an excellent reliability.

Clinical significance

Rigo Concept classification is mainly used by orthotist in the design of the Rigo-Chêneau Brace (Rigo Concept Bracing) and by PTs using Rigo Concept PSSE. Its reliability has been questioned. The author revisited the classification and defined in

a more accurate way its clinical and radiological criteria. The classification is an essential element for the treatment standardization.

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COMPARISON OF AUTOMATIC AND MANUAL MEASUREMENTS OF SPINE CURVATURES ON ULTRASOUND VOLUME PROJECTION IMAGES FOR 999 CASES WITH ADOLESCENT IDIOPATHIC SCOLIOSIS

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Background

Previous studies reported the feasibility of using radiation-free 3D ultrasound imaging technology for the assessment of adolescent idiopathic scoliosis (AIS)¹. Ultrasound volume projection images of spine can be generated in coronal view and ready for manually measuring the spine curvature as ultrasound curve angle (UCA)². Recently a deep-learning model for automatic ultrasound curve angle (UCA) measurement has been developed to reduce manual error and processing time³. The model is a dual-branch network to detect candidate key points and perform vertebra segmentation on ultrasound coronal images.

Objective (s)

This study aimed to investigate the correlation between newly developed automatic and manual measurement of spine curvatures on coronal ultrasound images.

Study Design

The design of the study is cohort study.

Methods

Subjects with different severity of scoliosis were recruited in a local hospital. Each subject was scanned once by 3D ultrasound. 999 subjects were included in this study. Automatic measurement and manual measurement were conducted on the resulted ultrasound coronal images by a newly developed software (Fig. 1a) and experienced raters following existing measurement protocol² (Fig. 1b). The correlation between two methods was studied.

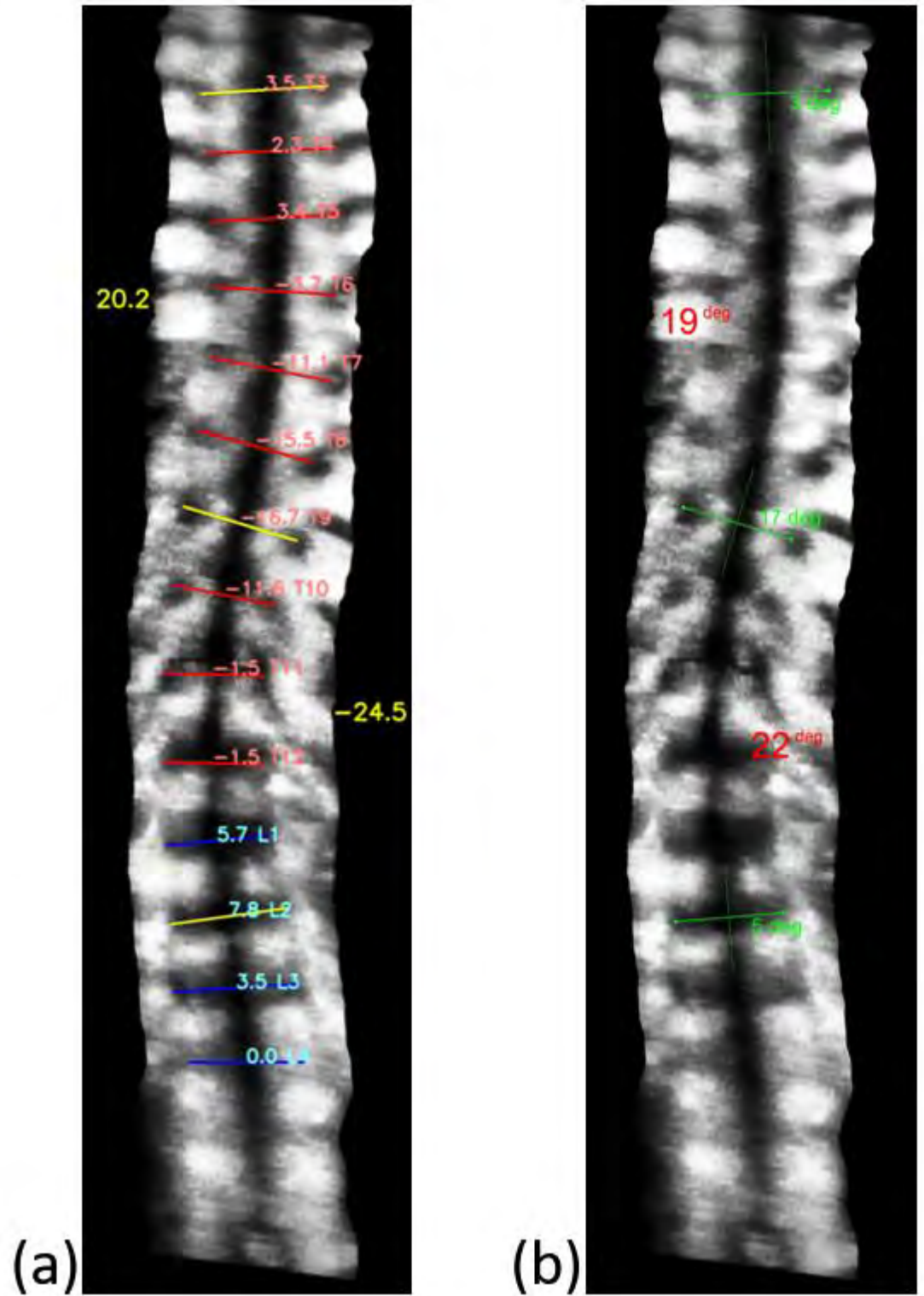


Fig. 1 – 3D ultrasound image of same subject measured by (a) the automatic method and (b) the manual method².

Results

A good linear correlation between the results of the two measurements ($y = 1.018x + 1.847$, $R^2 = 0.9023$).

Conclusion(s)

The automatic measurement could give comparable results to the manual measurement.

Clinical significance

The new automatic UCA measurement method could potentially save time for the operator's manual measuring work and ensure the consistency of results for the scoliosis assessment among different operators.

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EXAMINATION OF THE EFFECTS OF BRACES IN THE TREATMENT OF ADOLESCENT IDIOPATHIC SCOLIOSIS USING A RADIATION-FREE 3D SCANNER AND COMPUTER-ASSISTED ANALYSIS

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Background

Adolescent idiopathic scoliosis (AIS) is a 3-dimensional deformity (3D) that results in geometric and structural changes in the trunk surface and rib cage. However, the Cobb angle does not provide information regarding these changes.

Objective (s)

This study aims to investigate the changes in the spine and trunk surface following the use of brace in the treatment of AIS.

Study Design

The retrospective study included 10 AIS patients (8 females and 2 males) who had not previously received scoliosis treatment. Initial radiological evaluations and 3D scans of these patients were compared with radiological evaluations and 3D scans conducted after six or twelve months of brace use.

Methods

3D scans were processed by removing body parts not included in the assessment and aligning the scans with the center of the coordinate system based on volume mass centers. The models were then transferred to a 3D scanning analysis program to assess changes in the trunk surfaces. A 3D distance color map was generated, and 2-dimensional (2D) comparisons were performed. Changes in the Cobb angle and trunk surface were analyzed using RMS (Root Mean Square) value from 3D and 2D comparison data.

Results

Statistically significant improvement in the Cobb angle was observed following the use of the brace. However, no relation was found between the Cobb angle changes and the RMS value from the 3D and 2D comparison data.

Conclusion(s)

Brace treatment significantly reduced Cobb angles in some AIS patients. However, no significant correlation was found between Cobb angle changes and RMS values, suggesting that while 3D surface scanning provides useful insights, the study suggests that it should be conducted on a larger number of cases.

Clinical significance

The study aims to develop techniques for scoliosis follow-up that are radiation-free and provide information on changes in the trunk, thereby helping to determine the relationship between external deformities and internal spinal geometry.

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KYPHOSIS STIFFNESS TEST: IS IT RELIABLE?

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Background

The gold standard exam to measure thoracic kyphosis is the Cobb angle on standing X-rays. However, in adolescents with hyperkyphosis, evaluating the flexibility of the thoracic curve is essential for clinical decision-making and treatment planning. If the patient can extend the thoracic spine hyperkyphosis can be just a bad posture, while if the spine is stiff and kyphosis cannot be straightened, treatment is needed (exercises or bracing). Thoracic spine flexibility towards extension is measured with a lateral hyperextension radiography using a hard bolster. A clinical measure of thoracic kyphosis stiffness could reduce the need for X-rays and the associated risks of exposure to ionizing radiation.

Objective (s)

To verify the reliability (intra and inter-rater) of a new test to measure the flexibility of thoracic hyperkyphosis, the Kyphosis Stiffness Test (KST).

Study Design

Cross-sectional study.

Methods

Inclusion criteria included a diagnosis of hyperkyphosis (idiopathic or Scheuermann) with a Cobb angle (T3-T12) $>50^\circ$ and age 10-17. Patients were recruited from a tertiary institute specializing in the treatment of spinal deformities, using convenience sampling. The test was conducted twice (the second after 5 minutes) on the same patient by the same operator to assess intra-rater variability and once by three different operators to evaluate inter-rater variability. The patient lay prone with palms at shoulder height and extended his arms to achieve the maximum thoracic

spine extension. The tester applied a pressure on the spinous processes to verify the mobility of the thoracic spine towards extension. Stiffness was classified:

1. absent: kyphosis complete inversion
2. mild: kyphosis partial inversion
3. moderate: spine alignment
4. marked: kyphosis does not invert, only a few degrees of extension
5. severe: kyphosis unchanged.

Intra-rater and inter-rater reliability were assessed using Kendall's correlation coefficient, because of the ordinal nature of the data. In case of elevated number of ties, Kendall's tau-b was considered.



Kyphosis Stiffness Test. In thoracic hyperkyphosis patients, mobility, the tester applies pressure on the spinous processes towards extension. Stiffness can be absent (complete inversion), moderate (spine alignment), marked (only a few degrees), or severe (kyphosis unchanged).

Results

32 patients were recruited from January to October 2024, including 18 with idiopathic and 14 with Scheuermann hyperkyphosis, age 15.6 ± 1.6 , thoracic kyphosis Cobb $59^\circ \pm 11$.

- **Intra-rater reliability:** Kendall's coefficient showed a very strong intra-rater agreement ($\tau_b=0.908$, $p < 0.001$).
- **Inter-rater reliability:** The analysis revealed a very strong inter-rater agreement ($\tau_b=0.814$, $p < 0.001$).

Conclusion(s)

KST demonstrated a very strong intra and inter-rater agreement. These findings confirm that KST can be a highly reliable clinical tool for assessing thoracic kyphosis flexibility. Future studies should test the validity of the test.

Clinical significance

KST showed a very high reliability. If its validity is confirmed, it will help clinicians to screen patients for the need of no treatment, exercises, or bracing.

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3D ULTRASOUND IMAGING FOR SCOLIOTIC PARASPINAL MUSCLES

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Background

Adolescent idiopathic scoliosis (AIS) is defined by Cobb angle of spinal lateral deformity, but paraspinal muscle plays an important role in the onset, progression, and intervention of AIS. There is a believe that many AIS cases are caused by asymmetric paraspinal muscles. Therefore, it is crucial to have a tool to accurately and easily evaluate paraspinal muscle conditions during the management of scoliosis, particularly for conservative treatment of AIS. Electromyography can provide assessment for muscle, but mapping the whole spine is challenging. MRI can provide comprehensive assessment of muscle morphology in 3D, but the subjects need to be in supine position, and the procedure is long and expensive. B-mode ultrasound imaging is the most commonly used method for paraspinal assessment in the literature, but it can only provide 2D information at selected location, and often manually.

Objective (s)

To develop a method for paraspinal muscle evaluation for AIS patients in 3D using ultrasound imaging and automatic muscle segmentation with a deep learning model.

Study Design

It is a cohort study design to compare the muscle segmentation results between manual and automatic methods in 3D.

Methods

The study involves 8 AIS patients with 3D ultrasound scanning, using an ultrasound probe with a frequency of 7.5MHz and a width of 7.5cm. The scanning was conducted along the spine from L5 to T1, in about 30 second, with over 1500 B-mode images. Most parts of the paraspinal muscles were included in the images.

As shown in Fig. 1, a segmentation model based on an encoder-decoder network was developed to extract paraspinal muscle features in images. The segmented muscle images were mapped onto a 3D matrix using the recorded spatial information. An interpolation algorithm was utilized to ensure anatomically accurate 3D representation of muscles.

We evaluated the accuracy of automatic muscle segmentation compared to manual delineation, using dice similarity coefficient (DSC), and the computational efficiency of the proposed method, using frame per second (FPS).

Out of 8 subject data sets, 5 were used to train the segmentation model, with a totally 412 selected B-mode images, while 3 with 246 images were reserved for testing. Manual annotations were labelled as a reference for comparison.

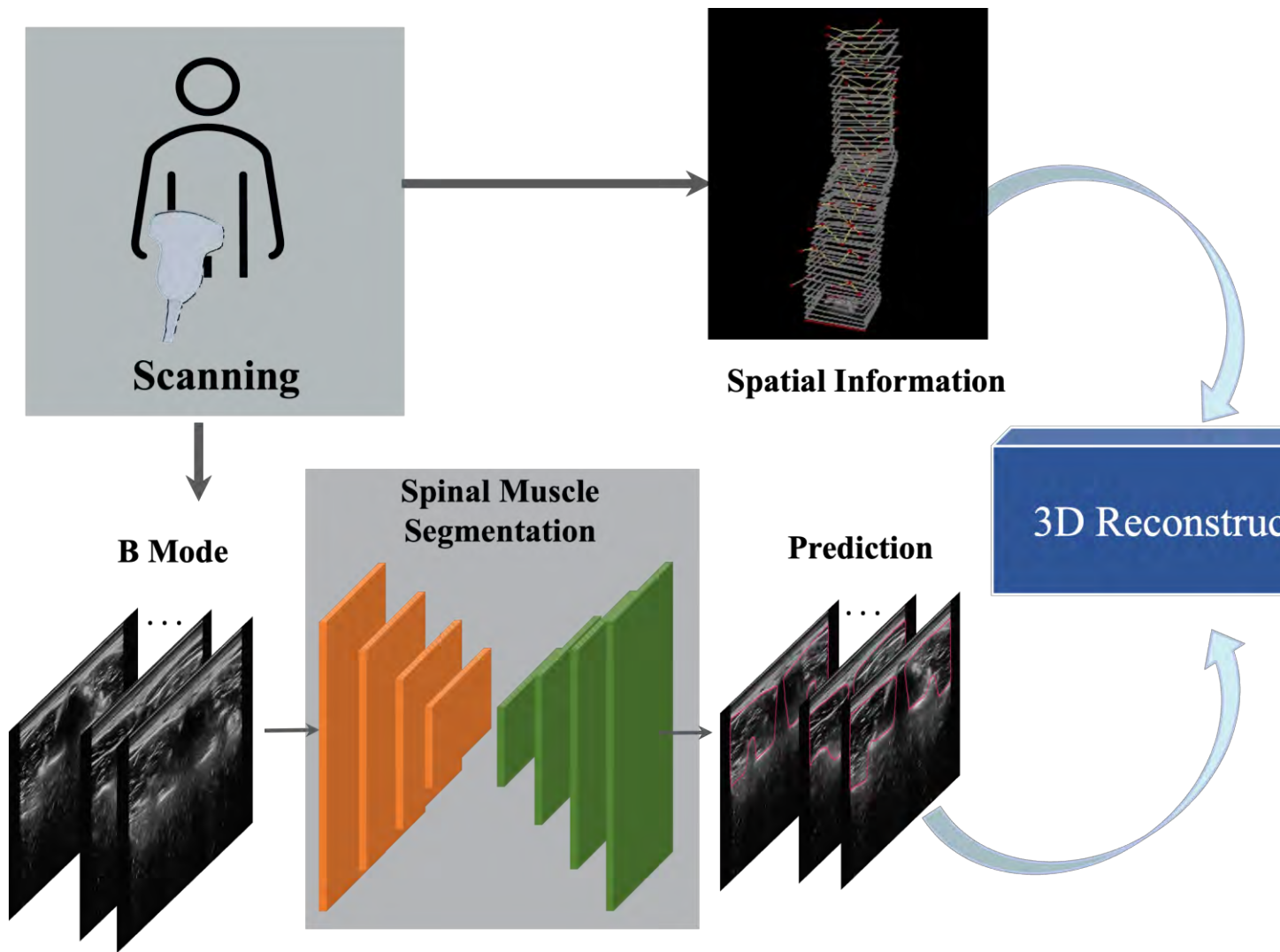


Fig.1. Illustration of the proposed auto-segmentation method for paraspinal muscles using a deep learning model and 3D reconstruction approach.

Results

The deep-learning model achieved a DSC of 81.3%, indicating a high level of agreement between the automatic segmentation and the manual annotation. Moreover, the method achieved a FPS rate of 34, paving the way for real-time applications.

Conclusion(s)

The results demonstrated the feasibility of the proposed 3D paraspinal muscle assessment method. Further studies with larger datasets are needed to validate its generalizability.

Clinical significance

The method enables real-time, accurate paraspinal muscle evaluation, improving monitoring and treatment planning for AIS patients.

