SOSORT

Book of Abstracts

LYON 2017

The International Conference of the Society on Scoliosis Orthopaedic and Rehabilitation Treatment
Scientific Committee

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- Stefano Negrini
- Joseph O'Brien
- Eric Parent
- Nigel Price
- Michele Romano
- Sanja Schreiber
- Fabio Zaina
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“The treatment of a confirmed scoliosis is a perpetual and unpleasant lesson in humility”

Roederer

“Among all those who did not want to subject themselves to control of the facts of their pathogenic assertions, and among all those who did not want to examine closely the relevant criticisms of the results of the treatments about which they speak enthusiastically without bringing of proof, indeed, few saw their assertions stand the test of time.”

Pierre Stagnara

“Without the theory, the practice becomes only a boring habit. Only the theory allows us to forge ahead and to develop the spirit of invention.”

Louis Pasteur

“Science without conscience is only destruction of the soul”

François Rabelais

- It is easy to encourage the research; it is more difficult to manage its contradictions.

- Scoliosis is a disease which lasts all of a person’s life. The patient with scoliosis is a low back pain patient in power.

- Scoliosis is a serious illness which has social, professional, and psychological consequences.

- Experience is not always transferable, but the reflection by some people always opens roads for the others.
- In the spine, “the soft” is probably more important than “the hard.”

- The radiograph shows only the “Chinese shadows” of the reality.

- The computer returns only what we gave it to eat. The computer cannot and never should supplant the observation and the clinical assessment of the clinician.

- The spirit of invention must be always preceded by the necessity of the knowledge.

**Various colleagues**

**O1.10 Effect of Orthotic treatment on curve correction & cardio respiratory functions in congenital scoliosis with single-level hemi vertebrae**


*The West Bengal University of Health Sciences/NILD - India*

**Introduction:** Congenital scoliosis is lateral curvature of the spine caused by deficiencies in formation or segmentation of the vertebrae or a mixture of both. The natural world of congenital scoliosis with hemivertebrae is changeable, especially when it is combined with a unilateral unsegmental bar. Orthotic treatments primary goal is to stop further curve progression.

**Objectives:** The aim of this study is to find the effect in treating congenital scoliosis with single-level hemi vertebrae using orthotic interventions on curve correction and its cardio respiratory functions.

**Methods:** 14 years old with single-level hemi-vertebrae related congenital scoliosis undertook non-operative at our body with an average supplement period of 2 years. Without orthotic intervention physiotherapy was continued for 1 year.

Moulded-TLSO fitted on the patient in according to a sub classification of the SRS definition of curve type.

Breathe cardio-respiratory data analysis and the metabolic data analysis done through the COSMED-Srl-Italy, K4B2. We measure the O2 consumption level (ml/min/kg), Tidal volume(VT),Heart rate, Energy cost EE/min(Kcal/min), VO2,VCO2,O2 expenditure.
Adaptability period was five minute. Data were taken at normal room-temperature while in the sitting position & 30 meter walking test.

**Results:** The cardio-respiratory table and graph established a significant better result in congenital scoliosis with spinal orthosis. Orthotic treatment gives good result over only physiotherapy treatment in term of curve progression & correction. Energy expenditure EE/min with brace was significantly in normal range 2.5359±0.4289 (P=0.0000). VCO2 was in significantly normal range with brace 135.561±22.1332 (P=0.9936). Heart rate was significantly decreased with brace 88.0000±8.7178 (P=0.8046).

### Table 1

<table>
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<th>Parameters</th>
<th>Mean</th>
<th>St. dev</th>
<th>P-value</th>
<th>T-value</th>
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<td>Normal EE/min</td>
<td>1.9842</td>
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<tr>
<td>With Brace EE/min</td>
<td>2.5359</td>
<td>0.4289</td>
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<tr>
<td>With Brace VCO2</td>
<td>135.561</td>
<td>22.1332</td>
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<td>Normal O2 exp</td>
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<td>Normal HR</td>
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<td>With Brace HR</td>
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<td>8.7178</td>
<td>0.2643</td>
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</tr>
</tbody>
</table>

Table 1: Mean value of EE, VCO2, O2 exp & HR.

*References*

2. Yi-Te Chen · Shih-Tien Wang · Chien-Lin Liu · Tain-Hsiung Chen Received: 12 December 2007 / Published online: 4 April 2008 Springer-Verlag 2008, Treatment of congenital scoliosis with singlelevel hemivertebrae

**O2.61 Prevention and treatment of scoliosis by Garchois Brace in children with type I SMA**

Rebecca Sauvagnac-Quera¹, Delphine Verollet¹, Audrey Benezit¹,⁵, Viviane Azzi¹, Isabelle Vaugier¹, Stéphane Tirolien¹, Jean Louis Neut³, Lofti Miladi³, Robert Carlier², Danielle Leclaire¹,⁵, Brigitte Estournet¹,⁵, Susana Quijano¹,⁵-⁶

1. Assistance Publique des Hôpitaux de Paris (AP-HP), Service de Pédiatrie, Hôpital Raymond Poincaré, Garches, Hôpitaux Universitaires Paris-Ile-de-France Ouest, France.
2. Assistance Publique des Hôpitaux de Paris (AP-HP), Service de Radiologie, Hôpital Raymond Poincaré, Garches, Hôpitaux Universitaires Paris-Ile-de-France Ouest, France.
6. Université de Versailles-St Quentin, U1179 UVSQ - INSERM, Montigny, France.
7. APHP, Center of Clinical Investigation - Technology Innovation, Raymond Poincaré, Hôpital, Garches, France.
Introduction: Spinal Muscular Atrophy (SMA) is the most frequent hereditary recessive neuromuscular disease. Respiratory insufficiency and scoliosis are very frequent complications and may have life-threatening consequences, especially in the most severe forms. Up to now, no brace has shown an impact in the prevention or treatment of scoliosis in these patients. We use for more than 30 years a brace in plexidur that does not interfere with pulmonary function (Garchois brace) in patients with early onset neuromuscular scoliosis.

Objectives: To evaluate the use and efficacy of Garchois brace (GB) in the prevention and the treatment of a series of SMA type Ib patients

Methods and Patients: We identified 100 patients with SMA not acquiring sitting position, but acquiring head support (type Ib SMA) followed at our centre between 1977 and 2015. We identified 32 patients that were treated by GB and had a follow-up in our department for three years or more. We collected and analyzed clinical, radiological and spirometric data.

Results: The GB treatment started at a mean age of 2.5 (0.74 – 9.26) and GB was worn for a mean of 9.5 ± 3.6 years before spinal fusion. The linear regression between Cobb angle evolution and years of scoliosis evolution showed an increment of 3.6° per year. Patients who had carried GB before 3 years old had Cobb angle evolution less important than those having carried after 3 years old, with an important group effect (p < 0.001). There was a perfectly compliant patient who has evolved only 12° before spinal fusion.

There was a good linear regression between vital capacity (VC) with GB compared VC without GB.

Conclusions: Garchois Brace is well tolerated in severe SMA patients and seems an effective tool to prevent and manage spinal deformities in the first decade of life in those who survive.

O3.3 Spinal lesions in CLOVES syndrome: analysis of clinical and imaging findings in 7 patients

Anatoly Levytskiy, Iryna Benzar.
Bogomolets National Medical University - Ukraine

Purpose: The acronym CLOVES was given on a heuristic basis to stand for congenital lipomatous overgrowth (CLO), vascular malformation (V), epidermal nevi (E), and scoliosis and spinal deformities (S). It is a sporadic malformational syndrome that has been first described in 2007, and in 2009 the letter S added since all patients have skeletal deformities.

Methods: We report 7 cases of CLOVES syndrome in children aged 3 month 12 years. All patients were examined for scoliosis, looking for spinal asymmetry, shoulder, and waist imbalance. Imaging studies include plain x-rays (radiography) of the spine, magnetic resonance imaging (MRI) of the chest, abdomen, pelvis, spine and limbs and ultrasound for vascular anomalies and kidneys.