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ASSOCIATION BETWEEN QUALITY OF LIFE QUESTIONNAIRES WITH CURVE MAGNITUDE, TRUNK ROTATION AND BODY SYMMETRY INDEXES IN ADOLESCENT IDIOPATHIC SCOLIOSIS

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Background

Scoliosis Research Society (SRS-22) questionnaire is a valid and reliable tool to measure quality of life for patients with spinal deformities. Trunk Appearance Perception Scale (TAPS) questionnaire is used to evaluate the self-image. Brace questionnaire (Br-Q) measures Quality of Life (QoL) for braced scoliotic patients. Trunk Aesthetic Clinical Evaluation (TRACE) scale is used for objective assessment of body symmetry by therapists. There is no study to compare these three different QoL questionnaires between them, also with TRACE and radiological and clinical parameters.

Objective (s)

Our study aimed to correlate SRS-22, TAPS and Br-Q with TRACE symmetry index, Cobb angle and Angle Trunk Rotation (ATR) and identify potential associations.

Study Design

Correlational study

Methods

160 adolescents diagnosed with scoliosis (146 girls – 14 boys, mean age 13.1 years, Risser 1.9) were recruited for our study. Mean Cobb thoracic angle was 34.8° (10° – 74°, SD 15.45), Cobb lumbar angle 29.6° (10° – 64°, SD 12.04), ATR thoracic 9.9° (2° – 20°, SD 4.24) and ATR lumbar 7.1° (2° – 30°, SD 7.08). 90 subjects (56.25%) had treatment with brace. TRACE score, Cobb angles and ATR for thoracic and lumbar curves, SRS-22 and TAPS questionnaires were documented on first visit, but the Br-Q for the

braced patients was filled in after three months. Spearman's rank correlation test was used for statistical analysis.

Results

Strong correlation was found between TRACE and ATR thoracic ($r=0.672$, $p<0.001$), moderate correlations between TRACE and Cobb thoracic ($r=0.446$, $p=0.001$), Cobb lumbar ($r=0.448$, $p=0.005$) and TAPS ($r=-0.393$, $p<0.001$), and weak correlation between TRACE and SRS-22 self-image ($r=-0.235$, $p=0.009$). SRS-22 total score had moderate correlation with Br-Q ($r=0.587$, $p<0.001$) and TAPS ($r=0.478$, $p<0.001$), weak correlation with ATR thoracic ($r=-0.265$, $p=0.01$). SRS-22 pain had weak correlation with Br-Q ($r=0.390$, $p<0.001$) and TAPS ($r=0.242$, $p=0.002$). SRS-22 mental health had moderate correlation with Br-Q ($r=0.576$, $p<0.001$), weak correlation with TAPS ($r=0.338$, $p<0.001$) and Cobb lumbar ($r=0.336$, $p=0.026$). SRS-22 self-image had moderate correlation with TAPS ($r=0.573$, $p<0.001$) and Br-Q ($r=0.429$, $p<0.001$), weak correlation with ATR thoracic ($r=0.388$, $p<0.001$). SRS-22 function had moderate correlation with Br-Q ($r=0.457$, $p<0.001$) and weak correlation with TAPS ($r=0.286$, $p<0.001$). Br-Q had weak correlation with TAPS ($r=0.258$, $p=0.017$). Interestingly, no correlation was found between TRACE and SRS-22 total ($r=-0.132$, $p=0.143$) and Br-Q ($r=-0.139$, $p=0.249$).

Spearman's rho							Spearman's rho	
		COBBTH	COBBLU	ATRTH	ATRLU			
SRS22TOTAL	rho	-0,059	0,174	-,265**	-0,017		TRSAT	rho
	p	0,657	0,258	0,010	0,874			p
PAIN	rho	0,153	0,176	-0,076	0,065		TAPS	rho
	p	0,249	0,254	0,465	0,557			p
MENHEAL	rho	0,028	,336*	-0,153	0,058		BRQ	rho
	p	0,833	0,026	0,140	0,598			p
S.IMAGE	rho	-0,182	0,015	-,388**	-0,124		TRACE	rho
	p	0,167	0,921	0,000	0,257			p
FUNCT	rho	-0,118	-0,087	-0,154	-0,035			
	p	0,374	0,575	0,137	0,749			
TRSAT	rho	-0,112	-0,086	-0,16	-0,122			
	p	0,619	0,802	0,282	0,472		Spearman's rho	
TAPS	rho	-,310*	0,043	-,449**	-0,108			
	p	0,018	0,783	0,000	0,328		TRACE	rho
BRQ	rho	-,379*	-0,35	-0,19	0,147			p
	p	0,019	0,093	0,178	0,339		TAPS	rho
TRACE	rho	,446**	,448**	,672**	0,181			p
	p	0,001	0,005	0,000	0,108		TRSAT	rho
** Correlation is significant at the 0.01 level (2-tailed).								p
* Correlation is significant at the 0.05 level (2-tailed).							BRQ	rho
								p

Conclusion(s)

Curve magnitude and trunk rotation are not well associated with QoL for scoliotic patients. There were mainly moderate correlations between SRS-22, Br-Q and TAPS. TRACE scale was strongly associated with ATR thoracic, moderately associated with Cobb thoracic and lumbar, weakly associated with TAPS and SRS-22 self-image, and not correlated with SRS-22 total and Br-Q.

Clinical significance

Our research demonstrated that Cobb angle, trunk rotation and body symmetry do not well correspond to patient's perspective for their quality of life, which should be independently evaluated.

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PREDICTION OF SCOLIOSIS PROGRESSION USING 3D ULTRASOUND IMAGING OF SPINE OF 447 SUBJECTS WITH 5-YEAR FOLLOW-UP

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Background

Only a portion of adolescent idiopathic scoliosis (AIS) cases will progress. However, in current clinical practice, all patients are followed up in a similar way. If there is method that can accurately predict the risk of progression for a specific case, it will greatly enhance the management of scoliosis, as we can put more resources for high-risk cases. Recently, 3D ultrasound imaging has been widely demonstrated by different research groups as a reliable and accurate supplement imaging modality for the assessment of scoliosis at screening, follow-up, and treatment outcome measurement stages, to reduce the use of X-ray doses. In addition, 3D ultrasound can provide 3D spinal profiles in coronal, sagittal and transverse planes. Meanwhile, previous studies have demonstrated that using 3D spinal deformity information can predict progression of scoliosis. Accordingly, the aim of this study is to investigate whether the volumetric information provided by 3D ultrasound of spine can be used for the progression prediction for scoliosis.

Objective (s)

To develop a deep learning model to effectively utilize the volumetric data of 3D ultrasound of spine for predicting scoliosis progression without radiation.

Study Design

It is a cohort study design to develop a method for predicting scoliosis progression

Methods

447 AIS patients were followed up for 5 years during their bone maturing period, and 3D ultrasound scanning was conducted every 6 to 12 months. A total of 611 pairs of consecutive data were obtained, with 34% progressive pairs, and 66% non-progressive pairs, and 400 sets were used for training, and 211 sets for testing. The obtained volumetric images were projected from 8 different angles in coronal-sagittal planes to form multi-view images as a representation of a 3D spinal profile. Subsequently, all the images were further fused by feature-decoupling to comprehensively characterize the spine morphology by integrating the shared spinal morphological features and the specific features from the coronal-sagittal planes. We used ultrasound curve angle (UCA) larger than 5 degrees as an indication of progression between each consecutive scan pair to train the model.

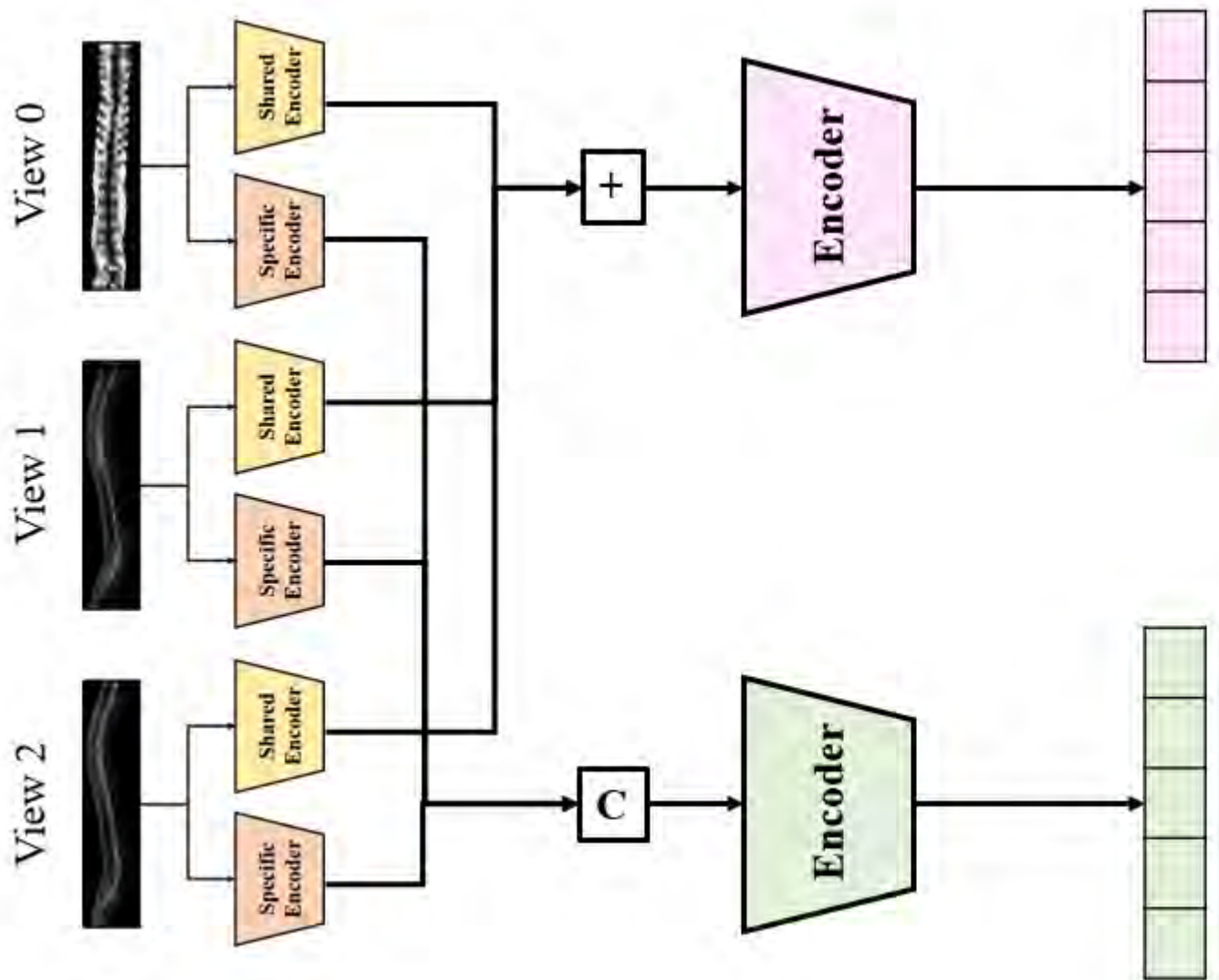


Fig 1. The deep learning model to integrate information from images projected from different directions of the 3D ultrasound volumetric images of spine for scoliosis progression prediction.

Results

Results revealed that the model achieved 87% prediction accuracy for scoliosis progression between two consecutive follow-up scanning.

Conclusion(s)

It is potential to use 3D ultrasound imaging and deep learning models to predict the progression of scoliosis. Studies are ongoing to develop models to predict the angle at the bone maturation.

Clinical significance

If the progression of scoliotic curve can be predicted accurately using a radiation-free method, we are able to put more resources on those high-risk cases. It can also help to avoid overtreatment for those low-risk cases.

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A TRANSFER LEARNING APPROACH FOR IDENTIFYING COBB ANGLE CHANGES IN ADOLESCENT IDIOPATHIC SCOLIOSIS MONITORING USING SURFACE TOPOGRAPHY

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Background

During initial and follow-up visits, adolescent idiopathic scoliosis (AIS) patients routinely undergo X-ray imaging to measure the Cobb angle (CA). However, the risks associated with cumulative radiation exposure highlight the need for alternatives to non-invasive scoliosis monitoring.

Objective (s)

This study proposes a transfer learning approach to identify CA change in AIS patients using 3D surface topography (ST) scans over a 1-year follow-up period.

Study Design

This cross-sectional study uses 3D torso scanning technology with a pre-trained convolutional neural network (CNN) model and regression algorithm for identifying CA change while monitoring AIS patients.

Methods

A transfer learning approach was developed and validated to assess CA change in AIS patients—a CNN extracted features from paired 3D ST scans. A regression model was then used to identify Δ CA. The whole framework was trained and tested on 223 paired full-torso ST scans collected over a 1-year

follow-up period from one clinical cohort. Performance was evaluated using metrics such as mean absolute error (MAE) to quantify identification accuracy.

Results

The regression model achieved an MAE of 2.29° with an error coverage of 96% in a $\pm 5^\circ$ error range.

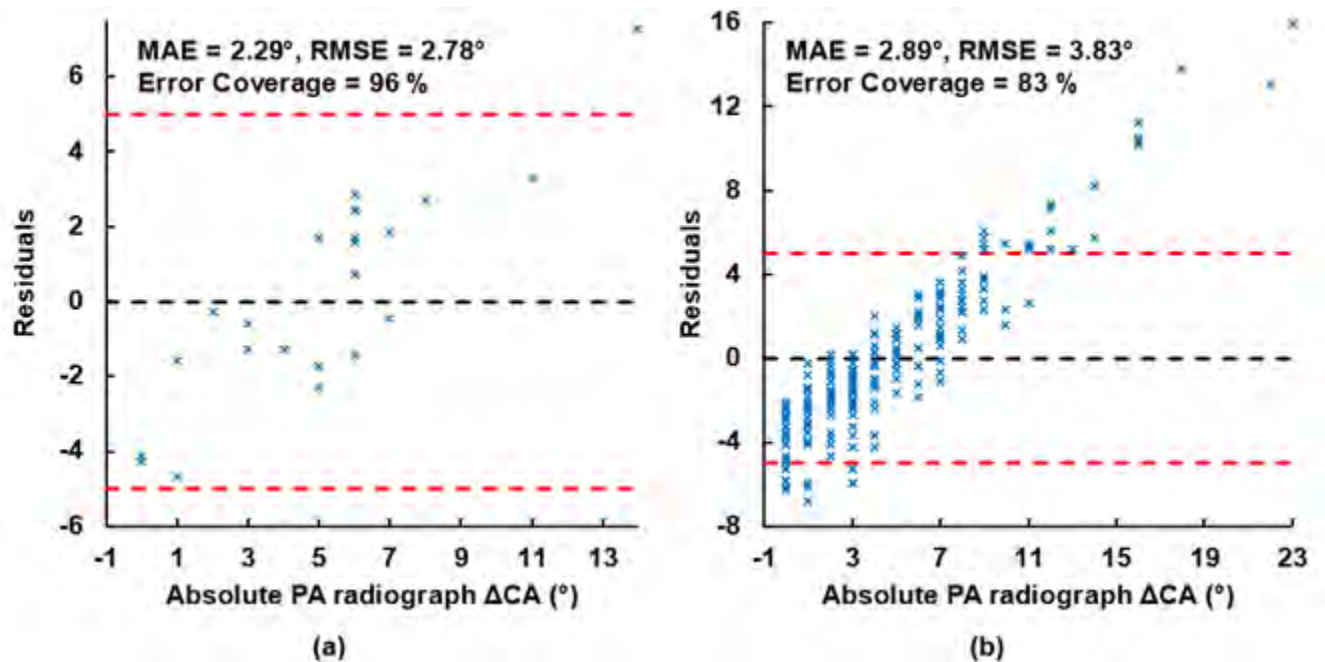


Figure 1: Residual analysis of the KN regressor for ΔCA in both the (a) training and (b) testing sets.

Conclusion(s)

The approach demonstrated the potential to eliminate unnecessary X-ray imaging during monitoring for 96% of cases between two visits. However, it only focuses on the change of the maximum scoliosis curve, highlighting the need for further research to enhance its applicability and ensure accurate monitoring of scoliosis.

Clinical significance

This study introduces a radiation-free method for monitoring scoliosis progression, addressing concerns about long-term radiation exposure in AIS patients. By providing reliable CA change detection, this approach has the potential to significantly reduce the frequency of X-ray imaging in routine scoliosis care while maintaining high diagnostic accuracy.

Final category: 7 Health-related Quality of Life and Patient-Reported Outcome Measurements

RELIABILITY AND VALIDITY OF THE CHINESE VERSION OF THE EARLY-ONSET SCOLIOSIS SELF-REPORTED QUESTIONNAIRE IN CHILDREN AGED 8 TO 10 YEARS WITH EARLY-ONSET SCOLIOSIS

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Background

The Early-Onset Scoliosis Self-Report Questionnaire (EOSQ-SELF) is a novel self-report instrument to evaluate the health-related quality of life (HRQoL) of early onset scoliosis (EOS) patients, as a complementary HRQoL assessment tool for the proxy-report 24-item Early-Onset Scoliosis Questionnaire (EOSQ-24).

Objective (s)

This study aimed to translate and adapt the EOSQ-SELF into a Chinese version and evaluate its reliability and validity in EOS patients.

Study Design

Cross-sectional study

Methods

A cross-sectional study was performed from July 2022 to September 2022. Patients aged 8 to 18 years with EOS were recruited. Forwards-backwards translation and cross-cultural adaptation of the original EOSQ-SELF were performed. The Chinese EOSQ-SELF was administered and collected twice through social media, with a 2 weeks interval. Reliability was evaluated by using internal consistency, and test-retest reliability was assessed by the intraclass correlation coefficient (ICC) of data between the two time points. A Delphi survey in the expert committee was used to investigate the content validity. SRS-22r, PedsQL4.0, and EQ-5D-Y scales were used to assess the criterion-related validity. Nonparametric tests and multiple linear regression were performed to evaluate the discriminative ability.

Results

A total of 101 valid responses from EOS patients were received. The mean age was 12.08 ± 2.19 years, and 53.47% were female. The mean Cobb angle was $60.56^\circ \pm 19.48^\circ$. Floor effects of 0.00% to 7.92% and ceiling effects of 0.00% to 52.48% were observed. Excellent internal consistency and test-retest

reliability of the Chinese EOSQ-SELF was observed, with a Cronbach's α coefficient of 0.942, McDonald's ω coefficient of 0.940, and ICC of 0.930. All domains of the Chinese EOSQ-SELF were significantly correlated with SRS-22r (0.709 to 0.878), PedsQL4.0 (0.568 to 0.718), and EQ-5D-Y (−0.598 to −0.625), depicting excellent criterion-related validity. Discriminative ability was validated in aetiology ($P<0.001$), severity of spinal deformity ($P<0.001$), treatment status ($P<0.001$), and ambulatory ability ($P<0.001$).

Conclusion(s)

The Chinese EOSQ-SELF is a reliable and valid tool for the assessment of self-report HRQoL in patients aged 8 to 18 years with EOS. It can be easily applied in clinical settings and for research purposes, as a complementary tool for the proxy-report EOSQ-24.

Clinical significance

This study demonstrates the clinical significance of the Chinese Early-Onset Scoliosis Self-Report Questionnaire (EOSQ-SELF) as a reliable and valid tool for assessing health-related quality of life (HRQoL) in early-onset scoliosis (EOS) patients aged 8 to 18 years. Its excellent psychometric properties make it a valuable complement to the proxy-report EOSQ-24, facilitating more accurate and individualized patient assessments. Clinicians can use the EOSQ-SELF in routine evaluations to better understand patients' perspectives on their health status, treatment outcomes, and overall quality of life. This tool enhances clinical decision-making and research efforts, ultimately improving the management and care of EOS patients.

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PEDIATRIC SPINE SURGEONS REPORT HIGH MENTAL HEALTH BURDEN AND LIMITED SUPPORT FOR SCOLIOSIS PATIENTS

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Background

Adolescents with scoliosis often present with comorbid mental health issues. Previous studies document higher rates of depression, anxiety, eating disorders, and body image concerns in this population compared to their peers. However, standardized protocols for screening, evaluation, and treatment of these issues are lacking.

This study explores mental health screening practices among pediatric orthopedic providers treating spine deformities, focusing on the extent of mental health considerations and barriers to effective care.

By identifying gaps in current practices, the study aims to promote a more holistic approach to scoliosis treatment that supports both physical and mental well-being.

Objective (s)

To assess current mental health screening practices among pediatric spine surgeons treating scoliosis, identify barriers to effective care, and explore the extent of mental health concerns in this patient population.

Study Design

Cross-sectional Survey Study.

Methods

54 pediatric spine surgeons who are part of a multi-center adolescent idiopathic scoliosis (AIS) registry were anonymously surveyed. The survey included a mix of closed-ended and open-ended questions. Responses to closed-ended questions were tallied. A sentiment analysis was performed on open-ended responses to identify themes.

Results

Of 54 surgeons surveyed, 28 (52%) responded, most with over 10 years of experience in pediatric spine deformity practices (Table 1). Survey results show that many physicians estimate up to half of their patients face mental health challenges related to their condition, with family dynamics playing a “significant” role and mental health burden on patients is “slightly increasing”. Despite this, only 12 (42%) conduct structured mental health screenings, and 6 (21%) do informal screenings. Of those screenings, tools like PROMIS and depression/suicide assessments are most common. However, only 2 (7%) “probably” follow up on low scores, and 11 (39%) report follow-up is unlikely (“probably not”).

Many respondents (64%) felt that they are not adequately addressing mental health. Referrals typically arise from positive screening results or observed symptoms, but barriers include limited provider availability, access, and insurance issues. When referrals are made, they are usually within the same institution.

Table 1. Survey Questions Responses

Total Responses		28
Does your practice utilize any structured mental health screening practices?	Yes	12
	No	16
Types of Structured Screening Used	PROMIS	4
	SRS	3
	Depression/Suicide Screen	4
	PHQ	2
Does your practice utilize any informal mental health screening practices?	Yes	6
	No	22
Types of informal screening practices	PHQ	1
	PROMIS	1
	Patient History	1
	Pre-op RN visit	1
What type of Patient Reported Outcomes (PRO's), if any, does your practice employ?	SRS	23
	PROMIS	12
	EOSQ	7
	PHQ	2
	CP Child	2
	ODI	2
	SAQ	1
Does your clinical team follow-up on low mental health scores (including mental health domain scores for general questionnaires)?	SF-12	1
	Definitely not	5
	Probably not	11
	Might or might not	10
	Probably yes	2
	Definitely yes	0
Have you noticed any recent trends in the mental health care burden on your patients?	No	5
	Slightly increasing	12
	Significantly increasing	0
	Slightly decreasing	1
	Significantly decreasing	0
What percentage of your patients do you feel experience mental health burden in relation to their diagnosis/treatment?	0-24%	8
	25-49%	17
	50-74%	2
	75-100%	1
Do you perceive that mental health is being adequately responded to in the patients with scoliosis that you treat?	Definitely not	2
	Probably not	16
	Might or might not	6
	Probably yes	3
	Definitely yes	1

Do you feel as though the family dynamic contributes significantly to your patients' mental health?	Definitely no	0
	Probably no	0
	Might or might not	2
	Probably yes	13
	Definitely yes	13
In what proportion of at-risk patients do you recommend mental health follow-up?	<5%	11
	5-24%	8
	25-49%	1
	50%+	8
In what proportion of at-risk patients do you refer for mental health follow-up?	<5%	14
	5-24%	4
	25-49%	5
	50%+	5
If you do recommend mental health follow-up, how often do you refer to providers internal to your own institution vs. outside providers?	Mostly Internal	17
	Equally Internal/External	3
	Mostly External	6

Conclusion(s)

This study reveals significant gaps in mental health care for pediatric scoliosis patients. Although many providers recognize the mental health burdens associated with scoliosis, most do not conduct routine screenings and feel they fall short in addressing these issues. Referrals, typically made to internal providers, are often hindered by barriers such as limited provider availability, access issues, and insurance constraints.

Clinical significance

These findings underscore the need for standardized mental health screening protocols and improved access to mental health resources within scoliosis care, allowing providers to better support both the physical and mental well-being of scoliosis patients.

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Background

Scoliosis has become the third "killer" after obesity and myopia, which threatens the physical and mental health of children and adolescents in China. The main types of scoliosis include structural scoliosis and non-structural scoliosis. Early screening, early diagnosis and early intervention can effectively prevent the development of the disease and reduce the incidence of the disease.

Objective (s)

To investigate the scoliosis of primary and secondary school students in Tai 'an city, and to calculate the incidence of scoliosis. Methods The adolescent scoliosis was screened by three-step examination in the middle and primary school students in the urban area of Tai 'an city.

Study Design

Observational study

Methods

The survey covered 5 middle schools (5,208 middle school students) and 6 primary schools (2,728 primary school students) in Taishan District of Tai 'an City and Daiyue District, and the physical examination time was June 2024. Six medical staff were selected to undergo relevant examination methods and learning and training according to the relevant requirements of the Technical Guidelines for the prevention and control of spinal deformity in children and Adolescents issued by the Disease Control Bureau of the National Health Commission of the People's Republic of China. The basic information, epidemiological history, scoliosis screening (shoulder position, scapular Angle position, lumbar concave, iliac crest position), lower limb biomechanical examination (pelvic forward, lumbar lordosis, knee hyperextension, X-leg, O-leg, flat foot, pes cavus), manual screening and instrument screening (thoracic, thoracolumbar, lumbar) were performed. Forward flexion test, trunk rotatometry examination.

Results

A total of 7934 students were included in the screening of abnormal spinal curvature, of which 573 students were detected with scoliosis, and the detection rate of scoliosis was 7.22%. Of the 7,934 students examined for scoliosis, 2,728 were tested for scoliosis in primary school, with a scoliosis of 94 students, and 5,206 were tested for scoliosis in secondary school, with 300 scoliosis students.

Conclusion(s)

The prevalence of scoliosis in primary and secondary school students in Tai 'an city was 7.22%, Scoliosis is mainly 1-degree scoliosis, and scoliosis is mainly located in the chest and waist segments.

Clinical significance

Regular screening should be performed in primary and secondary schools to effectively control scoliosis and further improve the physical and mental health and health care level of children and adolescents.

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THE EFFECT OF PRIOR SCOLIOSIS BRACING ON MENTAL HEALTH OUTCOMES FOLLOWING DEFINITIVE SURGERY FOR ADOLESCENT IDIOPATHIC SCOLIOSIS

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Background

Scoliosis is characterized by a 3-dimensional curvature of the spine with treatment ranging from conservative care, including physical therapy and bracing, to surgical management including growth-friendly or fusion surgeries. Decisions regarding treatment are largely based on patient characteristics including age, growth potential, and curve severity. Recent work has illustrated that brace wear can increase the level of stress patients undergo. Given that the goal of bracing is often to prevent the necessity for surgery, bracing “failure”, in which the curve progresses to a surgical range after conservative management, can be particularly challenging.

Objective (s)

This study aims to examine how bracing failure impacts patients psychologically. Specifically, we aim to determine whether bracing treatment failure and subsequent progression to surgery is associated with worse mental health and health related quality of life (HRQoL) when compared to surgical management in the absence of bracing.

Study Design

Retrospective Cohort

Methods

This study evaluates the psychological and HRQoL outcomes in AIS patients experiencing bracing progression to surgery compared to those undergoing surgery without prior bracing. The HARMS study group registry was queried for any AIS patients who had underwent index fusion. Inclusion criteria were as follows: patients with primary posterior spinal fusion, available bracing history data (yes/no), mental health patient reported outcomes through the SRS-22 questionnaire, and a minimum 2-year follow-up. Exclusion criteria were non-idiopathic scoliosis, prior surgical treatment for scoliosis, or unavailable bracing data. The Wilcoxon rank sum test and Fisher’s exact test were used to analyze the non-normally distributed data.

Results

632 patients met criteria to be included in the study. At baseline, the braced cohort was younger at diagnosis by 1.7 years ($p < 0.001$). There was no statistically significant difference between the two cohorts regarding age at surgery, sex, preoperative curves, or postoperative curves. Regarding SRS scores, the braced group had higher self-image (3.41 ± 0.69 vs. 3.25 ± 0.72 ; $p = 0.003$) and total SRS scores (3.85 ± 0.52 vs. 3.75 ± 0.54 ; $p = 0.024$) pre-operatively. These differences were not maintained immediately post-operatively, though at two-year follow up, the scores for braced patients were higher when compared to patients with no history of bracing in all categories excluding mental health (Table 1).

Table 1. SRS Scores Stratified by Bracing Cohort

		Brace Cohort [n (%)]		P-value
		Braced (n=238)	Not Braced (n=394)	
Preoperative				
	Pain	3.99 ± 0.74	3.88 ± 0.79	0.086
	Self-Image	3.41 ± 0.69	3.25 ± 0.72	0.003**
	General Function	4.18 ± 0.54	4.10 ± 0.65	0.242
	Mental Health	3.89 ± 0.76	3.83 ± 0.81	0.389
	Satisfaction	3.68 ± 1.00	3.71 ± 0.95	0.84
	Total	3.85 ± 0.52	3.75 ± 0.54	0.024*
Postoperative				
	Pain	3.60 ± 0.89	3.63 ± 0.84	0.799
	Self-Image	4.04 ± 0.57	4.28 ± 0.67	0.215
	General Function	3.45 ± 0.58	3.10 ± 0.67	0.198
	Mental Health	4.02 ± 0.64	3.88 ± 0.63	0.468
	Satisfaction	4.01 ± 0.90	4.44 ± 0.73	0.142
	Total	3.80 ± 0.49	3.84 ± 0.51	0.735
Two-Year Follow-up				
	Pain	4.41 ± 0.61	4.29 ± 0.68	0.019*
	Self-Image	4.41 ± 0.58	4.27 ± 0.67	0.010*
	General Function	4.50 ± 0.45	4.40 ± 0.54	0.019*
	Mental Health	3.99 ± 0.75	4.01 ± 0.78	0.646
	Satisfaction	4.64 ± 0.56	4.47 ± 0.75	0.016*
	Total	4.36 ± 0.46	4.25 ± 0.52	0.019*
Preoperative to Two-Year Difference				
	Pain	0.42 ± 0.06	0.41 ± 0.05	0.898
	Self-Image	1 ± 0.06	1.02 ± 0.05	0.798
	General Function	0.32 ± 0.05	0.3 ± 0.04	0.755
	Mental Health	0.1 ± 0.07	0.18 ± 0.06	0.386
	Satisfaction	0.96 ± 0.07	0.76 ± 0.06	0.031
	Total	0.51 ± 0.05	0.5 ± 0.04	0.876

Significant differences between variables indicated as follows: <.05*, <.01**, <.001***

Conclusion(s)

This study suggests that bracing “failure” may not negatively affect outcomes after surgery. The results indicate that the AIS population is resilient and while treatments do affect mental health and HRQoL in a meaningful way, one should not forgo bracing treatment due to fears that progression to surgery may adversely affect patient’s mental health in the long run. Furthermore, this study reaffirms that surgical treatment leads to better HRQoL outcomes immediately post-operatively that are sustained at two-year follow up.

Clinical significance

Bracing failure in AIS patients does not negatively impact long-term mental health or HRQOL outcomes compared to surgery alone

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SATISFACTION WITH NEUROMUSCULAR SCOLIOSIS CORRECTION SURGERY AS PERCEIVED BY THE FAMILY: CORRELATION WITH ASPECTS OF QUALITY OF LIFE AND COMPLICATIONS

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Background

Among the objectives of surgical correction of neuromuscular scoliosis are: curve reduction, pain improvement, and the patient's sitting position. The literature is robust regarding good surgical results; however, radiological images and spinal alignment appear to be weak predictors of quality of life in the perception of patients/family members. In this context, analyzing surgical satisfaction from the perspective of patients and their families, and which aspects influence this satisfaction, can help better align expectations of surgical results and target post-operative rehabilitation.

Objective (s)

To assess the family perception of satisfaction with neuromuscular scoliosis correction surgery and its correlation with quality of life domains and complications

Study Design

Retrospective cohort study

Methods

The sample consisted of a census of 344 medical records of patients undergoing neuromuscular scoliosis correction between 2019-2023. Upon hospital admission, a questionnaire was administered covering quality of life domains: mobility (independence in transfers), independence in personal care, limitation in sitting (time), pain, sleep (limited by pain), use of analgesics, family social activities, and health quality (EQ-VAS). During hospitalization, data were collected on gender, age, underlying diagnosis, functionality, and in-hospital complications. After 3, 6, and 12 months, the patient/family member was contacted by telephone and asked about their satisfaction with the surgery, followed by the same questionnaire used preoperatively.

Results

In the quality of life domains, there was an improvement in the EQ-VAS ($p<0.001$), pain ($p<0.001$), sleep ($p=0.03$), and sitting time ($p=0.007$). Mobility and personal care worsened, increasing dependence in both when compared to the preoperative period ($p<0.001$). No statistically significant differences were found in family activities or the frequency of analgesic use between the evaluated time points. Satisfaction with the surgery showed a slight decrease at the end of 12 months, but this was not statistically significant ($p=0.47$). When correlating satisfaction with the quality of life domains, higher rates of satisfaction were observed with reduced pain (6 months - $p=0.019$ and $p=0.009$), less difficulty sleeping (6 months - $p<0.001$), fewer limitations in family activities (3 months - $p=0.003$ and 6 months - $p=0.026$), sitting in a chair not limited by pain (3 and 6 months - $p<0.001$), higher EQ-VAS scores (3, 6 and 12 months $p<0.001$). No significant differences were observed between satisfaction and frequency of analgesic use, mobility, and personal care at the evaluated time points.