Results: In our patients CLOVES syndrome initially diagnosed as Proteus syndrome (n=3), chest infantile hemangiomas (n=1), Klippel-Trenaunay syndrome (n=2), multiple chest lipomas (n=1). Chest asymmetry due to lipomatous mass, slow flow vascular malformations, and scoliosis revealed in all patients. On x-ray wedge-shaped vertebrae was found in 3 patients. On MRI visualized paraspinal disorders, that is fatty masses (n=3), venous malformations (n=2), microcystic lymphatic malformations (n=2), macrocystic lymphatic malformations (n=1). Fatty infiltration of the erector spine muscles causes the muscular imbalance and worsens the course of scoliosis. Secondary extrinsic pulmonary restriction (caused by
scoliosis) appeared in a 12 year old girl. Before special treatment of scoliosis we performed soft tissue debulking (n=3) and percutaneous treatment of vascular malformations (n=2). Bracing is less effective than for idiopathic scoliosis; however, it can be useful for curves between 20 and 40 degrees. In two patients with chest venous malformations bracing was combined with compression garments. Dilated anomalous conducting trunk veins can be a source of lethal pulmonary emboli. Chest compression reduces abnormal veins space and prevents blood clots.

O4.40 Brace treatment influenced by Lumbo-Sacral Transitional Vertebra in adolescent scoliosis

Franz Landauer.

University Clinic of Orthopedics and Traumatology, Salzburg - Austria

Introduction: An oblique lumbosacral transition is suspicious of a lumbosacral transitional vertebra (LSTV), Bertolotti Syndrome.

Objectives: To find causes for poor lumbosacral brace correction in adolescent scoliosis.

Methods: 24 adolescent patients with scoliosis and oblique lumbosacral transition were examined. All of them showed a poor in brace correction and were radiologically suspicious to LSTV. In this cases an MRI investigation was initiated. The images were examined by its quality (Tesla), representation (axial, coronal, sagittal) and by the Castellvi classification.

Two groups were formed:

Group A) In 12 patients only sagittal and axial plane was supplied (standardized recording = standard to detect disc herniation).

Group B) In 12 patients sagittal, axial and coronal plane was supplied (extended recording).

Results: In 6 cases LSTV could be detected. Castellvi type: 2 cases Ia, 1 case Ib, 2 cases IIa and 1 case IIIa.

In group A) 1case of LSTV could be detected and no case could excluded with high probability. The adjustment of the MRI was also focused on the lumbar spine and not to the segment L5/S1. Also in 5 cases the lateral part of L5/S1 was not portrayed and iliolumbar ligament could not be detected. The MRI images were also inappropriate in 3 cases (1.5 Tesla) to answer the question of LSTV.

In group B) 5 cases of LSTV could be detected and in 3 cases LSTV could be excluded in a high probability. A suspicious asymmetrical iliolumbar ligament could be found in further 2 cases.

Conclusions: In cases of oblique lumbosacral transition an MRI in a high quality should be organized.

The sagittal, axial and coronal plane has to be required. For the representation of a fibrous transition like an iliolumbar ligament disorder or Castellvi type I and II an MRI device with >3.5 Tesla is necessary. The adjustment of the MRI has to be focused on the L5/S1 segment. Only Castellvi type III can be detected in MRI with low quality.

The limitation of the study is the selection of the patients (suspicious x-ray), but this does not influence the basic problem of the imaging.
In conclusion all cases with a limited brace correction of a lumbosacral curve an MRI should be initiated. The examination has to show all 3 body planes and has to be focused on the segment L5/S1 in a high quality.

Significance: In cases of poor lumbosacral brace correction or very oblique L5 an MRI should be arranged in a high quality.

References:

O5.31 Spine and Marfan disease

Jean Claude Bernard.
Centre des Massues, Lyon - France

Background: It’s necessary to evaluate and to follow all life long, the spine of patients with Marfan disease in order to diagnose the Marfan and to possibly treat the spine. The specific features of the Marfan’s spine help discovering the Marfan’s disease when the lumbar vertebrae show a scalloping or a dural ectasia. The Marfan’ spine can also be deformed with the appearance of a specific scoliosis or an isolated disturbance of the profile like kyphosis (dorsal or dorso-lumbar). This spine can become painful in relation to a spondylolisthesis or not.

The objectives of this study are to determine the frequency of the spinal problems and to specify the type of treatments of these patients.

Material and Methods: National retrospective study realized by the national Study Group of Scoliosis (GES) with the support of 7 competence centers and 1 national reference center, concerning the follow-up of the spine for patients with Marfan’s disease. The sample consists of 167 patients: 99 women and 67 men. The Sex ratio is majoritary for the women: 0.7. The mean age of the sample make up children and adults is 31 years.

Results: We find 72 % of spine deformity (scoliosis and kyphosis); in the literature, 63 % for Sponseller (1995) and 56 % for Garreau (2006). The spine problem discovery is effective in 12, 8 years (ET = 4, 2; range = 1-53). The mean age for the diagnosis of Marfan’s disease is 16, 4 years (ET = 14,8; range = 0-65). The treatment for spine deformities is an orthopaedic treatment in 50 % (50 % of efficiency) and 30 % by a surgical treatment (47 % of complications and 47 % of satisfactory results). For this sample, 43 % of the patients are a family Marfan origin and 47, 6 % are Marfan de Novo. 21% of them were diagnosed with scoliosis before the discovery of the Marfan disease for all patients. Only 40 % of the children-teenagers have a normal schooling. Concerning the adults, 47 % have a professional activity and 11, 7 % are in incapacity of which the majority affected by scoliosis.

Discussion: The absence of correlation between the occurrence of the scoliosis and the phenotypic board which presents the patient; no increase of the risk of the development of a scoliosis if it’s a family Marfan disease with known scoliosis. The spinal profile with a low Pelvic Incidence, a high frequency of type 1 of the Roussouly’s classification (30 %) increase the risk of mechanical complications during the orthopaedic or surgical treatment.

Conclusion: A clinical (pain, weakness, quality of life, endurance and muscular strength) and radiological systematic spine evaluation is suggested from the discovery of the disease and during all the growth. It is necessary to continue the regular follow-up in the adulthood by a functional evaluation and if needed, a social and occupational follow-up.
Orthopedic treatment of Early Onset Scoliosis in 2017

Isabelle Courtois, Frédéric Barral, Virginie Henriroux, Anne Briot, Eric Ebermeyer, Bruno Dohin.

CHU Saint Etienne - France

Background: The aim of this paper is to report our Saint-Etienne unit’s experience in taking care infantile scoliosis.

Design and Objective: Early onset scoliosis (EOS) represents only 1% of scoliosis in children. Nonetheless, these scolioses are more severe. Taking care of the curves is a long and difficult treatment process which requires the use of braces and surgery in some cases. The aim of this paper is to review the different types of braces available in 2017 that are efficient for this type of scoliosis.

Material and Methods: The study carried out here is an observational study. This study is based on the analysis of our 20th latest infantile scoliosis medical records (6 month to 3 year old patients diagnosed with scoliosis, except neurological scoliosis) Each record contains: clinical data of the child, Cobb Angles measurements, rib vertebra angle difference as defined by Min Mehta, calculated at different times.

Results and Discussion: Among our group of EOS, there are 40% female patients. Proportions of the different types of curves will be described.

MRIs were conducted for most of the patients: There were any intra-spinal abnormalities. Among our group of patients, most of curves are worsening. The first X-Ray on average at 15-month old shows a cobb angle at 30° and RVAD at 17° on average. Regarding scoliosis requiring a brace, the average age for the start of the treatment is 22 month old with a cobb angle at 44° and RVAD at 30° on average. The origins of the scoliosis remain unknown in only 4 cases. We work closely and systematically with geneticists in order to identify a potential genetic cause. We will describe the different aetiologies encountered in this group. The age at which a patient first starts to walk seems to be considered. In order to limit pulmonary complications, the thorax must grow without any hindrance. The Milwaukee brace was one of the first brace created for scoliosis treatments and is traditionally prescribed for early onset ones. Nonetheless, according to our own results, it’s not very satisfying as small children are not able to correct their posture themselves while wearing this brace. In addition, its unattractive design is also a problem so that all patients had started wearing a MW brace gave it up. So, we prescribe readily at first night-time bending braces made from CAD system. This kind of treatment can be quite effective to stabilize the curve. Nonetheless, it’s necessary to prescribe a full-time wearing. This change is made easier and more easily accepted as both child and parents are already familiar with wearing a brace. In this case, we prescribe a full-time PE monoshell brace. If the curve worsens quickly, serial casting is required, using general anaesthesia on young children. And besides, it’s improve the correction of the curves as it provokes muscle relaxation. The technical specificity of our unit is the use of soft cast. The team must be well trained in the use of soft cast as it’s much harder to handle. Nevertheless, it brings many advantages: it dries faster, much lighter, lasts longer, does not deteriorate (it can be used with children wearing nappies), can easily become removable by creating a velcro opening system. In a nutshell, the use of soft cast can definitely become a real orthopaedic treatment method for EOS.
Conclusion and Significance: Management of EOS must be based on the use of today’s technologies such as the use of computer-assisted techniques. It also must rely on materials such as soft cast. Also, working closely with surgeons is essential in order to look after the patients during all their growth.

**07.6 Juvenile Idiopathic Scoliosis: Bracing to Skeletal Maturity**

Amanda Whitaker,1 Michael T Hresko,2 James Wynne,2 Alexandra Grzywna,3 John Emans,2 Lawrence Karlin,2 Daniel Hedquist,2 Michael Glotzbecker.

1 Nationwide Children’s Hospital, 2 Boston Children’s Hospital, 3 Tufts University, USA

**Introduction:** Juvenile idiopathic scoliosis (JIS) treatment outcomes with brace treatment are limited in the literature with poorly described bracing protocols, with 49-87% progressing to surgery in the current literature. Young age, long follow-up, and varying treatment methods make studying this population difficult.

**Methods:** This is a retrospective review of 178 patients with JIS who underwent brace treatment between the ages of 4-10, with 102 patients to skeletal maturity. Family history, MRI results, curve type, Cobb angle, brace type, duration of wear, number of brace changes, compliance by report, and surgical procedures were recorded.

**Results:** Standard protocol for a child with a Cobb angle >20° is treatment in a brace for 18-20 hr a day (81%). Most (92%) were treated with a Boston brace. The curve characteristics at presentation most common were main thoracic and lumbar modifier B curves, an average Cobb angle of 29.8°, and average age of 7.9 years. MRI was obtained in the majority (97%) of patients and demonstrated abnormalities in 29 patients (16%). 23/29 intraspinal anomalies required operative intervention and were excluded. Noncompliance was 75% in the operative group and 25% in the nonoperative group. Overall, patients who underwent surgical correction (46%) were noncompliant (OR 11.3, 95% CI 3.2-39.7), had a medical comorbidity not associated with scoliosis (OR 8.9, 95% CI 2.1-38.1), and greater major Cobb angle (OR 1.1, 95% CI 1.02-1.19) with all p<0.05. Protective factors (p<0.05) included lumbar modifier B (OR 0.17, 95% CI 0.04-0.72), more changes of duration of brace wear during their treatment (OR 0.26, 95% CI 0.11-0.6), and older age at bracing (OR 0.6, 95% CI 0.37-0.97). During brace treatment, 34% of curves did not progress (<5°).

**Conclusions:** This is the largest series of JIS patients with a standard Boston bracing protocol followed to skeletal maturity. Intraspinal pathology requiring surgery was high (18%). The rate of JIS progressing to need spinal fusion is the lowest in published literature and may be lower with good brace compliance and strategic timing of brace wear changes during treatment to prevent brace fatigue. Risk factors are noncompliance, larger presenting curves, and medical comorbidities. Protective factors are lumbar modifier B, brace duration changes, and older age at the start of bracing.
Mi3C bracing for children with infantile or juvenile scoliosis

John Thometz1,3, XueCheng Liu1,3, Robert Rizza4, Ian English1,3, and Sergey Tarima2,3

1Dept. of Orthopaedic Surgery, Children’s Hospital of Wisconsin, 2Institute for Health and Society, 3Medical College of Wisconsin; 4Dept. of Mechanical Engineering, Milwaukee School of Engineering

Introduction: Approximately 70 years ago, Dr. Blount and Dr. Schmidt from our institution developed the Milwaukee brace to control curve progression for children with idiopathic scoliosis. Since then, a variety of other types of braces have been utilized clinically. Common indication for the use of these orthoses is to treat children with adolescent scoliosis. However, few braces have been designed for correcting spinal deformities in children with infantile and juvenile scoliosis. For this young population having a naturally rapid growth period and sensitive to skin pressure sores, the Milwaukee Contoured Corrective CAD/CAM based brace (Mi3CTM) with maximal correction of curvature has been designed and applied by two senior authors (Dr. Thometz and Dr. Liu) since June of 2012.

Objective: The purpose of this study aims to: 1) manage children with infantile or juvenile scoliosis using the newly developed the Mi3CTM brace; 2) investigate changes of Cobb angles in the AP view of X-ray between in and out of the Mi3CTM brace at 0, 3, 6, 9, and 12 months; 3) compare differences of Cobb angles in 3, 6, 9, and 12 month with the baseline.

Methods: Thirty-eight children (22 males, 16 females) with mean age of 6.2 years (ranging from 4 months to 10 year-old) were diagnosed with infantile or juvenile scoliosis. Prior to the use of Mi3CTM, 22 children received either casts or Boston brace. Spine correction was performed using a stockinette to manipulate the curvature in the 3D planes, simultaneously longitudinal traction applied. The manipulation can be done in the clinic while patients in standing position or in operating room while the infantile in a supine position. Then the trunk was scanned for CAD/CAM, where the engineer designed the asymmetric brace. All children are radiographically evaluated before bracing prescription, and in and out of brace at 3, 6, 9, or 12 months. A descriptive data analysis and linear mixed effect models with random intercept were performed.

Results and discussion: With gender, age, and time adjusted as potential confounders, there were significant reduction of Cobb angles between in-brace and out of brace status in the upper segment (-11°), middle segment (-12°), and lower segment (-12°) (P<0.001). When compared to the baseline without the brace, there were reductions or no change in the upper (-11.6% to -17.5%), middle (0.6% to -4.5%), and lower segments (3.6% to -12.2%) from 3-12 month follow-ups (see table 1).

Table 1. Cobb angle changes at 3, 6, 9, and 12 month out of Mi3CTM brace as compared to 0 month (P=0.05)

<table>
<thead>
<tr>
<th>Segment</th>
<th>Month</th>
<th>Mean ± SD (°)</th>
<th>Cobb angle change from baseline (°)</th>
<th>% Change from baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Curve</td>
<td>0</td>
<td>35.7±15.5</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>30.1±19.7</td>
<td>-5.6</td>
<td>-15.6%</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>30.2±21.5</td>
<td>-5.5</td>
<td>-15.5%</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>31.5±24.2</td>
<td>-4.2</td>
<td>-11.6%</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>29.4±24.3</td>
<td>-6.2</td>
<td>-17.5%</td>
</tr>
<tr>
<td>Middle Curve</td>
<td>0</td>
<td>25.0±10.0</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>25.2±11.2</td>
<td>0.2</td>
<td>6.6%</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>24.8±11.6</td>
<td>0.7</td>
<td>-4.9%</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>24.3±10.3</td>
<td>-0.7</td>
<td>-2.7%</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>23.9±10.0</td>
<td>-1.1</td>
<td>-4.5%</td>
</tr>
<tr>
<td>Lower Curve</td>
<td>0</td>
<td>28.9±14.0</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>25.4±14.3</td>
<td>-3.5</td>
<td>-12.2%</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>27.9±14.5</td>
<td>-1</td>
<td>-3.5%</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>30.2±14.2</td>
<td>1.3</td>
<td>4.5%</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>28.9±14.2</td>
<td>1</td>
<td>3.6%</td>
</tr>
</tbody>
</table>
Conclusion and significance: Based upon SRS criteria for success in spine correction, 70% of patients successfully achieved correction of the spinal curvature, 30% of children had curve progression, but none of them required any surgical intervention in 12 month follow-up. Meanwhile, the clinical protocol to treat children with Mi3CTM bracing procedure has been established. The Mi3CTM brace is considered as an effective modulator for children with EOS and may also provide an alternative management for children who are not tolerant to casting or TLSO.