Table 1. Main correlations between satisfaction with surgery and aspects of quality of life

		Strongly disagree		Partially disagree		Neither agree nor disagree		Partially agree		Totally agree		
		N	%(CI95%)	N	%(CI95%)	N	%(CI95%)	N	%(CI95%)	N	%(CI95%)	p-value
Satisfaction x Presence of pain												
3 months	Yes	4	3 (0-10)	2	2 (0-8)	3	2,7 (0-9)	9	8 (2-15)	94	84 (78-91)	0,173
	No	4	3,6 (0-10)	0	0 (0-5)	3	2,3 (0-7)	6	5 (0,8-10)	116	90 (86-95)	
6 months	Yes	3	3,5 (0-11)	2	2,4 (0-10)	0	0 (0-8)	71	83 (77-92)	9	10 (5-19)	0,019
	No	1	0,9 (0-5)	2	1,7 (0-5)	0	0 (0-4)	4	3,5 (0-7)	108	94 (90-98)	
12 months	Yes	2	3 (0-12)	3	4,3 (0-14)	1	1,4 (0-11)	10	14 (6-24)	54	77 (68-86)	0,009
	No	2	1,7 (0-6)	2	1,7 (0-6)	1	0,9 (0-5)	5	4,3 (0-9)	105	91 (87-95)	
Satisfaction x Limitation to sit in a chair												
3 months	Prevents sitting down	2	15,4 (0-46)	0	0 (0-30)	1	7 (0-38)	2	15,4 (0-46)	8	61,5 (46-92)	0,001
	Prevents sitting for more than 1h ¹	2	20,7 (0-66)	1	16,7 (0-66)	2	7,7 (0-23)	2	20,7 (0-66)	26	84,6 (77-99)	
	Sit as long as you like	4	2 (0-6)	1	0,5 (0-4)	3	1,5 (0-5)	12	6 (2,5-10)	179	90 (86-94)	
6 months	Prevents sitting down	1	16,7 (0-62)	1	16,7 (0-62)	0	0 (0-45)	0	0 (0-45)	4	66,7 (50-100)	<0,001
	Prevents sitting for more than 1h ¹	1	12,5 (0-51)	1	12,5 (0-51)	0	0 (0-19)	4	38,3 (7-33)	17	86,7 (80-100)	
	Sit as long as you like	2	1 (0-5)	2	1 (0-5)	0	0 (0-4)	10	6 (2-9)	159	92 (88-95)	
12 months	Prevents sitting down	0	0 (0-100)	0	0 (0-100)	0	0 (0-100)	0	0 (0-100)	1	100 (100-100)	0,037
	Prevents sitting for more than 1h ¹	2	31 (0-86)	0	0 (0-21)	1	0 (0-21)	5	25 (0-86)	14	70,6 (53-91)	
	Sit as long as you like	6	3,6 (0-8,2)	2	1 (0-6)	1	0,6 (0-5)	11	6,6 (2-11)	147	88 (84-92)	
Satisfaction x Difficulty sleeping due to pain												
3 months	Prevents sleep	1	5 (0-21,1)	0	0 (0-16,1)	0	0 (0-16,1)	2	10 (0-26,1)	17	85 (75-100)	0,069
	You get less than 6h ¹ of sleep	1	5,6 (0-24,0)	2	55,6 (0-100)	1	5,6 (0-24,0)	2	11,1 (0-29,5)	14	72,2 (55,6-91)	
	Sleep undisturbed by pain	6	2,9 (0-7,1)	0	0 (0-4,2)	5	2,4 (0-6,7)	12	5,8 (2,4-10)	184	88,9 (85,5-93)	
6 months	Prevents sleep	0	0 (0-39,5)	0	0 (0-39,5)	0	0 (0-39,5)	2	29 (14,3-68)	5	71 (57-100)	<0,001
	You get less than 6h ¹ of sleep	1	8,3 (0-35,1)	1	100 (100-100)	0	0 (0-26,8)	5	42 (17-68,4)	6	50 (25-77)	
	Sleep undisturbed by pain	3	1,6 (0-5,3)	3	1,6 (0-5,3)	0	0 (0-3,7)	7	3,8 (1,1-7,5)	170	93 (90,2-96,6)	
12 months	Prevents sleep	0	0 (0-29,1)	0	0 (0-29,1)	1	10 (0-39,1)	2	20,0 (0-49,1)	7	70 (50-99,1)	0,546
	You get less than 6h ¹ of sleep	1	9,1 (0-35,3)	0	0 (0-26,2)	0	0 (0-26,2)	1	9,1 (0-35,3)	10	81,8 (72,7-100)	
	Sleep undisturbed by pain	3	1,8 (0-6,9)	6	3,5 (0-8,7)	1	0,6 (0-5,7)	13	7,6 (3,5-12,8)	147	86,5 (82,4-91,6)	
Satisfaction x Mobility												
3 months	Independent	0	0 (0-15,4)	0	0 (0-15,4)	2	9,5 (0-24,9)	1	4,8 (0-20,1)	18	85,7 (76,2-100)	0,658
	Transfer from bed to CR ²	0	0 (0-27,4)	0	0 (0-27,4)	0	0 (0-27,4)	0	0 (0-27,4)	6	100 (100-100)	
	Posture and decubitus changes	0	0 (0-11,2)	0	0 (0-11,2)	0	0 (0-11,2)	1	6,7 (0-17,8)	14	93,3 (87-100)	
	Dependent	8	3,9 (0-8,5)	2	1,0 (0-5,5)	4	2,0 (0-6,5)	14	6,8 (3-11,4)	177	86,3 (82,4-91)	
6 months	Independent	0	0 (0-15,4)	0	0 (0-15,4)	2	9,5 (0-24,9)	1	4,8 (0-20,1)	18	85,7 (76-100)	0,658
	Transfer from bed to CR ²	0	0 (0-27,4)	0	0 (0-27,4)	0	0 (0-27,4)	0	0 (0-27,4)	6	100 (100-100)	
	Posture and decubitus changes	0	0 (0-11,2)	0	0 (0-11,2)	0	0 (0-11,2)	1	6,7 (0-17,8)	14	93,3 (86,7-100)	
	Dependent	8	3,9 (0-8,5)	2	1,0 (0-5,5)	4	2,0 (0-6,5)	14	6,8 (3-11,4)	177	86,3 (82,4-90,9)	
12 months	Independent	0	0 (0-17,8)	2	9,1 (0-26,8)	0	0 (0-17,8)	2	9,1 (0-26,8)	18	81,8 (72,7-99,6)	0,739
	Transfer from bed to CR ²	0	0 (0-23,0)	0	0 (0-23,0)	0	0 (0-23,0)	1	14,3 (0-37,3)	6	85,7 (71,4-100)	
	Posture and decubitus changes	0	0 (0-27,4)	0	0 (0-27,4)	0	0 (0-27,4)	0	0 (0-27,4)	6	100 (100-100)	
	Dependent	4	2,5 (0-8,1)	4	2,5 (0-8,1)	2	1,3 (0-6,8)	13	8,3 (3,8-14)	134	85,4 (81-90,9)	
Satisfação x Cuidados pessoais												
3 months	Independent	0	0 (0-28,7)	0	0 (0-28,7)	1	10,0 (0-38,7)	1	10 (0-38,7)	8	80 (70-100)	0,241
	Help with washing or dressing	0	0 (0-5,8)	0	0 (0-5,8)	1	3,4 (0-9,3)	0	0 (0-5,8)	28	96,6 (93-100)	
	Dependent	8	3,9 (0-8,5)	2	1,0 (0-5,6)	4	1,9 (0-6,6)	15	7,2 (3,4-1)	178	86,0 (82-90,7)	
6 months	Independent	0	0 (0-28,7)	0	0 (0-28,7)	1	10 (0-38,7)	1	10 (0-38,7)	8	80,0 (70-100)	0,241
	Help with washing or dressing	0	0 (0-5,8)	0	0 (0-5,8)	1	3,4 (0-9,3)	0	0 (0-5,8)	28	96,6 (93,1-100)	
	Dependent	8	3,9 (0-8,5)	2	1,0 (0-5,6)	4	1,9 (0-6,6)	15	7,2 (3,4-12)	178	86 (82,1-90,7)	
12 months	Independent	0	0 (0-12,8)	0	0 (0-12,8)	0	0 (0-12,8)	1	7,7 (0-20,5)	12	92,3 (84,6-100)	0,622
	Help with washing or dressing	0	0 (0-15,5)	1	5,3 (0-20,8)	0	0 (0-15,5)	1	5,3 (0-20,8)	17	89,5 (84,2-100)	
12 months	Dependent	4	2,5 (0-7,7)	5	3,1 (0-8,3)	2	1,2 (0-6,4)	14	8,8 (3,7-14)	135	84,4 (79,4-89,5)	0,003
	Completely limits	4	8,2 (0-19,9)	0	0 (0-11,7)	2	4,1 (0-15,8)	4	8,2 (0-19,9)	39	79,6 (71,4-91,3)	
	It has some limitations	3	3 (0,10,6)	2	2 (0-9,6)	3	3,0 (0-10,6)	10	10,0 (4-17,6)	82	82,0 (76,0-89,6)	
6 months	Not limited	1	1 (0-4,2)	0	0 (0-3,2)	1	1,0 (0-4,2)	2	2,1 (0-5,2)	93	95,9 (92,8-99,1)	0,003
	Completely limits	4	8,2 (0-19,9)	0	0 (0-11,7)	2	4,1 (0-15,8)	4	8,2 (0-19,9)	39	79,6 (71,4-91,3)	
3 months	It has some limitations	3	3 (0,10,6)	2	2 (0-9,6)	3	3,0 (0-10,6)	10	10,0 (4-17,6)	82	82,0 (76,0-89,6)	0,003
	Not limited	1	1 (0-4,2)	0	0 (0-3,2)	1	1,0 (0-4,2)	2	2,1 (0-5,2)	93	95,9 (92,8-99,1)	

Conclusion(s)

This study found no proportional correlation between increased or decreased satisfaction with the factors evaluated. Gains in quality of health, sleep time, reduced pain, and greater tolerance to sitting in a chair were higher satisfaction rates, while postoperative complications reduced them. In-hospital complications, reduced mobility, and greater dependence on personal care were indifferent, suggesting that satisfaction seems to be related to individual patient/family expectations.

Clinical significance

Aligning expectations with the expected surgical results can avoid false expectations and better guide post-operative rehabilitation.

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PRE-OPERATIVE EOSQ-24 SCORES ARE WORSENING OVER TIME

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Background

The Early Onset Scoliosis Questionnaire (EOSQ-24) is a proxy survey designed to evaluate and follow the health-related quality of life (HRQoL) of patients with early-onset scoliosis (EOS). In recent years, a number of studies have shown that mental health among children and adolescents is worsening even in the absence of surgical interventions. The changes in HRQoL of adolescents with idiopathic scoliosis (SRS22) have been studied, but no studies exist analyzing EOS patients and their parents. We aimed to determine changes in the HRQoL of EOS patients and the burden on their parents based on the results of the EOSQ-24.

Objective (s)

Recent studies have shown worsening mental health in children due to social media use, sedentary lifestyles, and the Covid-19 pandemic. We hypothesize that HRQoL scores in EOS patients have worsened in recent years.

Study Design

Retrospective analysis of a multicenter database.

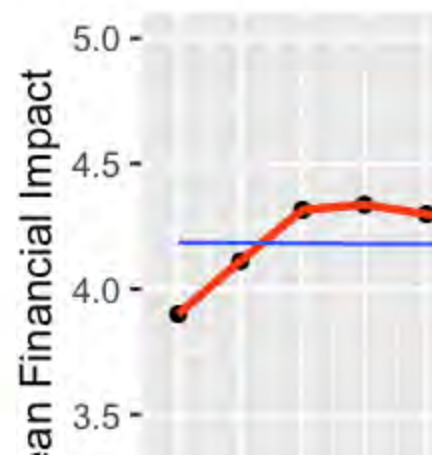
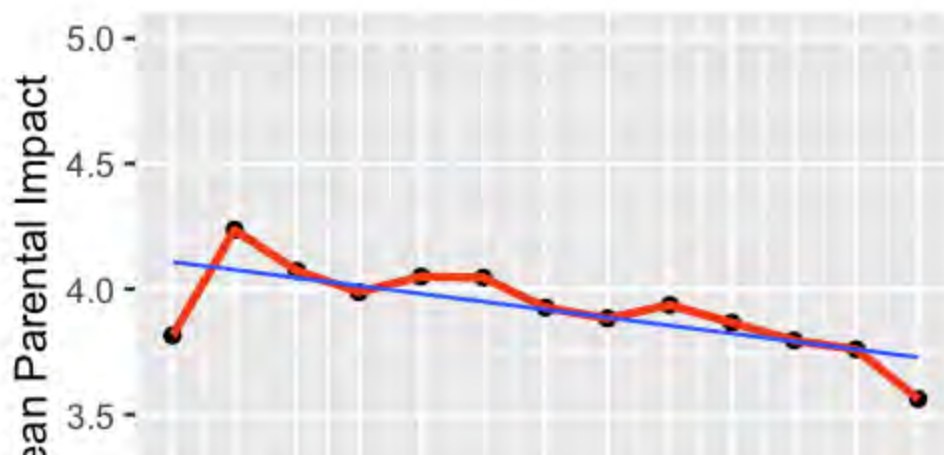
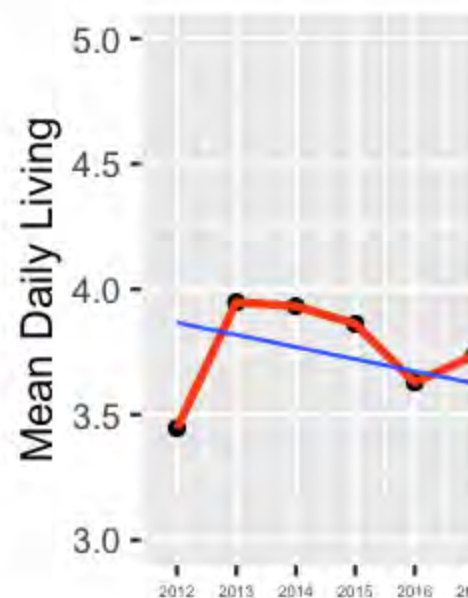
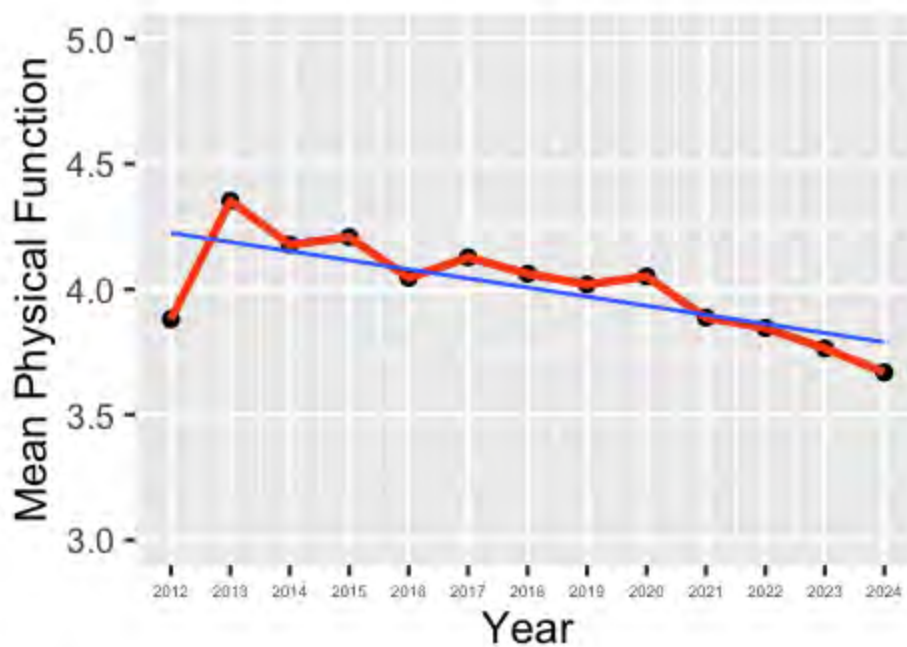
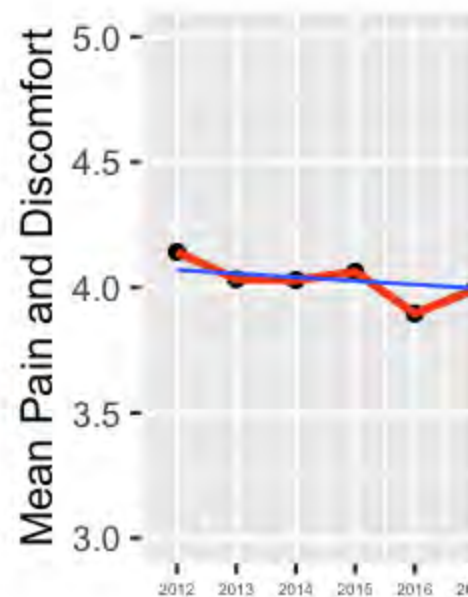
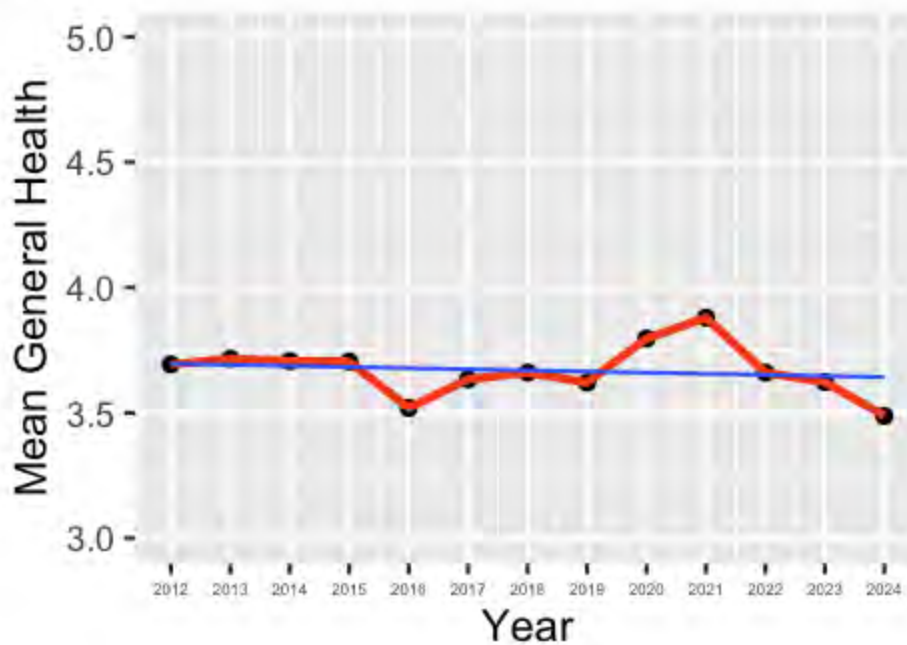
Methods

A retrospective query of a multicenter database identified 1786 patients with EOS who had not yet had any intervention (observation only) whose parents completed a total of 3986 EOSQ-24s from 2012 to 2024. A mean score from 1 to 5 was calculated for each EOSQ-24 domain (general health, pain and discomfort, pulmonary function, transfer, physical function, daily living, fatigue and energy level, emotion, parental impact, financial impact, and child satisfaction) at each year. Multiple linear regression was performed to reduce the effect of confounding variables. The mean score of each EOSQ-24 domain at each year was the dependent variable, and the independent variable was years from 2012. Coefficients with $p < 0.05$ were considered significant.