O10.65 Effect of An Intensive Schroth Intervention on Pulmonary Function in Adolescents with Idiopathic scoliosis

Nikola Jevtic\textsuperscript{1,2}, Sanja Schreiber\textsuperscript{3}, Olivera Klisuric\textsuperscript{4}, Borislav Obradovic\textsuperscript{2}, Nata\v{s}a Danilovic\textsuperscript{4}, ArpadToth\textsuperscript{4}, Axel Hennes\textsuperscript{5}

\textsuperscript{1}Scoli Center, Novi Sad, Serbia, \textsuperscript{2}Faculty of Sport and Physical Education, University of Novi Sad, Serbia, \textsuperscript{3}Department of Pediatrics, University of Alberta, Edmonton, Canada, \textsuperscript{4}Department of Physics, Faculty of Sciences, University of Novi Sad, Serbia, \textsuperscript{5}MVZ-Medical-Therapy-Center, Spine-Concept-Sobernheim, Germany

Introduction: Adolescent idiopathic scoliosis (AIS) is a 3D deformity of the spine that may cause pulmonary restrictions, abnormal ventilation patterns, impaired function of respiratory muscles, asymmetric motion of the chest wall, and abnormal patterns of ventilation during exercise. Schroth physiotherapeutic scoliosis-specific exercises (PSSE) are neuromuscular exercises that aim to correct the spinal deformity and posture affected by scoliosis using 3D corrective exercises combined with specific de-rotational breathing. Schroth PSSE camp is an intensive PSSE approach consisting of 10-day intensive intervention during which patients exercise 4.5 hours per day under the guidance of a Schroth therapist. PSSE have been shown to improve pulmonary function. The Society on Scoliosis Orthopaedic and Rehabilitation Treatment (SOSORT) recommends the use of respiratory exercises to improve pulmonary function of patients with AIS.

Objective: To determine the change in pulmonary function in patients with AIS under the influence of an intensive 10-day PSSE treatment.

Method: For measuring pulmonary function, we used Biopac (Biopac Student Lab Systems 4.0, Inc. ISO9001:2008) with accompanying BSL 4 software and MP hardware driver. We measured the following outcomes: Vital Capacity (VC), Inspiratory Reserve Volume (IRV), Expiratory Reserve Volume (ERV), Total Lung Capacity (TLC) and Maximal Voluntary Ventilation (MVV). All measurements were performed according to the standard protocol for measuring pulmonary function.

We used dependent t-test to determine the within-group differences from baseline to the end of a 10-day intensive PSSE intervention. We also calculated the corresponding effect sizes (r) for the outcomes, as $r = \sqrt{t^2/(t^2 + df)}$, where t is the corresponding t-value and df is degrees of freedom.

Results: There were 22 patients with AIS. Mean age was 13.9 ± 2.0, and mean Cobb angle 34.6°±12°. Nine patients had a major lumbar, and thirteen major thoracic curves. On average, patients experienced significantly greater improvement on all variables, except on IRV. VC improved from 2.43 l ± 0.69 l to 2.83 l ± 0.76 l (t(21)= -4.54, p=0.000, r=0.70); TLC improved from 3.43 l ± 0.69 l to 3.83 l ± 0.76 l (t(21)= - 4.56, p=0.000, r=0.70); IRV remained unchanged (t(21)= -1.1, p=0.28, r=0.23), ERV improved from 0.58 l ± 0.36 l to 0.79 l ± 0.39 l (t(21)= - 2.58, p=0.02, r=0.49); and MVV improved from 52.13 l/min ± 16.77 l/min to 66.54 l/min ± 17.85 l/min (t(21)= - 5.04, p=0.000, r=0.74).
Conclusion and Significance: All but one pulmonary function parameter was improved. The effects sizes for VC, ERV, TLC and MVV were large. Schroth PSSE intensive 10-day intervention improves pulmonary characteristics in patients with AIS.

O11.33 The immediate pulmonary effect of the new Lyon ARTbrace: Spirometry study of a case series of 64 consecutive Adolescent idiopathic scoliosis collected prospectively

Jean Claude de Mauroy¹, Fabio Gagliano², Frédéric Barral³

¹Clinique du parc - Lyon, ²Clinique St Charles - Lyon, ³Department of Pediatrics, University of Alberta, Edmonton, Canada, ⁴Groupe Lecante - Lyon, france

Introduction: One of the disadvantages of bracing scoliosis is the effect on pulmonary function during pubertal thoracic development. The new Lyon ARTbrace has 4 basic characteristics designed to facilitate breathing.

1. Asymmetry with breathing expansion in the concavity,
2. Adjustable during the growth,
3. Lateral thoracic support at the sub-axillary level (baby-lift) which allows to detach the sterno-clavicular high strap to facilitate inspiration.
4. Lumbar lordosis with an anterior abdominal expansion

The objective is to calculate the average percentage change of the 3 main parameters 1. Forced Vital Capacity (FVC), 2. Forced Expiratory Volume in 1 second (FEV1), 3. Peak Exploratory Flow (PEF) immediately 3 days after fitting the brace.

Method: A series of 62 consecutive patients selected according to the SRS-SOSORT criteria was measured using the Contec SP10 spirometer between May and November 2016. All the curvatures are thoracic because lumbar scoliosis, treated with another detorsion brace (GTB), are excluded. The measurement takes place at the time of the radiological brace control, the child is staying for about an hour without the brace. No specific physiotherapy was performed. The best of 3 measurements was chosen and the order with and without brace was randomised. The statistical analysis was carried out using SPSS 20.

Results and discussion: A paired-samples t-test was conducted to compare:

Pair 1 FVC without and with brace
Pair 2 FEV1 without and with brace
Pair 3 PEF without and with brace

1. FVC is significantly higher without brace (M=2.47, SD=0.62) than in-brace (M=2.27, SD=0.60).
\[ t(63)=-3.89, p<.000 \]

2. FEV1 (pair 2) is not significantly higher without brace (M=2.06, SD=0.54) than in-brace (M=2.02, SD=0.63).
\[ t(63)=0.855, p=0.396 \]

3. PEF (pair 3) is not significantly lower without brace (M=3.36, SD=1.31) than in-brace (M=3.47, SD=1.32).
\[ t(63)=-0.930, p=0.356 \]

Despite their importance, spirometric data are often lacking in the evaluation of braces. (Margonato 2005) found a -37% decrease of FVC and FEV1 in abbott plaster cast. (Kennedy 1989) notes a -14% decrease of the FVC with TLSO. The percentage is slightly less -11% with Boston brace (Katsaris 1999). The percentage is -13% with Carbon brace (Bernard 2005). The im-
mediate decrease of -7% in FCV with ARTbrace is the lowest reported to date.

The fact that FEV1 is less altered is normal since a brace does not cause airway obstruction.

The fact that the PEF is improved, even in a non-significant way is unexpected. We can even consider that the brace improves the ventilatory mechanics.

**Conclusion:** All braces decrease the FVC, but thanks to its original design, the immediate limitation is only 7%: the lowest reported to date. The other obstructive and mechanical parameters are not significantly modified.

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**O12.73 Sagittal and coronal spine balance in 584 healthy subjects: clinical plumbline values and correlation with x-ray measures**

Alessandra Negrini, Massimiliano Vanossi, Sabrina Donzelli, Fabio Zaina, Michele Romano, Stefano Negrini

ISICO - Italy

**Introduction:** X-ray is the gold standard to evaluate spinal sagittal and coronal parameters. To reduce the burden of x-rays and reduce costs, easy to use tools are used in clinical practice. Plumbline Distances (PD) showed acceptable repeatability, good validity and sensibility in identifying thoracic hyperkyphosis, however no study provided normative data of healthy subjects at different age and bone maturity.

**Objectives:** To assess the normative clinical value of the plumbline distances in a healthy wide population of growing subjects and to correlate it with x-ray measures.

**Methods:** Design: cross-sectional study. Participants: 584 healthy subjects (341 females) presenting for a first visit with x-rays showing no spine deformity. The whole sample (ALL) was divided in 5 groups according to age and bone maturity: 6-9 years old (n=106); >10 ys, open triradiate cartilage, Risser 0 (n=129); > 10 ys, closed triradiate cartilage, Risser 0 (n=104); Risser 1-2 (n=126); Risser 3-5 (n=119).

The plumbline distances were taken by maintaining a tangent to thoracic kyphosis apex, at the following points: C7, T12, L3, S2. Kyphosis Index (KI) (C7+L3), sagittal and coronal balances (C7-S2) were calculated.

Statistics: descriptive statistics to summarize the sample characteristics, one way ANOVA to test differences in the age groups, Pearson correlation to correlate clinical with x-ray measures.

The study was approved by the local Ethical Committee and informed consent from participants was collected before recruitment.

**Results:** In ALL plumbline distances at C7, T12, L3 and S2 were respectively 39.9±16.7 (CI 95% 38.6-41.3), 21.4±15.3 (CI 95% 20.2-22.7), 39.9±15 (CI 95% 38.6-41.1), 20.6±17 mm (CI 95% 19.3-22); KI was 79.8±26.8 mm (CI 95% 77.6-82), sagittal balance was 19±16.9 mm (CI 95% 18-20.7), it was positive (C7 anterior to S2) in 84% of subjects; 13.5% had a coronal imbalance of 11.4±5.4 mm (CI 95% 10.2-12.6) to the right and 24.7% had a 13.2±6 mm (CI 95% 10.2-12.6) to the left. ANOVA of KI and sagittal balance showed a significant difference (p<0.0001) between groups, with a progressive increase from 6-9 years old Group to Risser 1-2 Group. KI correlated to thoracic kyphosis Cobb degrees (r=0.46).
Conclusions and significance: The present study presents the normative value of a very easy and feasible clinical tool: the plumbline distances. These values can be considered as a reference during patient evaluation. The radiographic exam remains a standard to make diagnosis. Further studies will compare these normative with pathological data.

O13.63 Position related discrepancy of trunk rotation measurements

Justyna Bloda¹, Jakub Was², Dariusz Czaprowski², Mateusz Kozinoga³,⁴, Tomasz Kotwicki³

¹Department of Physical Education, Józef Piłsudski University of Physical Education, Warsaw, Poland, ²Department of Physiotherapy, Józef Rusiecki University College, Olsztyn, Poland, ³Department of Spine Disorders and Pediatric Orthopedics, University of Medical Sciences, Poznan, Poland, ⁴Rehasport Clinic, Poznan, Poland

Introduction: One of the source the variability of angle of trunk rotation (ATR) can be the position of subject during the Adams forward bending test. The aim of the study was the assess the ATR variability related to subject position.

Methods: The study comprised 97 children: 67 with idiopathic scoliosis (IS) and 30 healthy subjects, aged 9-18 years. In the scoliotic group the mean Cobb angle was 27.9° ± 13.1° for the thoracic and 23.6° ± 11.2° for the thoracolumbar/lumbar spine, respectively. ATR was measured with Bunnell scoliometer during forward trunk flexion performed in standing position (Adams test). Maximal ATR value was evaluated for the proximal thoracic (Th1-Th4), main thoracic (Th5-Th12) and lumbar spine (L1-L5).

The measurements were performed in the following variants of position: (1) forward bend using the reference position (feet placed at the hip width, hands joined, facing between feet), (2) forward bend in spontaneous position, (3) forward bend with feet parallel one against the other, (4) forward bend towards one foot, (5) forward bend with asymmetrical position of lower limbs in sagittal plane (sliding one foot 1 cm, 3 cm or 5 cm forward).

For each subject and at each level of the spine (proximal thoracic, main thoracic and lumbar) the differences (changes) between ATR values measured in the reference position versus the foregoing variants were calculated. In each variant the maximum difference was designated as ATR variability (Δ ATR).

Results: During forward bend towards the left foot the Δ ATR was equal to or greater than 3° in 60% of subjects. There were no significant differences between Δ ATR in proximal thoracic, main thoracic and lumbar spine for the habitual position (p=0.363) as well as during forward bend towards the right foot (0.277) or the left foot (p=0.635). The position of sliding one foot forward 3 cm or 5 cm resulted in Δ ATR significantly higher in the lumbar than in the thoracic spine.

There was no association between the position related ATR variability and number of curvatures, location of curvature, value of Cobb angle as well as skeletal maturity according to Risser (p>0.05).

In children with IS, the Δ ATR was significant higher during forward bend towards left foot (p=0.023) as well as during sliding forward 1 cm the right foot (p=0.018) and the left foot (p=0.012) compared to healthy children.

Conclusion: Sliding forward one foot causes the greatest ATR change in the lumbar spine. The position related variability of ATR is not related to parameters of scoliosis. In children with IS the position related variability of ATR is greater than in healthy children. Significance: In clinical practice one should take into account the subject position during Adams test.
O14.102 Correlation between the hump measured in forward bending of the trunk, in standing position and the real rotation of the apical vertebra

Michele Romano, Alessandra Negrini
ISICO, Milan- Italy

**Introduction:** The ATR measure is one of the most important clinical measurement of scoliosis patients. It is the most Important Information for screening and fundamental also for therapy management. The ATR is a clinical sign considered closely related to rotation of the vertebrae interested by the scoliotic curves. The ATR assessment is performed with the patient in forward bending of the trunk, to make appear the hump.

**Objectives:** The purpose of the study is to understand better the real value of the hump assessed in the classical position (forward bending of the trunk), compared with the measurement performed with the patient in standing position.

Another aim is to assess the real association of the vertebral rotation measured on the X-ray and its hypothetical clinical correspondent represented by the hump.

**Methods:** 40 female adolescents at their first evaluation before any treatment were recruited for the study.

A series of measures has been carried out:
- ATR with patient in forward bending of the trunk.
- ATR with patient in standing position, using a Formetric Diers (standing ATR).
- Measurement of the real height difference of the two side portions of the trunk, similar to the measure of the classical hump. The humps were assessed in the same area of the hump measured in forward bending.
- Measurements of the vertebral rotation using the Raimondi method.

This group of humps was divided into two subgroups: thoracic hump (25 patients) and lumbar hump (18) to understand if there are significant differences between the correlation analysis of the two subgroups.

The statistical analysis was performed using the Pearson index and the T-test

**Results:** The average results were: ATR 9.80°±3.5°; ATR in standing 7.75°±3.1°; vertebral rotation 14.68°±7.6°.

The correlation between the ATR and the standing ATR is weak 0.24 (p = 0.0002). While the measure of the hump assessed in standing position and the corresponding vertebral rotation, measured on the X-ray, shows a moderate correlation: 0.47 (p = 8.38849E-08).

Subgroup analysis:
- The 25 thoracic ATR (9.92°±3.5°) and standing ATR(7.28°±3.06°) doesn’t shows any correlation: -0.03 (p-value = 0.01) while the standing ATR and the corresponding vertebral rotation shows a moderate correlation: 0.56 (p = 7.69).
- The 18 lumbar ATR (average 9.62°±3.4°) and standing ATR (average 8.2°±3.2°) show a strong correlation: 0.72 (p value = 0.09) while the standing ATR and the corresponding vertebral rotation show a weak correlation: 0.31 (p value = 0.0002).

**Conclusions and Significance**

There is not a corresponding link between the real rotation of the apical vertebra of a scoliosis curve and the relative hump. The stronger correlation between the hump measured in forward bending and standing position of the trunk is only related to the lumbar spine. The hump classically measured for scoliosis assessment does not correspond to the real rotation of the apical vertebra, so, this data need a reasoning about the real significance.
O15.24 The natural history of idiopathic scoliosis during growth: a meta-analysis

Francesca Di Felice, Fabio Zaina, Sabrina Donzelli, Stefano Negrini

ISICO (Italian Scientific Spine Institute), Via Bellarmino 13/1, Milan, 20141 - Italy

Introduction: The real risk of progression of idiopathic scoliosis is considered to vary during different growing phases, but so far data concerning this issue refer only to a few studies and narrative reviews. Today no systematic reviews or meta-analysis are available to pool the results of different studies.