Results

Multiple linear regression revealed a significant decrease in transfer (-0.026 , $p < 0.001$), physical function (-0.025 , $p = 0.002$), daily living (-0.042 , $p < 0.001$), fatigue and energy level (-0.014 , $p = 0.047$), emotion (-0.025 , $p < 0.001$), parental impact (-0.023 , $p < 0.001$), and child satisfaction (-0.017 , $p = 0.024$). General health, pain and discomfort, pulmonary function, and financial impact demonstrated no significant change.

Overall



Conclusion(s)

Parents of patients with EOS report that their children's HRQoL has decreased significantly in more than half of domains in the last twelve years, suggesting that the burden on these patients and their parents has worsened over time. Further study is needed to determine causes of these trends.

Clinical significance

Worsening EOSQ-24 scores of children with EOS over the last decade indicate an increased need for mental health counseling and support as a facet of treatment.

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HOW DOES SCOLIOSIS SEVERITY INFLUENCE QUALITY OF LIFE IN ADOLESCENTS WITH IDIOPATHIC SCOLIOSIS? A CROSS-SECTIONAL STUDY

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Background

Adolescent Idiopathic Scoliosis (AIS) is a complex three-dimensional spinal deformity with a global prevalence of 2-3%, predominantly affecting females during adolescence. AIS is diagnosed through X-rays revealing curvatures exceeding 10°, measured by the Cobb angle. AIS can impact quality of life (QoL), particularly as the severity of the Cobb angle increases, affecting areas such as self-image and mental health.

Objective (s)

To evaluate QoL in patients with AIS, particularly assessing how curvature severity correlates with declines in QoL.

Study Design

A retrospective cross-sectional study.

Methods

Sample was provided by the Escoliose Brasil Institute, with electronic medical records collected from patients in January 2019 to June 2024. The study was approved by the Research Ethics Committee (blinded) and adhered to the STROBE checklist. Inclusion criteria was patients aged 10 to 16 years with AIS (Cobb angle $\geq 10^\circ$), without a history of surgeries or pre-existing diseases. Patients were classified into four groups based on the major Cobb angle curve: mild ($10-20^\circ$), moderate ($21-40^\circ$), severe ($41-60^\circ$), and very severe ($>60^\circ$). QoL was assessed by the Scoliosis Research Society Outcomes Questionnaire (SRS-22). The normality of the data was tested using the Shapiro-Wilk Test. The Pearson correlation coefficient was calculated to assess the relationship between continuous and parametric variables while the Spearman correlation test was calculated for non-parametric data or categorical variables to identify correlations between the Cobb angle severity and the SRS-22 scores. An intersection graph identified the Cobb angle threshold where QoL declines.

Results

A total of 1,321 AIS were included. A weak negative correlation was found between Cobb angle and QoL ($r=0.15$; $p<.001$). In the mild curvature group, a weak correlation in function and activity ($Rho=-.14$; $p=.04$) and self-image and appearance ($Rho=-.15$; $p=.03$). No significant correlations were found in the moderate and severe groups. In the very severe group, were found correlation to pain ($Rho=-.24$; $p=.01$), self-image and appearance ($Rho=-.21$; $p=.02$) and subtotal-score ($Rho=-.25$; $p=.01$). The intersection graph indicated that QoL declines when the Cobb angle exceeds 65° (figure 1).

Conclusion(s)

There is a weak, but significant inverse correlation between the Cobb angle and QoL in AIS with very severe curvatures (above 65°), especially in pain and self-image.

Clinical significance

Understanding the correlation between quality of life and the Cobb angle is important to determine multidisciplinary treatment

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IMPACT OF SIDE-SHIFT MOBILITY ON HEALTHCARE OUTCOMES AND INITIAL COBB ANGLE IN SCOLIOSIS PATIENTS

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Background

Scoliosis, defined by lateral spinal curvature and vertebral rotation, is measured by the **Cobb angle**. Trunk mobility classifications, **Type One** (hypercorrection/overcorrection) **Type Two** (midline/partial correction), reflect differing flexibility and response to corrective forces. Type One indicates greater

flexibility, while Type Two suggests increased rigidity. Hypercorrection facilitates multiplanar adjustments due to **coupled motion**, enhancing correction in scoliosis management. This study examines the relationship between initial Cobb angle and healthcare outcomes in these classifications.

Objective (s)

To investigate:

1. Differences in initial Cobb angle between Type One and Type Two classifications.

Associated healthcare outcomes: functional status (SRS-22r), quality of life (EQ-5D), and spinal appearance (SAQ).

Study Design

Level 3: Retrospective comparative study.

Methods

Population:

Data were analyzed from 60 scoliosis patients (mean age: 14 ± 2 years; 40% male), classified as **Type One** (n=30) or **Type Two** (n=30) using Betts' criteria.

Outcome Measures:

- **Cobb Angle:** Quantifies spinal curvature.
- **SRS-22r:** Evaluates function, pain, self-image, and mental health.
- **EQ-5D:** Assesses health-related quality of life.
- **SAQ:** Measures perception of spinal appearance.

Analysis:

Independent samples t-tests compared mean values between groups, with $p < 0.05$ as significant. Correlations assessed relationships between Cobb angle and outcomes

Results

Table 1: Initial Cobb Angle and Healthcare Outcomes by Side-Shift Classification

Outcome	Type One (n=30)	Type Two (n=30)	p-value
Initial Cobb Angle (°)	33.4 ± 5.6	40.6 ± 6.1	<0.01
SRS-22r (mean score)	3.78 ± 0.56	3.12 ± 0.72	<0.01
EQ-5D (score / 100)	64.2 ± 18.3	75.4 ± 15.6	0.02
SAQ (score / 50)	24.7 ± 5.8	30.2 ± 6.3	<0.01

CLINICAL DATA INTERPRETATION

- **Initial Cobb Angle:**
 - **Type One:** Lower angles ($p < 0.01$), reflecting greater flexibility and correctability.
 - **Type Two:** Higher angles, indicative of increased trunk rigidity.
- **Healthcare Outcomes:**
 - **SRS-22r:** Higher scores in Type One suggest better functional outcomes.
 - **EQ-5D:** Type Two patients reported superior quality of life.
 - **SAQ:** Type Two patients expressed greater satisfaction with spinal appearance.

Figure 1: Correlation Analysis

- **Type One:** Strong negative correlation between Cobb angle and SRS-22r ($r = -0.65$).
- **Type Two:** Positive correlation between Cobb angle and EQ-5D ($r = 0.58$).

Conclusion(s)

Initial Cobb angle reflects critical differences in trunk mobility classifications. **Type One** mobility, with lower angles, aligns with better functional outcomes due to enhanced flexibility and multiplanar corrections. **Type Two**, with higher angles, correlates with better quality of life and appearance satisfaction. These findings emphasize the importance of tailoring scoliosis treatment to individual patient characteristics.

Clinical significance

This study underscores the importance of tailoring scoliosis management strategies based on trunk mobility classifications and initial Cobb angle. Type One mobility, characterized by lower Cobb angles and greater flexibility, facilitates multiplanar corrections, leading to improved functional outcomes as reflected by higher SRS-22r scores. In contrast, Type Two mobility, associated with higher Cobb angles and increased rigidity, aligns with better perceived quality of life (EQ-5D) and spinal appearance satisfaction (SAQ).

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TEST-RETEST RELIABILITY AND CONVERGENT VALIDITY OF THE ENGLISH VERSIONS OF THE ISYQOL AND ISYQOL INTERNATIONAL AGAINST RADIOGRAPHIC MEASUREMENTS AND ESTABLISHED QUALITY OF LIFE QUESTIONNAIRES IN ADOLESCENTS WITH IDIOPATHIC SCOLIOSIS

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Background

To evaluate the effects of treatments for Adolescent Idiopathic Scoliosis (AIS), clinicians often administer patient-reported outcome measures (PROMs), such as the Italian Spine Youth Quality of Life (ISYQOL) questionnaire. The ISYQOL was developed to measure health-related quality of life, providing insights into patient well-being. Upon comparing multiple translations, the ISYQOL exhibited limitations, resulting in the removal of four items, creating the ISYQOL International. The measurement properties of the ISYQOL and ISYQOL International should be compared.

Objective (s)

This study aimed to compare the test-retest reliability and convergent validity of the English ISYQOL and ISYQOL International in conservatively treated females with AIS.

Study Design

A cross-sectional validity and test-retest reliability study.

Methods

Conservatively treated females with AIS were consecutively recruited from a Canadian pediatric scoliosis clinic. Participants completed five scoliosis-specific PROMs online – the ISYQOL, Scoliosis Research Society-22r, Spinal Appearance Questionnaire, Truncal Anterior Asymmetry Scoliosis Questionnaire, and the Body Image Disturbance Questionnaire – Scoliosis version – during their clinic visit as well as at one- and two-weeks post-visit. Radiographic measurements, including maximum Cobb angle, thoracic and lumbar vertebral rotations, and coronal balance were also collected. Test-retest reliability between one and two weeks was assessed using Intra-Class Correlation Coefficients ($ICC_{3,1}$), and by the Standard Error of Measurement (SEM). Convergent validity of the ISYQOL questionnaires against other established PROMs and radiographic measurements was evaluated using Pearson correlation coefficients.

Results

Participants included 100 females aged 13.9 ± 1.8 years (mean curve angle $28.8^\circ \pm 13.9^\circ$). Among these, 42 participants completed the retest questionnaire (mean curve angle of $25.0^\circ \pm 9.0^\circ$). The ISYQOL demonstrated test-retest reliability adequate for research use, with $ICC_{3,1} = 0.89$ (95%CI = 0.80; 0.94) and SEM = 24.0, while the ISYQOL International showed reliability adequate for clinical use, with $ICC_{3,1} = 0.93$ (95%CI = 0.88; 0.96) and SEM = 22.4.

Correlations between the ISYQOL and established questionnaires were statistically significant ($p < 0.01$) for all PROMS ($|r| = 0.31$ to 0.67), except the TAASQ breast size domain ($r = 0.19$). Correlations with radiographic measurements were statistically significant ($r = -0.26$ to -0.33), except for lumbar rotation and coronal balance ($r = -0.05$ and -0.08).

Similarly, correlations for the ISYQOL International were statistically significant for all PROMS ($|r| = 0.32$ to 0.66) except the TAASQ breast size domain ($r = 0.18$). Correlations with radiographic measurements were also similar ($r = -0.27$ to -0.37), with no statistical significance for lumbar rotation and coronal balance ($r = -0.05$ and -0.09).

Table 1. Correlations between the ISYQOL, ISYQOL International and other established questionnaires and radiographic measurements

		ISYQOL	ISYQOL International
Spinal Appearance Questionnaire - SAQ	Appearance	-0.46	-0.50
	Expectations	-0.50	-0.52
	Total	-0.53	-0.56
Scoliosis Research Society - SRS-22r	Function	0.49	0.46
	Pain	0.53	0.54
	Self-Image	0.53	0.54
	Mental Health	0.48	0.48
	Total	0.67	0.66
Body Image Disturbance Questionnaire – Scoliosis Version - BIDQ-S	Total	-0.58	-0.59
Truncal Anterior Asymmetry Scoliosis Questionnaire - TAASQ	Breast	0.34	0.35
	Breast – Location	0.31	0.32
	Breast – Shape	0.38	0.40
	Breast – Size	0.19	0.18
	Appearance	0.56	0.58
	Clothing	0.53	0.54
	Clothing – General	0.50	0.55
	Clothing – Specific	0.49	0.49
Radiographic Measurements	Cobb Angle	-0.33	-0.37
	Thoracic Rotation	-0.26	-0.27
	Lumbar Rotation	-0.05*	-0.05*
	Coronal Balance	-0.08*	-0.09*

ISYQOL: Italian Spine Youth Quality of Life Questionnaire

* Correlation NOT significant ($p > 0.05$)

Conclusion(s)

The ISYQOL International, despite including fewer items, can be used in clinical and research settings. It demonstrates stronger test-retest reliability while maintaining similar construct validity to the original ISYQOL.

Clinical significance

The ISYQOL International provides clinicians and researchers with a reliable tool for assessing quality of life. Its international design facilitates future multinational collaborations.

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DETERMINING THE PATIENT ACCEPTABLE SYMPTOM STATE OF ISYQOL, ISYQOL INTERNATIONAL, SAQ, AND TAASQ QUALITY OF LIFE AND APPEARANCE QUESTIONNAIRES FOR ADOLESCENTS WITH IDIOPATHIC SCOLIOSIS

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Background

Patient-reported outcome measures (PROMs) are commonly used by clinicians to monitor the effects of Adolescent Idiopathic Scoliosis (AIS) treatments. Although many scoliosis-specific PROMs, such as the Italian Spine Youth Quality of Life (ISYQOL) Questionnaire, Spinal Appearance Questionnaire (SAQ), and Truncal Anterior Asymmetry Scoliosis Questionnaire (TAASQ) have adequate reliability and validity, their patient acceptable symptom state (PASS) - the value beyond which patients consider their health state as acceptable - is unknown.

Objective (s)

This study aims to determine the PASS of the ISYQOL, ISYQOL International, SAQ, and TAASQ in a sample of conservatively treated females with AIS.

Study Design

A cross-sectional analysis using receiver operating characteristic (ROC) curves to determine PASS thresholds.

Methods

Conservatively treated females with AIS were consecutively recruited from a Canadian pediatric scoliosis clinic. Participants completed the ISYQOL, SAQ, and TAASQ online during their clinic visit. Question four of the SRS-22r, "If you had to spend the rest of your life with your back shape as it is right now, how would you feel about it?" was used as the anchor to determine the achievement of the PASS. Participants who reported feeling "very happy" were classified as having reached the PASS. The correlation between the anchor question and the ISYQOL, ISYQOL International, SAQ, and TAASQ was evaluated using Spearman correlation coefficients. PASS threshold scores and the area under the curve (AUC) for each questionnaire were determined using ROC curves.

Results

Participants included 100 females with a mean age and curve angle of 13.9 ± 1.8 years and $28.8^\circ \pm 13.9^\circ$. The AUCs for the ISYQOL and ISYQOL International were not statistically significant (AUC = 0.60 and 0.59). Similarly, the AUCs for all TAASQ domains and sub-domains were not statistically significant, ranging from AUC = 0.55 to 0.69. However, the SAQ Total score and Expectations domain showed statistically significant AUCs at 0.70 and 0.71, respectively.

The PASS threshold scores for the ISYQOL and ISYQOL International were 73 and 51. These thresholds correctly identified 6/19 and 16/19 participants who achieved the PASS, while correctly identifying 73/81 and 29/81 participants as not achieving the PASS. The PASS threshold scores for the SAQ Total score, Appearance, and Expectation domains were 25 (14/19), 20 (18/19), and 6 (11/19), respectively.

The PASS threshold score for all domains and sub-domains of the TAASQ was 4, with a variable but low range of correctly identifying participants achieving the PASS (1-8/19).

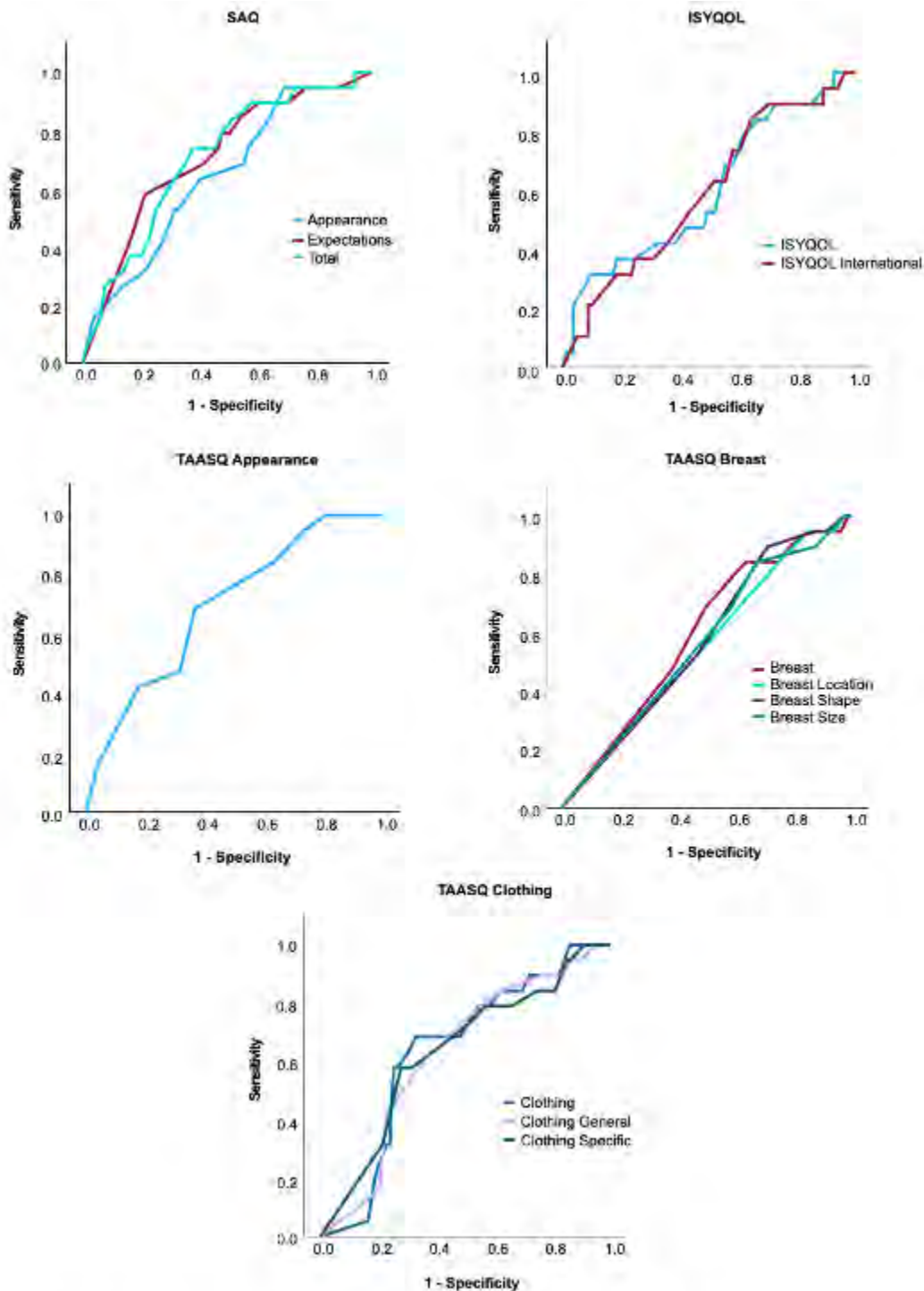


Figure 1. Receiver operating characteristic curves for the SAQ, ISYQOL, ISYQOL International, and TAASQ

Conclusion(s)

Using an appearance-based anchor, we have proposed PASS thresholds for the ISYQOL, ISYQOL International, SAQ, and TAASQ.

Clinical significance

Clinicians can use these cut-off scores as thresholds to determine whether patients have achieved the PASS for these tools. However, given the low AUC values for both versions of the ISYQOL and TAASQ, we recommend using these thresholds with caution.

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Analysis of factors influencing the psychological health status of adolescent idiopathic scoliosis patients

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Background

Adolescent idiopathic scoliosis (AIS) is a three-dimensional deformity of the spine that develops rapidly in adolescence, which has a significant impact on the quality of life and mental health of patients. At present, there are relatively few studies on the mental health status of AIS patients and its influencing factors.

Objective (s)

To explore the influencing factors of mental health status of adolescent idiopathic scoliosis patients, and to provide scientific basis for clinical psychological intervention.

Study Design

A cross-sectional study design was used to select a certain number of AIS patients as the research object. The general information, scoliosis degree, social support and coping style of patients were collected through questionnaire survey. Symptom checklist 90 (SCL-90) was used to evaluate the mental health status of patients, and statistical methods were used to process and analyze the data.

Methods

A cross-sectional study design was used to investigate 425 AIS patients with questionnaires. The general information, Cobb angle of scoliosis (measured by X-ray), score of social support rating scale (SSRs), score of Coping Style Questionnaire (CSQ) and score of symptom checklist 90 (SCL-90) were collected

and analyzed. SPSS 26.0 software was used for statistical analysis, including t-test, one-way analysis of variance (ANOVA), Pearson correlation analysis and multiple stepwise regression analysis.

Results

The total score of SCL-90 in AIS patients was (143.2 ± 32.5), which was significantly higher than that in normal adolescent control group ($p < 0.001$). The mean Cobb angle was 23.6° (the standard deviation was 9.4°). The total score of social support was (38.4 ± 7.2), and the score of positive coping style was (24.8 ± 5.1). Correlation analysis showed that Cobb angle was positively correlated with the total score of SCL-90 ($r = 0.415$, $p < 0.001$), while the total score of social support and positive coping style were negatively correlated with the total score of SCL-90 ($r = -0.326$, $p < 0.001$ and $R = -0.289$, $P < 0.05$), $P < 0.001$). Multiple stepwise regression analysis showed that Cobb angle ($\beta = 0.324$, $p < 0.001$), total score of social support ($\beta = -0.215$, $p < 0.01$) and positive coping style ($\beta = -0.187$, $p < 0.05$) were independent factors for predicting mental health status of AIS patients, and the model explained 39.8% of the total variation.

Conclusion(s)

The mental health status of adolescent idiopathic scoliosis patients is affected by many factors, which should be paid attention to in clinical work, and targeted psychological intervention should be carried out to improve the quality of life of patients.

Clinical significance

This study provides a theoretical basis and practical guidance for clinical psychological intervention, helps to improve the mental health level of AIS patients, and promotes their physical and mental health development. In addition, the research results have a certain reference value for improving the comprehensive treatment of AIS patients.

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CAN QUESTIONS FROM THE SCOLIOSIS RESEARCH SOCIETY QUESTIONNAIRE-22 BE MAPPED TO THE EUROQOL-5 DIMENSION 5-LEVEL?

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Background

The EuroQoL-5 dimension 5-level (EQ5D-5L) is a generic quality of life measure, from which quality adjusted life years is calculated. It however lacks specificity to scoliosis. Successful mapping of the disease-specific Scoliosis Research Society 22-item questionnaire (SRS-22) to the EQ5D-5L, could help to establish the value of scoliosis treatment and therefore aid funding decisions.

Objective (s)

Identify whether the SRS-22 can be mapped to the EQ5D-5L.

Study Design

Pilot retrospective cohort study.

Methods

91 complete data sets from patients with Idiopathic Scoliosis (IS) who attended a supervised Physiotherapy Scoliosis Specific Exercise programme between 2015 and 2017, were selected at random. SRS-22 and EQ5D-5L data from pre- and post-treatment; 6-, 12-, and 18-months post-treatment were analysed. Questions from the SRS-22 were paired onto the five EQ5D-5L domains. T-tests, boxplots and distribution testing were used in order to test the similarities between results for SRS and EQ5D. P-values of <0.05 were considered statistically significant.

Results

91 complete data sets from 75 patients were analysed. 87% were female. There were 40 adults (mean age = 36.4, range = 18-76) and 35 children (mean age = 14.2, range = 10-17). 5% of participants had a single thoracic curvature, 55% had a double curvature and 40% had thoraco-lumbar or lumbar curvatures.

There was no significant difference between the paired questions on the SRS-22 for 3 out of the 5 EQ5D-5L domains. EQ5D-5L usual activity (mean=4.57) paired with SRS-22 question 9 (mean=4.49) ($p=0.5378$; 95% CI [-0.18, 0.35]). EQ5D-5L pain (mean=4.10) paired with SRS-22 question 2 (mean=3.86) ($p=0.06921$; 95% CI [-0.02, 0.50]). EQ5D-5L anxiety/depression (mean=4.53) paired with SRS-22 question 7 (mean=4.31) ($p=0.08521$; 95% CI [-0.03, 0.47]).

There was no significant difference pre-treatment between the paired SRS-22 question 5 (mean=4.13) and the EQ5D-5L mobility domain (mean=4.60) ($p=0.06497$; 95% CI [-0.03, 0.98]). There was, however, a significant difference post-treatment, between SRS question 5 (mean=4.39) and EQ5D mobility (mean=4.68) ($p = 0.008303$; 95% CI [0.07, 0.49]).

The EQD5 self-care domain (mean=4.92) did not map to the paired SRS-22 question 12 (mean=4.19) ($p=0.000$ 95% CI [0.58, 0.95]). However, it did map to SRS-22 question 14 (mean = 4.43) ($p=8.05e-06$ 95% CI [0.28, 0.71]).

Conclusion(s)

Four questions on the EQ5D-5L could be mapped to a question on the SRS-22. These questions could be used to establish economic information specific to scoliosis treatment. The mobility domain requires further investigation to conclude its suitability for mapping. The self-care pairing should be interpreted with caution as this does not equate well with SRS-22 question 14.

Clinical significance

Using a disease specific questionnaire to estimate quality adjusted life years in scoliosis patients, could help to guide treatment funding decisions in this patient group.

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POLISH ADAPTATION OF 24-ITEM EARLY ONSET SCOLIOSIS QUESTIONNAIRES (EOSQ-24)

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Background

The negative impact of spinal deformities on health-related quality of life (HRQoL) is well known. One goal of early onset scoliosis (EOS) treatment is to improve HRQoL for patients and reduce the burden on the family.

Objective (s)

The aim of the study was to carry on the process of cultural adaptation of the American English version of the Early Onset Scoliosis Questionnaire 24 (EOSQ-24) into Polish.

Study Design

Cross-cultural adaptation of questionnaire.

Methods

Translation and cross-cultural adaptation of the original EOSQ-24 were performed according to published guidelines by the experts committee. The Polish version of the EOSQ-24 -PL was applied to forty-five EOS patients (age 7.3 ± 2.3 years, Cobb angle 24.8 ± 8.5 degrees). The sample included 31 patients with idiopathic scoliosis, thirteen with congenital, and one with neuromuscular scoliosis. The assessment of parents considered each item of the EOSQ- 24 -PL relevant to their child's health condition. EOSQ consists of 24 question items, which are divided into domains. Transformed scores are from 0-100 (lower scores mean greater disability).

The reliability (internal consistency, test-retest reliability), floor and ceiling effects and discriminative validity of the Polish version of the EOSQ-24 were calculated. Internal consistency was assessed using the Cronbach alpha coefficient. Test-retest reliability was evaluated using the intraclass correlation coefficient (ICC). Discriminative validity for scoliosis etiology was tested using the Mann-Whitney test.

Results

All items and domains showed very good global internal consistencies (Cronbach alpha 0.919 and 0.835, respectively). Test–retest reliability ranged from 0.77 to 0.98 ICC values, indicating good to excellent agreement.

There was not a floor effect or a ceiling ranging from 0 to 68.9 % in the domains data.

When etiologies were compared, there was a statistically significant difference between idiopathic and congenital groups in Pain and Discomfort, Daily living, Fatigue, Emotion, and Parental burden domains.

The lowest score domains were Financial burden in the idiopathic (41.9 ± 19) and congenital group (42.3 ± 15) and General Health (58.7 ± 12) domain in the congenital group.

Conclusion(s)

The Polish version of the EOSQ-24-PL is a reliable and a valid tool for the psychometric assessment of children with EOS and the family burden.

Clinical significance

The EOSQ-24-PL can be applied in routine clinical practice to monitor the effectiveness of treatment in this specially demanding patients with Early Onset Scoliosis.

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IMPACTS OF CURVE SEVERITY AND TYPE OF BRACE PRESCRIPTION ON THE QUALITY OF LIFE OF ADOLESCENTS WITH IDIOPATHIC SCOLIOSIS

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Background

Adolescent idiopathic scoliosis (AIS) can significantly impact the health-related quality of life (HRQoL) of adolescents during their growth. The French-Canadian adaptation of the Italian Spine Youth Quality of Life questionnaire (ISYQOL-F) has shown strong reliability, including good internal consistency and excellent temporal stability, as well as satisfactory convergent validity. However,

the questionnaire has not yet been used to test the association between scoliosis severity or different brace prescriptions (part-time or full-time) and HRQoL.

Objective (s)

The purpose of this study was to assess the construct validity of the ISYQOL-F, through hypothesis testing, to determine the impact of the severity of the scoliosis curve (mild vs. moderate/severe) as well as of different brace prescription regimens (no brace, part-time brace or full-time brace), on HRQoL scores in adolescents with AIS.

Study Design

The design of the study was a cross-sectional study. One hundred and eleven patients with AIS (86 females, 25 males; Age: 10-18 years; mean Cobb angle: $28 \pm 12^\circ$) were recruited from the CHU Sainte-Justine outpatient clinic in Montreal, Canada.

Methods

Patients completed the ISYQOL-F questionnaire in the clinic waiting room prior to their scheduled scoliosis consultation. A priori hypotheses of group differences were analysed to test the impact of scoliosis severity and brace usage. First, ISYQOL-F scores were compared between patients with mild scoliosis (Cobb angle $10-25^\circ$) and those with moderate to severe scoliosis (Cobb angle $> 25^\circ$). Second, scores were compared across brace prescription groups (no brace, part-time brace, full-time brace). Statistical analyses included independent t-tests and one-way ANOVA with Bonferroni post hoc comparisons. Multivariable linear models were constructed to confirm associations and adjust for potential confounding variables.

Results

Participants with a Cobb angle greater than 25° showed a significantly lower quality of life than those with mild scoliosis ($p < 0.001$). A significant difference in ISYQOL-F scores was found between the no brace, part-time brace, and full-time brace groups ($p = 0.019$). Post hoc tests revealed significant differences between participants with no brace and those with a full-time brace ($p = 0.028$), and between those with part-time and full-time braces ($p = 0.038$). These associations remained statistically significant in a multivariable model adjusted for age, sex, Risser, BMI and physiotherapy treatment.

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Conclusion(s)

ISYQOL-F shows that patients with AIS and moderate to severe curves (Cobb >25°) or full-time brace prescriptions have lower quality of life. The questionnaire's ability to discriminate between these groups supports its construct validity.

Clinical significance

Findings support the construct validity of the ISYQOL and suggest that early and less invasive conservative treatment may be associated with a better HRQoL in adolescents at risk of progression, though further research is needed.

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QUALITY OF LIFE AND SELF-IMAGE IN PATIENTS WITH IDIOPATHIC SCOLIOSIS TREATED AT A THERAPY CENTER IN SÃO PAULO

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Background

Idiopathic scoliosis is a three-dimensional deformity, the etiology is considered multifactorial and the etiopathogenesis is unclear. Patients with scoliosis who do not undergo specific treatment commonly develop pain and a degenerative process in adulthood and aging. In addition, there is a great psychosocial impact on these patients and it is known that conservative treatment has the potential to improve quality of life and self-image.

Objective (s)

Aim: to characterize the profile of individuals diagnosed with scoliosis (non-surgical) treated at the Therapy Center of the Associação de Assistência à Criança Deficiente (AACD) in São Paulo and to analyze quality of life and self-image with the TAPS and SRS-22 questionnaires at different times (initial, 6 months, 12 months and 18 months).

Study Design

This is a retrospective longitudinal study, approved by the AACD Research Ethics Board, São Paulo - Brazil, opinion 6.325.193.

Methods

The data was collected from medical records were analyzed from 2022 1th January to 2024 31 March of patients undergoing conservative treatment with and without a brace. The data were described through tables and graphs.

Results

187 patients diagnosed with idiopathic scoliosis with a mean age of 13 years were included, 146 females and 42 males. Curve severity 91 participants with a moderate curve. TAPS with and without a bracing had no difference between times (initial, 6 months, 12 months and 18 months ($p = 0.1$); SRS - 22 with and without the use of the brace there was no difference, however, a difference in relation to the times: initial, 6, 12 and 18 months ($p = 0.02$).

Conclusion(s)

Conclusion: Future studies are necessary to analyse the influence of scoliosis on patients with scoliosis idiopathic. Although it's possible to notice a difference between patients who does specific treatment may help the quality of life in a long term analysis

Clinical significance

It's important to analyse the impacts of quality of life and self-image in this patient to understand how the scoliosis can affect the life and even commitment of this parties with the treatment. It's an important psychological change on this age and we can improve our treatment with this knowledge.

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NIGHT-TIME BRACING VERSUS DAY-TIME BRACE FOR BACK PAIN IN ADULTS WITH SCOLIOSIS: SIX-MONTH RESULTS OF A RETROSPECTIVE CONTROLLED STUDY

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Background

Adult scoliosis is sometimes associated with back pain, and severe curves can progress over time. Bracing is quite a common approach in such patients, but only a few papers are available to assess their efficacy.