Objective: The aim of this study is to provide a systematic review and a meta-analysis of the current literature concerning the natural history of idiopathic scoliosis during growth.

Methods: We searched the MEDLINE, EMBASE and SCOPUS databases up to November 2016 to retrieve articles reporting about natural history of scoliosis during growth. Eligible studies were prospective or retrospective studies that enrolled patients with infantile, juvenile or adolescent idiopathic scoliosis followed up without any treatment from the time of detection. The studies were included only if they reported the progression rates during growth of untreated patients. Two authors independently reviewed each article for data extraction and quality assessment. The main outcome measure was the rate of progression. For the meta-analysis, the studies were grouped according to diagnosis: Infantile Idiopathic Scoliosis (IIS), Juvenile Idiopathic scoliosis, (JIS) and Adolescent Idiopathic Scoliosis (AIS). Due to expected heterogeneity, we applied a random effect model to pool data together.

Results and Discussions: Of the 1797 citations screened, we assessed 61 full-text articles and included 13 of these (2301 participants). Three studies included IIS patients (347 participants), 5 studies included a mixed population of JIS and AIS (1330 participants), 5 studies included AIS patients only (624 participants) The random pooled estimated progression rate was 49% (95CI: 1-97%) for IIS; 44% in a mixed group of patients affected by juvenile or adolescent IS (95CI: 16-71%) and 42% in AIS (95CI: 11-73%). The criteria to define progression were slightly different among studies, being this a change of 5, 6 or 10° Cobb, or a progression over the threshold of 50° Cobb. Risser, age and clinical features varied among studies. During growth, idiopathic scoliosis tends to progress in a high percentage of cases. The progression rate varies according to the age at diagnosis, with infantile scoliosis being the most unpredictable. There are many confounders like age, Risser sign and baseline Cobb angles that were not consistent among studies, and this makes the data quite heterogeneous as reported in our analysis. These features, together with the different definitions of progression can explain the variability of results among different studies.

Conclusions: What is clear from almost all the studies is the risk of progression of the Cobb angle during growth, even if the rate of scoliosis progression is extremely variable among studies. We suggest that future research about natural history looks in a more detailed way at the clinical parameters that can predict progression, and give more homogeneous definition of progression.
O16.93 Adolescent Idiopathic Scoliosis: Prevalence, Risk of Progression and Quality of Life assessment in children aged between 10-18 years old screened in schools of the Metropolitan Region of Chile (Preliminary report)

Oscar Urrejola, Pamela Espinoza, Marcela Cárcamo Marcela, Theo Grivas, Josette Bettany-Saltikov

Introduction
Scoliosis prevalence varies around the world, where farthest countries from the Equator line had reported mayor prevalence compared to those are near to it. There is a lack of epidemiological evidence in South America and Africa due to a lack of prevalence studies originated from school screening programs, therefore, Chile has not certain statistical information regarding to adolescent idiopathic scoliosis (AIS) prevalence. Literature support school screenings for scoliosis as an effective method to collect epidemiologic data.

Objectives
Establish prevalence, determinate the population with risk of progression and evaluate the quality of life of AIS population aged between 10 to 18 years old screened in schools randomly selected in the Metropolitan Region of Chile, to determinate the real health problem to support public health decision-making according to the reality of the country.

Methods
A 2 years’ length prevalence study will be conducted, where 1,200 students aged between 10-18 years old, that meets the inclusion criteria and both, student and parents, had signed the informed consent. Screening will be performed during the Physical Education class. Girls and boy will be screened separately. The evaluation team composed by an orthopedic surgeon (spine specialist) and a physical therapist (certified by the BSPTS) will ask children to perform Adam’s Test in standing and sitting position measuring the angle of trunk rotation (ATR) with a scoliometer. When ATR is ≥ 6°, referral order to Posterior-Anterior (PA) and lateral Xrays in standing position that includes iliac crest vision exam will be provided. Once the evaluation team has the Xrays results, the orthopedic surgeon will measure: Cobb angle, vertebra rotation, Risser sign, thoracic kyphosis angle and lumbar lordosis angle. Scoliosis diagnosis will be confirmed when having a Cobb angle ≥ to 10° with vertebrae rotation according to the SRS diagnostic criteria standard; risk of curve progression will be calculated using the formula proposed by Lonstein and Carlston (Cobb angle – [ 3 x Risser sign] /chronologic age).

Results and Discussion
150 students were screened for scoliosis, where 50,7% were female and 49,3% were male students (74 and 76 respectively). Of them, 15,53% (23 students) had an ATR greater or equal to 6° and were derived for and Xray exam to confirm or deny scoliosis diagnosis. Of the aforementioned, 7 students did not take the Xray exam; 6 did not meet the inclusion criteria; and 10 subjects had a scoliosis diagnosis confirmation. Mild scoliosis was found on 9 subjects (2 males and 7 females); moderate scoliosis was found on 1 female student; and none of them had severe scoliosis. The most common scoliosis pattern was a single left thoracolumbar curve (4 students), followed by a double mayor curve with a right thoracic and left lumbar convexity (3 students), then a single right thoracic curve (2 students), and finally a double mayor curve with left thoracic and right lum-
bar curve pattern (1 student). The female: male ratio of this sample was 8:2, and the final prevalence was 6.67%. According to the Lonstein and Carlston Risk of Progression Factor, two female students were early diagnosed with scoliosis, presenting a 80% and a 40% probability for curve progression having Risser 0 at the age of 10 with Cobb angles of 15° and 19° respectively.

Meanwhile, one female student had a late scoliosis diagnosis having a moderate scoliosis, exposing a 50% of risk of progression at the age of 16 with Risser 4.

The final results of this study would complement and support health decision-making, especially in the actualization of the MINSAL (acronym of Minister of Health in spanish) Clinic Guidelines for scoliosis surgical treatment, where knowing the real prevalence of AIS in the Metropolitan Region (that concentrates the 39% of the total adolescent population aged between 10-18 years old of the country) will lead to identify the real frequency and to provide adequately economic resources not just to surgically treat this condition but, to create further health prevention and promotion policies in scoliosis.

Conclusion and Significance

In this preliminary results AIS prevalence is a double of the value reported in the literature, therefore, for the very first time national guidelines need to be actualized based on the results of this study that determinates the real magnitude of AIS health problem in the country; furthermore, public health policies regarding to prevention and promotion in scoliosis is needed to be actualized where early detection and a more effective school screening program need to be redefine.

Economic resources should be destined to conservative treatment as well, in order to prevent curve progression in those AIS population with higher RoP that is actually without any economic support.

O17.80 A literature review on idiopathic scoliosis in Brazil including an assessment of conservative treatment

Maria Lúcia de Macedo Cardoso¹, Patricia Italo Mentges²

¹ Oswaldo Cruz Foundation (Fiocruz), Rio de Janeiro, Brazil, ² Brazilian Scoliosis Project, Rio de Janeiro, Brazil

Introduction: The position statement of the main societies on spine research highlights that conservative treatment of scoliosis can decrease the likelihood of curve progression to the point of avoiding surgery. SOSORT has continuously produced guidelines on conservative treatment. However, in Brazil there are no public policies for the early detection of scoliosis, and studies on the epidemiology are scarce. The availability of treatment in public hospitals is limited, focused on surgery, and information on conservative treatments is rarely available.

Objectives: To review the literature produced by Brazilian researchers on idiopathic scoliosis, categorize their subject matters, and identify how conservative treatment are taken into account.