Objective (s)

To test the effectiveness of six months of a custom-made brace, worn at night, in reducing pain and improving function in adult scoliosis patients compared to a prefabricated day-time brace worn 2-4 hours daily

Study Design

Retrospective cohort study with a historical control group

Methods

We compared a sample of consecutively recruited adult females with back pain and scoliosis treated with a custom-made TLSO night-time brace (TLSO) to a group treated with day-time prefabricated brace (DAYBRACE).

Outcomes: Graphical rating scale (GRS), Oswestry Disability Index (ODI), Core Outcome Measures Index (COMI).

Patients were evaluated at baseline and six months after they started wearing their braces.

We used two-ways ANOVA and calculated Minimal clinically important differences (MCID). We defined improvement as a change equal or greater than the MCID and we checked the association between the proportion of clinically meaningful improved patients and the brace type with chi2.

We ran a logistic regression model to see if the OR of reaching results were higher with one of the braces.

Results

The TLSO included 25 adult females, age 62.3 ± 9.5 , curve $60.4 \pm 17.7^\circ$ Cobb, wearing the brace 7.2 ± 2.2 hours per day. The DAYBRACE included 20 adult females, age 67.8 ± 10.5 , curve $62 \pm 13^\circ$ Cobb, wearing the brace 2-4 hours daily.

Improvements were similar for both braces for back and leg pain. There was a statistically significant improvement in worst pain score in patients wearing a TLSO compared to DAYTIME (F 6.32 p=0.0158) the change is significant over time (F=20.54 p=0.000),

Considering MCID for ODI, 32% of the patients treated with TLSO improved compared to 25% in DAYTIME group (chi2 0.26 p=0.607).

COMI had minimal MCID in 44% of cases in TLSO and 30% of those in DAYTIME (chi2 0.93 p=0.34).

Leg pain: 15% of patients reaching MCID in the DAYTIME group compared to 8% in the TLSO group (chi2 0.55 p=0.46).

Back pain: 20% of patients in the DAYTIME group compared to 4% in the TLSO group (chi2 2.88 p=0.09).

The logistic regression model showed that the odds of improvement were not different between the two braces. COMI results were 56% higher in patients treated with TLSO (p=0.34 95%CI 0.2-1.9). ODI results were 22% higher in patients treated with TLSO p=0.61 95%CI 0.2-2.6.

Conclusion(s)

Night-time bracing shows similar results to day-time brace worn for 2-4 hours, with clinical improvements of pain and disability. It's worth exploring this approach as a further option for these patients.

Clinical significance

This study describes a further conservative treatment option for patients with back pain and scoliosis

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SCaRES - SCOLIOSIS CAREGIVER RESPONSE AND EMOTIONAL SCALE: A RASCH-VALIDATED QUESTIONNAIRE TO MEASURE THE PSYCHOLOGICAL IMPACT OF CHILDREN'S SCOLIOSIS ON THEIR PARENTS

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Background

Having a child diagnosed with a chronic condition can be stressful for parents who report higher rates of mood disturbances, anxiety and diminished quality of life (QoL). However, little attention has been paid to the parents of children with scoliosis who undergo conservative treatment. Careful assessment of the parents' psychosocial status, well-being and functioning is essential, given the latter's involvement in treatment management. Currently, there are no questionnaires to assess this population's QoL.

Objective (s)

to develop a Rasch consistent questionnaire for measuring the impact of their children's pathology and treatment on QoL of parents of patients with spinal deformities.

Study Design

Cross-sectional psychometric study.

Methods

We used a conventional approach for content analysis on an online blog addressed to patients and families with scoliosis to identify the parents' self-reported problems affecting their QoL. We arranged a pool of 55 items. A group of 24 scoliosis experts rated the items' appropriateness for measuring the parents' QoL, resulting in the selection of 48 items to create the first version of the questionnaire ranked with a 5-point Likert scale. We ran a series of 4 rounds of Rasch analysis on progressively refined questionnaire versions administered to 300, 164, 100 and 305 convenience samples of parents caring for a child diagnosed with scoliosis and undergoing conservative management, respectively.

Results

After 3 rounds of analysis, we reduced items to 20 and categories to a 4-point Likert scale. In the fourth analysis, the Principal Component Analysis of residuals (PCAr) highlighted two hidden dimensions. Accordingly, two items were removed, and the analysis was re-run on 18 items. The variance explained was 14.39 eigenvalue (44.4%), and the variance in 1st contrast was 2.56 eigenvalue (7.9%). However, the artefacts caused by the 1st contrast had a low impact on the questionnaires' measures. All 18 items fit the Rasch model. The questionnaire targeting was satisfactory. The Person's ability spanned 6.99 logits from -5.17 to 1.82 with an ability mean measure of -1.41 logits (SD = 1.14 logits). Item difficulty spanned 2.07 logits from -1.17 to 0.90. Reliability was 0.83, which allows for the distinction of the 3.32 strata participant's mean. Eight participants had the minimum score (2.7%). No DIF was noted for parents' age, gender, or child's age and gender.

Conclusion(s)

The 18-item questionnaire reliably measures QoL in parents of children with scoliosis undergoing conservative treatment. These findings support its validity and practical utility in clinical settings. Future studies will implement the tool in everyday clinical life to confirm its usefulness.

Clinical significance

This study provides a validated, Rasch-consistent tool to assess the QoL of parents managing children with scoliosis and explore an unmet need in this population. This tool will enable clinicians to understand parental challenges and tailor support strategies better.

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CORRELATION BETWEEN SCOLIOSIS RESEARCH SOCIETY (SRS-22) QUESTIONNAIRE AND ITALIAN SPINE YOUTH QUALITY OF LIFE (ISYQOL) QUESTIONNAIRE. CAN WE USE THEM FOR THE SAME PURPOSE?

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Background

Scoliosis Research Society (SRS-22) is the most widely used questionnaire for measuring quality of life in patients with spinal deformities. It is divided in 5 subcategories (pain, mental health, self-image, function and treatment satisfaction), but has no separate questions for braced patients. Italian Spine Youth Quality of Life (ISYQOL) is a recently developed questionnaire, consisted of 20 questions (13 generic and 7 brace-specific questions). Both questionnaires have shown good validity and reliability in previous studies.

Objective (s)

Our aim was to assess the association between SRS-22 and ISYQOL questionnaires, finding out if they provide similar results for the same patients.

Study Design

Correlational study

Methods

We randomly selected 50 consecutive patients in our clinic, that were instructed to fill in both SRS-22 and ISYQOL questionnaires at the same day. Our inclusion criteria were age 10-18 years, Cobb angle > 10°, having treatment either exclusively with Physiotherapeutic Scoliosis Specific Exercises (PSSE) for <25° or PSSE with bracing for >25°. We recruited 44 girls and 6 boys with mean age of diagnosis 12.1 years (SD 0.69, 10 – 16.3), average duration of treatment 19.7 months (SD 16.7, 1 – 64), mean thoracic Cobb angle 26.5° (SD 9.03°, 11° – 52.5°) and lumbar Cobb angle (SD 8.49°, 11° – 46°). For our analysis we divided SRS-22 scores in Total, Pain, Mental Health, Self-image and Function, while ISYQOL scores were

divided in Total, Without Brace (questions 1-13) and Only Brace (questions 14-20). Spearman's rank correlation test was used for statistical analysis in SPSS software.

Results

Mean SRS-22 Total score was 81.67 (SD 9.85, 52 - 98), Pain 22.27 (SD 2.31, 16 - 25), Mental Health 18.67 (SD 3.61, 9 - 25), Self-image 18.92 (SD 3.51, 7 - 25), Function 21.82 (SD 3, 12 - 25). Mean ISYQOL Total score was 8.68 (SD 5, 1 - 26), ISYQOL Without Brace 5.94 (SD 2.82, 1 - 15), ISYQOL Only Brace 2.74 (SD 3.46, 0 - 11). We found statistically significant correlations between SRS-22 Total and ISYQOL Total ($r=-0.220$, $p=0.128$), ISYQOL Without Brace ($r=-0.248$, $p=0.086$) and ISYQOL Only Brace ($r=-0.097$, $p=0.508$). No significant correlation was detected for all subdomains of SRS-22 and ISYQOL sub-categories ($p > 0.05$). We found moderate correlation between ISYQOL Total and Lumbar Cobb angle ($r=0.416$, $p=0.005$) and weak correlation with Thoracic Cobb angle ($r=0.333$, $p=0.036$). SRS-22 Function showed weak correlation with Lumbar Cobb angle ($r=-0.309$, $p=0.044$), but SRS-22 Total, and the other SRS-22 domains had no correlation with Cobb angles.

Conclusion(s)

It seems that there is no significant correlation between SRS-22 and ISYQOL scores, although they are both used to evaluate quality of life in patients with spinal deformities. Cobb angle was weakly correlated with ISYQOL Total and SRS-22 Function scores.

Clinical significance

SRS-22 and ISYQOL are reliable questionnaires, but they must be used separately, as they failed to show good association between them.

Final category: 8 Telehealth / Technology / Digital Health / Apps

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RANDOMIZED CLINICAL TRIAL OF NIGHTTIME CHRONIC CONTINUOUS TRACTION FOR IMPROVING MODERATE ADOLESCENT IDIOPATHIC SCOLIOSIS

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Background

Adolescent Idiopathic Scoliosis (AIS) is a prevalent spinal deformity observed in adolescents aged 10 to 16 years. For patients with moderate AIS, characterized by a Cobb angle between 25° and 45°, bracing remains the primary non-surgical treatment. However, factors such as the bulkiness of the brace, the required wearing duration, and its impact on daily life often result in poor patient compliance, thereby compromising treatment efficacy. Chronic Nighttime Traction (CNT) presents a promising

alternative. With its lightweight design and high patient acceptance, CNT offers a potential solution for managing moderate AIS during nighttime hours.

Objective (s)

Chronic continuous traction at night may provide a new nighttime treatment solution for the treatment of moderate AIS

Study Design

This was a single-center, randomized controlled trial (RCT) with two parallel groups: CNT group and the control group. The study involved 64 patients diagnosed with moderate AIS. Follow-up assessments were performed at baseline and 12 months after the intervention.

Methods

Participants

- **Inclusion criteria:**
 1. Age between 10–16 years
 2. Diagnosis of AIS with Cobb angle between 25° and 45°
 3. Bone maturity status of Risser stage < 4
 4. No prior history of spinal surgery or other spinal pathologies
- **Exclusion criteria:**
 1. Known intolerance to traction therapy
 2. Presence of other neuromuscular or spinal disorders

Intervention

- **CNT group:** Participants wore a chronic traction device for 6–8 hours nightly .
- **Control group:** Participants underwent conventional rehabilitation therapy, including posture correction, breathing exercises, and core muscle strengthening, administered 3 times per week.

Primary Outcome

- Change in Cobb angle from baseline to 12 months.

Secondary Outcomes

- Change in spinal rotation angle
- Scoliosis Research Society-22 (SRS-22) questionnaire scores (including pain, appearance satisfaction, and psychological well-being)
- Treatment adherence (measured by hours of nightly traction wear or completion rate of rehabilitation sessions)

Statistical Analysis

Data were analyzed using paired t-tests for within-group comparisons and independent t-tests or chi-square tests for between-group comparisons.

Results

After 12 months of treatment, 46 patients were treated as shown in Table 1

Outcome Measure	CNT (n=24)	Control (n=22)	Statistical Significance(P-value)
Cobb Angle Improvement	65%of patients showed areduction >5°	35%of patients showed an improvement	P<0.001
Mean Cobb Angle Reduction	8.3°(95%CI:6.5°-10.1)	4.1°(95%CI:2.8°-5.4)	P<0.001
Spinal Rotation Angle Change	Mean decrease of 4.2°	No significant change	P<0.05
SRS-22 Appearance Satisfaction	4.5±0.6	3.7±0.8	P<0.05
Average Wearing Time (per night)	6.5 hours	N/A	N/A
Rehabilitation Completion Rate	83%	72%	N/A

Conclusion(s)

CNT is a safe, effective, and highly compliant non-surgical treatment option for moderate AIS. The results suggest that CNT offers superior improvements in Cobb angle reduction, spinal rotation, quality of life, and treatment adherence compared to traditional rehabilitation methods.

Clinical significance

To provide a lightweight overnight treatment solution for refusing full-time direct moderate AIS treatment.

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M-IBRACE: EMPOWERING PATIENTS UNDERGOING BRACE TREATMENT WITH THE MHEALTH M-IBRACE SOLUTION TO IMPROVE EMPOWERMENT, ADHERENCE AND COLLABORATIVE CARE: MVP DEVELOPMENT AND ACCEPTABILITY STUDY

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Background

As a treatment for moderate adolescent idiopathic scoliosis, the orthopedic brace is prescribed 20-23h/day. However, the actual wearing time is much less (average 13.4h/day, compliance rate 64%), indicating a problem with treatment adherence.

Objective (s)

The aims were to design a connected orthosis addressing conditions of non-adherence through a patient empowerment approach, and to validate the acceptability of its mobile application with a group of patients undergoing brace treatment.

Study Design

System co-design, acceptability study

Methods

Multidisciplinary working sessions with patient-partners, clinicians, engineers, scientists and mobile health specialists were conducted in a living lab setting to co-design the M-iBrace system integrating updated brace designs, a multifunctional monitoring sensor, an engaging patient-oriented mobile app and a web portal for the care support team, all tailored to overcome barriers to non-adherence and make brace treatment both patient-specific and compelling. Practical, technological, and legal considerations were integrated into the solution. Acceptability of the mobile app was assessed through a focus group with 6 adolescents, using an interview grid based on Sekhon's health intervention acceptability framework (2016, 2022).

Results

A minimal viable prototype (MVP) of the M-iBrace system was developed, featuring a patient-facing mobile app compatible with Android, iOS, and web platforms, linked to the brace via a Bluetooth-enabled multifunctional monitoring sensor. The app enables autonomous monitoring by tracking wearing time, assessing patient well-being, and including validated interactive questions (MOBI questionnaire) to address barriers to adherence. A complementary web application for the care team supports personalized treatment monitoring based on app and sensor data, tailored to individual patient needs. Focus group participants provided positive feedback, finding the app particularly useful for tracking daily wearing time, fostering treatment ownership, and enhancing their sense of empowerment. While they were open to trying the system and sharing data with their clinical team, they preferred not to share data with parents.

Participants also suggested improvements, which were relayed to the development team for future iterations.

Conclusion(s)

The M-iBrace system represents a shift in clinical practices by placing both the patient and their clinical care team at the heart of the treatment approach, fostering treatment ownership and empowerment for the patient while enabling personalized, connected care and collaborative support. A pilot pragmatic trial will be conducted to assess the system's acceptance, usability, and preliminary effectiveness, paving the way for its broader validation.

Clinical significance

The M-iBrace system offers a promising approach to addressing adherence challenges by empowering patients and their clinical care team to take an active role in the treatment process, with the potential to enhance therapeutic effectiveness, patient outcomes, and quality of life.

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APPLICATION OBSERVATION OF AI MARKERLESS MOTION CAPTURE SYSTEM IN HOME EXERCISE TRAINING FOR ADOLESCENT IDIOPATHIC SCOLIOSIS

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Background

The conservative treatment effect of adolescent idiopathic scoliosis (AIS) is closely related to patient compliance. The heavy academic workload of adolescents makes it difficult for them to frequently visit professional institutions for physical therapy, leading to reduced compliance with physiotherapeutic scoliosis specific exercise (PSSE).

Objective (s)

This study applies an AI markerless motion capture system to monitor the posture of AIS patients during home PSSE training, observing the effectiveness of this system in home PSSE intervention for AIS patients, in order to provide new ideas for remote treatment and home rehabilitation of AIS.

Study Design

A longitudinal study.

Methods

Ten RigoE-type female mild AIS patients were randomly divided into two groups. Both groups underwent PSSE treatment, with specific exercises including standing muscle cylinder, standing muscle armor, and frog on the pond. Both groups visited the hospital once a week for treatment, with the control group guided by a rehabilitation therapist and the experimental group guided by an AI markerless motion capture system. Both groups were re-examined after 24 weeks of training. The Cobb angle of the full spine X-ray in the coronal plane, the cross-sectional area and thickness of the multifidus muscles on both sides of the apex, and the root mean square (RMS) of the multifidus muscles next to the apex were measured before and after training. SPSS 20.0 was used for statistical analysis of the above values, with results expressed as mean $\pm$ standard deviation ($\bar{x} \pm s$). Paired sample t-tests were used for within-group comparisons, and independent sample t-tests were used for between-group comparisons; a P-value of less than 0.05 was considered statistically significant.

Results

There were no significant statistical differences in age, Cobb angle, multifidus cross-sectional area ratio, thickness ratio, and multifidus RMS ratio between the two groups before training ($P > 0.05$). After training, both groups showed significant changes in Cobb angle, multifidus cross-sectional area ratio, thickness ratio, and multifidus RMS ratio within the group ($P < 0.05$), and no significant statistical differences were found between the groups ($P > 0.05$). Both groups showed a significant reduction in Cobb angle after training, and the morphology and function of the multifidus muscles changed significantly, with similar degrees of change in both groups.