Methods: Electronic searches of bibliographic databases were carried out using the Boolean expression: (“idiopathic scoliosis” OR “escoliose idiopatica”) AND (Brazil OR Brasil), with no limits to year publication or language. The number of retrieved articles per database were: Scopus, 102; Pubmed, 42; Scielo, 26 in English and 35 in Portuguese; Virtual Health Library, 13; EMBASE, 7, totaling 225. Duplicate appearances of the same article in different databases or under different languages, as well as by authors who were not affiliated to Brazilian institutions were excluded. We thus evaluated 129 articles.
Results: Of the 129 articles, 71 are on surgical issues. The others are on: assessment, 28; pathology, 15; physiotherapy, 5; epidemiology, 6; orthosis, 2; treatment (not physiotherapy), 2.

The 2 articles of orthosis lack follow-up information and conclusive outcomes. Of the 5 articles on physiotherapy, 2 are on exercises and the preliminary results are based on small samples and on a short follow-up period. Another one is an assessment of the reliability of Global Postural Reeducation evaluation, while a fourth article is a proposal of a protocol for respiratory physiotherapy. The last one is on side-shift therapy associated with a shoe lift.

SOSORT is cited in 7 articles. The 2005 guideline was mentioned by 3 articles, all on surgery. The 2008 Guideline is quoted in one article when mentioning the treatments of scoliosis. The 2011 Guideline, considered the most important consensus on scoliosis, appears in the references of 2 articles, one on pathology that is a literature review on muscle disorders, and the article on physiotherapy and shoe lift, but it is not discussed in the body of the text. An assessment study on functional exercise mentions one article based on SOSORT criteria about the role of regular aerobic exercises.

Conclusion: In the literature on idiopathic scoliosis produced in Brazil, surgery is often considered as the main treatment. The studies on conservative treatment are scarce, and are mostly based on less reliable evidences. SOSORT criteria and guidelines are not taken into account as support for such studies.

O18.96 Markerless, structured light back surface topography measurement system for posture and scoliosis among children and adolescents aged 5-19 years in selected cities of the Mazovian Voivodship in mid-north-eastern Poland

Wojciech Glinkowski1, Bozena Glinkowska1, Katarzyna Walesiak1, Agnieszka Zukowska1, Jakub Michonski2, Paweł Bolewicki2, Robert Sitnik2

1 Medical University of Warsaw, 2 Warsaw University of Technology- Poland

Introduction: The gold standard for spinal deformity detection remains standing full-column radiographs with the exposure to ionizing radiation. On the other hand, the iPhone and scoliometer measurements, with a high to very high reliability and moderate to very high validity require bending the subject forward because of the lack of possibility to examine the subject standing.

The frailty of the scoliometer allows operating in the vertical position only. The Adam’s test also shows the human sight weakness that makes impossible to assess the asymmetry of the trunk of the standing subject accurately. The trunk asymmetry is discernible if the subject bends forward. Three-dimensional surface topography can measure the trunk asymmetry if the device is accurately calibrated three-dimensional space. The results of the standing full-column radiographs evaluation remain 2 Dimensional, and weak correlations between 2D and 3D imaging derive from the surface of the skin that covers soft tissues and the skeleton. The measurements methodologies of radiographic and 3D measurements are different as well. Sev-
eral studies assume the school posture and scoliosis screening as controversial. However, several studies confirmed the usefulness of the surface topography for this purposes. The aim of the study was to assess spinal curvatures and static postural characteristics with three-dimensional surface topography and to determine the characteristics of the diversity of posture measurements and curvatures of the spine in the cohort study population.

**Material and Methods**: The study was performed in elementary and middle schools in selected cities of the Mazovian Voivodeship in mid-northeastern Poland. The ethics board approved this study.

The study was conducted with the approval of the Bioethics Committee. Parents or Legal Guardians or mature by law subjects signed the informed consent. Additionally, the Voivodeship Directorate of Schools and the Voivodeship Office of Education approved the study. Eleven thousand eight hundred and seventy-two children and adolescents were assessed. The study cohort of subjects was measured using a custom-made structured light illumination (SLI) scanner with an accuracy of 0.2 mm, built using a DLP projector and an industrial camera. Duration of the measurement was 0.9 s. Results were produced in the form of a point cloud. The diagnostic device was metrologically tested and utilized earlier in scoliosis screening. Widely used spine parameters and deformation indexes like Posterior Trunk Symmetry Index (POTSI), Deformity in the Axial Plane Index (DAPI), 3D ATR, SHS, surface kyphosis and lordosis angles and sagittal trunk inclination and others were measured. Each subject was examined in static standing posture using markerless, structured light back surface topography measurement system for posture and scoliosis and custom made assessment software with measurements algorithms incorporated into the system. The client software was used to mark relevant anatomical landmarks on the back surface. Each measurement was analyzed by physician or physiotherapists trained in operating the software. The lordosis and kyphosis measurements mimic the method described in Debrunner’s kyphometric evaluation. Sagittal trunk inclination angle is drawn in the sagittal plane between the plumb line and line that passes through the far posterior surface point of C7 spinous processus and the point of the top of the intergluteal furrow. Sagittal trunk inclination angle may relate to SVA in radiographic sagittal balance measurement. The subjects did not wear shoes during the assessment and exposed only the back area to ensure privacy.

**Results**: The Informed Consent to the study was obtained from Parents or Legal Guardians of 44.62% of children and adolescents in schools, where the study was conducted. Significant organizational and pedagogical effort was noted. Children and adolescents averagely aged 11.43 years (from 5 to 19, STD 2.57). Their average body mass was 45.66 kg [14-136, STD 15.08] and average height was 152.84 cm, [107-197, STD 16.12]. The average values of back assessment parameters were as follows: POTSI 23.94% [9.6-88.05, STD 11.38]; DAPI 1.11% [-0.01 - 104.4, STD 1.30]; kyphosis angle 11.8° [10-93.28, STD 7.22]; and lordosis angle 33.85° [0-56, STD 8.77], anterior trunk inclination 3.89° [0.0 – 17.34, STD 2.73], pelvis asymmetry angle 3.89° [0.52 – 42.61, STD 2.55], waist asymmetry angle 0.3° [-39.8 – 11.58, STD 2.08], shoulders asymmetry angle -0.36° [-27.97 – 38.50, STD 2.26], ST Thoraco lumbar Angle of Trunk Rotation ATR ThL 3.89° [0.52 – 42.61, STD 2.55] and SHS 10.82° [0.0 – 144.54, STD 8.87].

Mean values if the ST kyphosis angle in boys (11.02o) and girls (11.91o) were different in almost every age significantly (p<0.01). Mean ST lordosis angles in males (35.17o) and girls
(32,110) were normally distributed and significantly different. The mean anterior trunk inclination angle was not significantly different in boys (3.97°) and girls (3.75°).

Conclusions and Significance: The total number of the cohort subjects examined in this study confirms the efficiency of the 3D surface topography system used in the large-scale study for posture and scoliosis detection. The characteristic distributions were noted for all measured parameters. Postural screening remains a powerful tool that can be used to identify children and adolescents with scoliosis or sagittal plane deformities and monitor changes of the back surface. The implementation of the study may diminish the full-column radiographs among children and adolescents. Screening utilizing SD Surface topography has the potential to make a longitudinal assessment of change in spinal deformity without serial radiographs.

O19.95 Epidemiological analysis of Adolescent Idiopathic Scoliosis (AIS) in terms of diagnosis, family history, hobbies, pain and curve type

Karavidas Nikos
Scoliosis Best Practice Rehab Services - Greece

Introduction: AIS affects 2%-3% of the general population. However, the age of onset varies, there is no clear association with family history or activities, while pain prevalence and scoliosis type are not well studied yet.

Objectives: The purpose of this study is to make an epidemiological analysis, providing useful data to be considered for prevention and future studies.

Methods: A retrospective analysis from a prospective database, was performed, to determine the characteristics of AIS patients. The analyzed parameters were: age of diagnosis, person who firstly made the diagnosis, pre-menarche or post-menarche, curve magnitude at the time of diagnosis, family history, patient’s hobbies, existence of pain and type of curvature. The data from 175 patients (154 females-21 males) were analyzed.