Table1: Experimentally relevant results: cobb angle and p

Group	Number of cases	Age	Cobb Angle (°)			
			Before Treatment	After Treatment	<i>t-paired Value</i>	<i>P-value</i>
AI group	5	11.4±0.54	16±1.58	12.6±1.67	4.185	0.014
Therapist group	5	11.4±0.89	15.6±0.89	14.6±2.30	1.414	0.23
<i>t value</i>		-1.839	-0.492	1.571		
<i>P value</i>		0.103	0.636	0.155		



Group	<u>Multifidus Thickness Ratio</u>				<u>Multifidus RMS Ratio</u>		
	Before Treatment	After Treatment	<i>t-paired Value</i>	<i>P-value</i>	Before Treatment	After Treatment	<i>t-paired Value</i>
AI group	1.18±0.92	1.10±0.04	3.136	0.035	1.62±0.37	1.17±0.45	2.9
Therapist group	1.14±0.74	1.05±0.27	3.164	0.034	1.26±0.12	1.11±0.06	4.1
<i>t value</i>	-0.694	-0.322			-2.06	-1.839	
<i>P value</i>	0.507	0.756			0.073	0.103	

Conclusion(s)

The AI markerless motion capture system, when guiding AIS patients in PSSE training, showed similar effects to therapist-guided training and can effectively improve mild AIS.

Clinical significance

The AI markerless motion capture system can serve as a home training guidance device for AIS patients and provides new ideas for remote diagnosis and treatment of AIS.

GAN-BASED DIAGNOSTIC DL MODEL FOR REAL SCOLIOSIS SCREENINGS

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Background

Adolescent idiopathic scoliosis (AIS) is the most prevalent spinal deformity, characterized by a spinal curvature of 10° or greater with unknown causes in individuals aged 10 to 18 years. The prevalence of AIS ranges from 0.47% to 5.2%, highlighting the importance of screening in school-age adolescents. Early detection can lessen the necessity for surgical intervention through non-surgical treatments like bracing.

Recently, artificial intelligence (AI) has emerged as a cutting-edge diagnostic and screening method for scoliosis programs. For instance, a study created an automated scoliosis screening algorithm using a deep learning model based on photographs of bare backs. However, these AI models may perform poorly due to limited external dataset images and tend to struggle with low-quality images captured in their raw form.

Generative Adversarial Networks (GANs) have attracted significant attention for their capability to produce high-quality synthetic images. They offer a potential solution to the data scarcity in scoliosis datasets and can enhance model generalizability for practical applications.

Our objective is to investigate whether GANs can generate realistic scoliotic images to improve the performance of existing scoliotic diagnostic models.

Objective (s)

Previous indicated that both Transfer Learning (TL) and Data Augmentation (DA) can enhance the performance of deep learning models for disease diagnosis when there is limited data. However, there has not yet been a direct comparison between these two methods and the GAN-based DA approach specifically for scoliosis diagnosis using back photographs.

Consequently, this study seeks to assess the effects of GAN, TL, and DA on the accuracy of a new deep learning model designed for the automated diagnosis of scoliosis in patients based on back images.

Study Design

Retrospective study

Methods

We used 156 bare back photos of scoliotic and normal patients from two publicly available datasets. We employed StyleGAN2 approach to generate images with scoliotic and normal characteristics. Additionally, traditional data augmentation methods, such as horizontal flipping and random rotation, were applied to create new images. In total, we generated 2000 images using both traditional DA and GAN, which were then used to train two identical deep learning networks based on the ResNet architecture. We also utilized transfer learning from a model initially trained on the bony structures of the spine for our third model.

Results

The GAN-based data augmentation outperforms both traditional data augmentation and transfer learning, achieving an accuracy of 0.94 and AUC of 0.92, compared to 0.89 and 0.87 for transfer learning, and 0.81 and 0.83 for traditional methods. GAN data augmentation can enhance deep learning model performance by diversifying the training dataset and increasing robustness to noise and image quality variations.

Conclusion(s)

Generative methods are highly effective for data augmentation, especially in cases with limited datasets like scoliotic images.

Clinical significance

GAN ensures better deep learning model generalizability for real-world scoliosis screenings.

EVALUATING CHATGPT 4.0'S ACCURACY AND POTENTIAL IN SCOLIOSIS CONSERVATIVE TREATMENT: A PRELIMINARY STUDY ON CLARITY, VALIDITY, AND EXPERT PERCEPTIONS

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Background

Large Language Models (LLMs) like ChatGPT have become accessible tools for patients and caregivers seeking medical guidance. However, their accuracy, clarity, and validity in specialized contexts, such as scoliosis conservative treatment, are largely unexamined.

Objective (s)

This study evaluates whether ChatGPT 4.0 provides evidence-based, appropriate, and comprehensive answers to common questions about scoliosis management.

Study Design

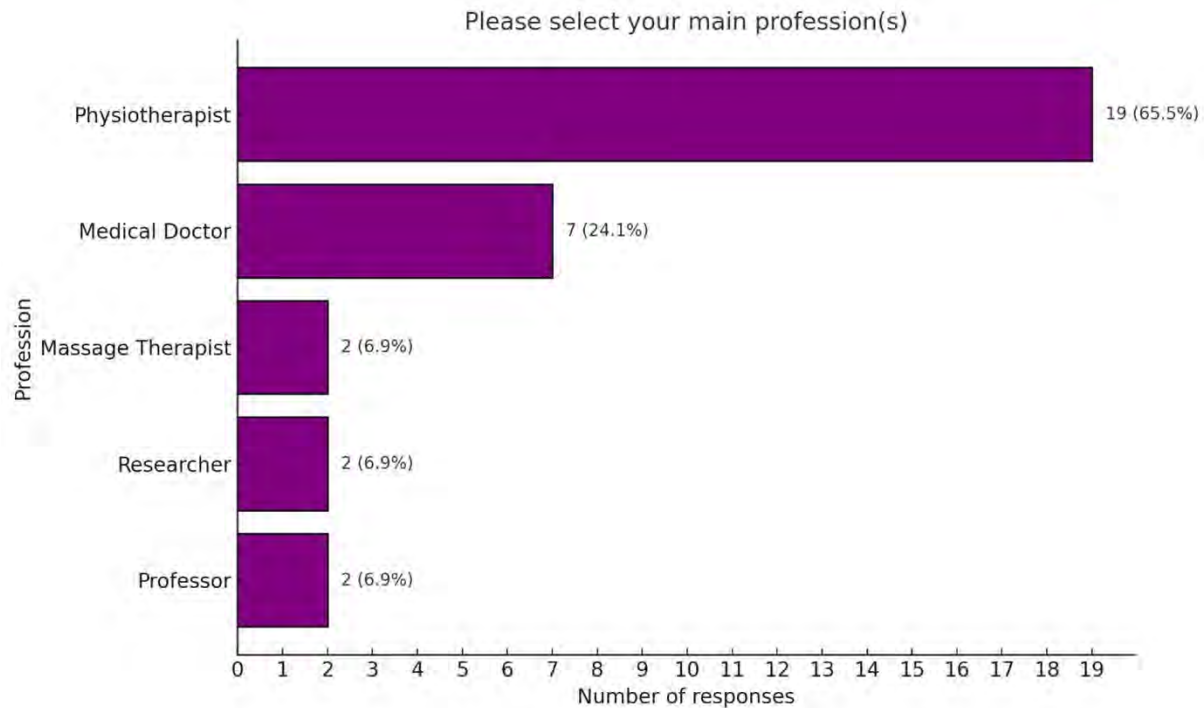
Cross-sectional observational

Methods

Between November and December 2024, 14 FAQs on scoliosis conservative treatment were identified through expert input and LLM-generated suggestions. These were submitted to ChatGPT 4.0 on the same day (06/12/2024) with the prompt: "I'm a scoliosis patient. Limit your answer to 150 words." Responses were evaluated by 29 multidisciplinary (see Figure 1 for details on the professionals involved) scoliosis experts (mean age 41.2 ± 10.8 years; 55.2% females, 44.8% males; median years of experience 9.5, IQR 6.0-14.0) using a 6-point Likert scale through Google Forms surveys (response ratio 29/37, 78,4%). All data are considered as categorical variables and are reported as percentages (%). Inter-rater reliability was measured using Fleiss' Kappa. Content validity was assessed using the Content Validity Ratio (CVR). CVR was calculated as follows: $CVR = [n_e - (N/2)] / (N/2)$ where n_e is the number of experts rating an answer as "appropriate" and N is the total number of experts. Scores of 4–6 (Likert scale) were

considered as "appropriate" and 1–3 as "non-appropriate." A minimum CVR of **0.38** indicated valid answers (69% agreement).

Figure 1. Details on the professionals involved



Results

Fleiss' Kappa showed slight agreement (0.10). The CVR threshold (≥ 0.38) was met in 78.5% (11/14) of responses. Answers to "What is scoliosis?", "Can exercises or physical therapy cure scoliosis?", and "What is the best sport for scoliosis?" scored 0.37, 0.37, and -0.58, respectively, due to factual errors (37.1%) and incomplete information (27.1%). Conversely, responses on the causes of scoliosis, its progression, and future disability achieved full consensus (CVR 1.0).

Conclusion(s)

The study highlights that ChatGPT 4.0 delivers clear and professional answers, especially on well-documented medical topics like the causes and progression of scoliosis. However, its performance was uneven in some areas, with factual errors and incomplete answers surfacing. Experts' mixed evaluations point to the challenges of interpreting responses in a complex field like scoliosis treatment. Training LLMs with expert-reviewed guidelines is crucial to enhance reliability and accuracy.

Clinical significance

Despite some inconsistencies, the generally positive feedback suggests that AI, like ChatGPT, can be a valuable tool for patient education—provided its limitations are carefully managed.

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POSTURAL EVALUATION OF PATIENTS WITH IDIOPATHIC SCOLIOSIS THROUGH TELEHEALTH: A SYSTEMATIC REVIEW

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Background

The increasing use of remote patient care for individuals with scoliosis has created opportunities for the development and utilization of different tools and methods of evaluation.

Objective (s)

The primary objective of this review was to identify the postural variables evaluated in scoliosis patients through telehealth. The secondary objectives are (a) to determine how postural variables were measured (capture and analysis) and (b) to determine the degree of reliability (validity and/or reproducibility) of the instruments/methods used to obtain the measured variables.

Study Design

Systematic review

Methods

Systematic searches were conducted by two independent reviewers in the PubMed, Scopus, EMBASE, and IEEE databases using the MeSH terms "scoliosis" and "telemedicine" and their synonyms. This study followed the MOOSE guideline (Meta-analysis of Observational Studies in Epidemiology). The methodological quality assessment was performed using the Critical Appraisal Skills Program (CASP) for diagnostic studies.

Results

136 studies were found in the databases, and 20 were found through manual search of references. After removing duplicates ($n = 41$), 101 studies were excluded, leaving 14 for full-text reading. Of these, six studies were included for qualitative synthesis, with a total of 1002 subjects. The postural variables evaluated were angle of trunk rotation (ATR), angle between body segments (in development), movement - oscillations per second (Hz/s), impedance (Ohms/mm), synchronous postural observation,

and aesthetic deformity. Among the proposed methodologies for postural assessment through telehealth were mobile application (photo or video-based apps), accelerometer, instrumented t-shirt with sensor, and synchronous observation: via video conference (by a professional) and in person (by the parents). Only two studies provided validity and reproducibility coefficients, however, it was not possible to conduct a meta-analysis because the presented coefficients were different. In the assessment of methodological quality and risk of bias using the CASP, the average quality assessment score was 78,3%.

Conclusion(s)

This review provided an overview of the postural variables that can be evaluated in patients with scoliosis through telehealth, including angle of trunk rotation, angle between body segments (under development), movement - oscillations per second (Hz/s), impedance measures reflecting torso elongation (Ohms), and synchronous postural observation and aesthetic deformity. Both synchronous and asynchronous capture methods were used, using smartphones, tablets, or sensors, and various analyses were performed using dedicated apps or software. However, as too few and heterogeneous studies reported measurement properties, it was not possible to meta-analyse the reliability (validity and/or reproducibility).

Clinical significance

The synthesis of information regarding the assessed postural variables in patients with scoliosis via teleconsultation provided in this review will be useful for implementation in clinical practice, research, and especially for use by the patients themselves.

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A COMPARISON OF VIRTUAL DESIGN WORKFLOWS FOR THORACOLUMBAR ORTHOSES USING A RETROSPECTIVE DATASET

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Background

Thoracolumbar orthoses (TLSO) are the current gold standard for conservatively managing adolescent idiopathic scoliosis. The most significant clinical challenge and the leading cause of treatment failure is patient non-compliance. This can be linked to the labour-intensive and time-consuming process of manufacturing TLSOs. Advancements in virtual workflows which include 3D-scanning, 3D-modelling and 3D-printing offer a novel ability to rapidly manufacture TLSOs. Virtual design workflows for TLSOs have been commercially launched and published in recent literature. Through a deeper investigation, these workflows mainly rely on a 'direct edit' style of CAD modelling which is inefficient. A novel TLSO design workflow was developed as part of this research work using an efficient parametric modelling approach.

Objective (s)

This research study aimed to evaluate the usability, repeatability and robustness of the novel parametric algorithm for TLSO design with respect to pre-existing virtual workflows.

Study Design

Retrospective

Methods

Three virtual orthotic workflows (W1, W2, W3) were evaluated with two design users (A1, A2) and five patients from a retrospective 3D-scan dataset. The anterior-posterior scoliosis Xray, 3D-scan and deformity metrics were collated for each patient. Design user A1 & A2 completed a TLSO design for each patient using each workflow (W1, W2, W3). This was repeated twice resulting in three TLSO designs for each patient within each workflow. For each TLSO model the design time, number of generated mesh tessellation errors, usability metrics, linear deviation, file storage and folder storage was recorded. These metrics have not been previously evaluated in literature but are important metrics to consider for commercial applications and implementation of this research.

Results

Each of the three workflows had unique advantages and disadvantages. W1 provided a user-friendly and simplified TLSO design procedure. Whilst this resulted in the best average design time, performed well in usability metrics, W1 had poor intraobserver and interobserver reliability and required a large amount of digital storage to support the design software. W2 required software suited to modelling and manipulation of complex meshes and had improved intraobserver and interobserver reliability in comparison to W1. However, W2 lacked specific TLSO modelling tools built into the workflow or software. The workflow required two software programs to complete all design processes which was inefficient for the user. The novel, parametric workflow (W3) consistently performed well across the range of recorded metrics.

Conclusion(s)

Whilst virtual design workflows are emerging, there are limited studies comparing and evaluating the quality of the design approach. This work completed a comparative analysis of design and modelling approaches for the application of TLSO design and identified areas for further development.

Clinical significance

As early-bracing and time-efficient methods are critical for treatment success, the parametric approach has potential to be a novel tool for increasing an orthotist's productivity and ability to work remote from the patient.

REPEATABILITY AND INTRA AND INTERRATER REPRODUCIBILITY OF THE DIPA-S EHEALTH© CAPTURE AND ANALYSIS SYSTEM FOR CLINICAL ASSESSMENT OF SCOLIOSIS

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Background

The quantitative assessment of patients with scoliosis is a crucial aspect for diagnosis and monitoring, as well as being essential for clinical decision-making concerning various treatment indications. Technological advancements and the rapid shift to the digital realm have brought innovations in assessment tools, along with the possibility of providing care through teleconsultation.

Objective (s)

To assess the repeatability, intra and interrater reproducibility of the DIPA-S eHealth© system for capturing and measuring clinical variables of scoliosis, including frontal trunk imbalance (FTI), sagittal trunk imbalance (STI), and angle of trunk rotation (ATR).

Study Design

Observational cross-sectional study on reliability and agreement.

Methods

The study adheres to the GRRAS checklist for cross-sectional studies on reliability and agreement. Patients were photographed using the DIPA-S eHealth Capture© mobile application by family members, physiotherapists, or surgeons. Three photos were taken in each position: standing in the frontal and sagittal planes and in the axial plane in forward bending position of the trunk. The photos were analyzed by three independent evaluators using the DIPA-S eHealth Analysis© software. For repeatability, each photo was analyzed twice consecutively by the three evaluators. For intrarater reproducibility, only one evaluator reanalyzed the first photo from each plane with a 5-day interval. For interrater reproducibility, the three evaluators analyzed the first photo from each plane. The intraclass correlation coefficient (ICC), standard error of measurement (SEM), and minimal detectable change (MDC) were used ($p < 0.05$).

Results

The sample comprised 262 images ($n=30$). Repeatability was excellent for all three evaluators in all three planes (ICC 0.94 to 1.00). Intrarater reproducibility was excellent in all three planes (ICC 0.88 to 0.99). Interrater analysis was excellent for the frontal and axial planes (ICC 0.98 and

0.93), respectively. However, it was weak in the sagittal plane ICC 0.32. The SEM ranged from 0.02 to 17.6 and MDC from 0.03 to 34.6.

Conclusion(s)

The DIPA-S eHealth© Capture and Analysis system demonstrates reproducibility for use in the clinical assessment of scoliosis through teleconsultations.

Clinical significance

The possibility of a new entirely remote evaluation method will enable professionals involved in the treatment of patients with scoliosis to have a broader reach, allowing for quantitative clinical assessment to be conducted anywhere in the world. In this proposed protocol, physical presence is not necessary.