Results: The age of diagnosis was 3-5.9 years in 5 patients (2.9%), 6-9.9 years in 33 patients (18.9%), 10-11.9 years in 61 patients (34.8%), 12-13.9 years in 53 patients (30.3%) and above 14 years in 23 patients (13.1%). 94 girls (61%) were diagnosed pre-menarche and 58 (39%) post-menarche. The Cobb angle at time of diagnosis was 10°-25° in 96 patients (54.8%), 25°-40° in 68 patients (38.9%) and above 40° in 11 patients (6.3%). The first diagnosis was made by family members in 70 patients (40%), a pediatrician in 55 patients (31.4%), an orthopedic or other doctor in 24 patients (13.7%), school screening in 14 patients (8%), sport coach in 8 patients (4.6%) and random x-ray in 4 patients (2.3%). No family history reported in 98 patients (56%). No hobbies reported in 43 patients (24.6%). The most common activities were ballet (30 patients, 17.1%), swimming (29 patients, 16.6%), other types of dancing (25 patients, 14.3%), gymnastics (20 patients, 11.4%), volleyball (18 patients, 10.3%) and tennis (15 patients, 8.6%). No pain existed in 146 patients (83.4%), while 15 patients had some upper back pain (8.6%) and 14 low back pain (8%). The analysis of scoliosis type was based on the Schroth BSPTS classification. 57 patients (32.5%) had 4C type, 49 patients (28%) 3C type, 29 patients (16.6%) N3N4 type, 25 patients (14.3%) Single Thoracolumbar type and 15 patients (8.6%) Single Lumbar type.
Conclusions and significance: Some useful conclusions can be drawn from the present study. Regarding the diagnosis of AIS, it seems that there is still a high percentage of patients diagnosed at a late growth stage. Moreover, 38.9% of our patients were firstly diagnosed within the brace indication range (25°-40°) and 6.3% even over 40°. School screening and pediatricians can play an important role in early detection of AIS, which can provide better treatment results. Family history was positive in 44% of our patients. Our results about hobbies are in accordance with the existed literature, showing a high prevalence of AIS among gymnastics, ballet dancers and swimmers. As for the type of scoliosis, double scoliosis was slightly more than single.

O20.30 Biomechanical strategies of spine, pelvis and lower limbs to achieve the stand-to-sit task: A kinematic study with tridimensional motion analysis

Jean-Claude Bernard, Emmanuelle Chaleat-Valayer, Agnès Troncy, Marion Montané, Soline Bellaiche, Eric Berthonnaud.

Centre des Massues, Lyon - France

Objective: The goal of this preliminary study is to analyze the biomechanical strategies of spine, pelvis and lower limbs (LL) with tridimensional motion analysis during stand-to-sit task, an understudied movement in the literature, however, source of questioning in clinical practice.

Observations: One female and one male, healthy participants, (respectively 28 and 48 years old) were included without history of pathology and with normal pelvic incidences. Participants performed stand-to-sit movements on a stool without using their hands. Once movement ended, participants’ thighs were parallel to the floor. The sensors were placed on the bony landmarks of LL and along the spinous processes from the middle of the sacrum to C7. The seven cameras of the Vicon device recorded a total of three trials. The studied parameters were the evolution of kinematics curves of the spine, the pelvis and the LL in the different planes during the movement.

Results: Significant differences between the two subjects are particularly the amplitudes of variation in spinal curvatures and the intercondylar distance. Subject’s lumbar curvatures decreased during the movement: -39° for the female, -16° for the male. The thoracic curvatures move in the same direction: -36° for the female, -13° for the male. The intercondylar distance of the female increased by 4cm, that of the male by 15cm.

Discussion – conclusion: These results bring out the two different biomechanical strategies for the same task. During stand-to-sit task, are solicited preferentially either the spine (in that case the female) or LL (in that case the male). What about the strategy used by patients with chronic low-back pain? These preliminary results provide new prospects in the understanding of the interaction between spine, pelvis and LL and must be confirmed by a cohort study.
O21.69 Assessment of lower limb muscle flexibility and trunk mobility in patients with idiopathic scoliosis

Mateusz Kozinoga 1,2, Katarzyna Politarczyk 2, Dariusz Czaprowski 3, Justyna Leszczewska4, Łukasz Stolinski 1,2, Krzysztof Korbel 1,2, Tomasz Kotwicki 1

1. Spine Disorders Unit, Department of Pediatric Orthopaedics and Traumatology, Poznan University of Medical Sciences, Poznan, 2. Rehasport Clinic, Poznan, 3. Department of Physiotherapy, Józef Rusiecki University College, Olsztyn, 4. Department of Physical Education, Józef Piłsudski University of Physical Education, Warsaw, Poland

Introduction: Patients with IS can present reduced flexibility of muscles which may hinder the process of scoliosis physiotherapy. The lower limb muscles and trunk flexibility assessment is an element of clinical evaluation of IS patients which is considered during planning the physiotherapy. Continuing authors’ previous pilot study, this study includes expanded number of patients.

The aim of the study was to evaluate the flexibility of: hamstrings and iliopsoas as well as trunk flexibility in children with IS versus healthy controls.

Material and methods: The study group consisted of 100 children with IS (aged 6-16 years, mean 12.7 (SD 2.8), 85 females, 15 males). The inclusion criteria: Cobb angle evaluated on the anterior-posterior radiograph performed in standing position >10°, the angle of the trunk rotation (ATR) >4°. The control group consisted of 88 children (aged 3-16 years, mean 7.3 (SD 3.6), 40 females, 48 males). The inclusion criteria: no IS, ATR <5°.

In all children the evaluation of particular muscles was performed: hamstrings (straight leg raise test, SLR, popliteal angle test, PA), iliopsoas (modified Thomas test) using Saunders digital inclinometer. Trunk flexibility was assessed: trunk forward and lateral flexion (finger tips to floor test, FTF, side bending test) with measuring tape. The protocol of the study was consistent with the standard proposed by Kendall et al. (2005). The results were related to the standard range of motions proposed by Kendall et al. (2005): hamstrings 80-90° of flexion in the hip/extension in knee, iliopsoas > 10° of extension in the hip, trunk forward flexion: touching fingers to the floor (score 0 cm), lateral trunk flexion: touching the head of fibula.

The groups were compared using Student t-test for independent groups or U Mann-Whitney.

Results: The measurements performed by one researcher showed (values for the study group; values for the control group, respectively): SLR right 56.5° (SD 13.2), left 55.5° (SD 13.1); SLR right 57.8° (SD 12.5), left 58.3° (SD 10.9), (p=0.39 right side, p=0.18 left side). Popliteal angle right 40.9° (SD 13.8), left 40.6° (SD 13.6); popliteal angle right 42° (SD 11.7), left 40.5 (SD 10.8), (p=0.54 right, p=0.1 left). Iliopsoas right 27.6° (SD 6.9), left 28.3° (SD 7.9); iliopsoas right 27.4 (SD 7.7), left 28.7° (SD 8.0), (p=0.23 right, p=0.05 left). Lateral trunk flexion (<0 means fingertip below, >0 above the head of fibula) to the right -2.03 cm (SD 4.3), to the left -2.2 cm (SD 4.2); to the right -1.48 cm (SD 3.5), to the left -1.38 cm (SD 3.6), (p=0.47 right, p=0.35 left). Fingertip to floor test 2.84 cm (SD 11.8) above the floor in the study versus 5.56 cm (SD 8.9) above the floor in the control group (p=0.1).
Conclusions: Children with IS presented a reduced flexibility of hamstrings and reduced trunk flexibility. There were no significant differences between children with IS versus healthy controls in terms of flexibility of hamstrings, right iliopsoas, trunk forward and lateral flexibility. Subjects with IS demonstrated lower flexibility of left iliopsoas (limit of significance). However, since these differences are within the specified measurement error, they seem to have no clinical significance. Significance: During planning physiotherapy the possibility of reduced flexibility of the lumbo-pelvic-hip complex muscles and the trunk should be taken into account. However, it seems that this reduction does not result from the deformation of the spine.

O22.32 Unhealthy sagittal profiles (posture) and serious neuromuscular tightness in Dutch youth

Piet JM van Loon¹, Ruud GHP van Erve¹, Lorette Seeters², Daniek Bakker², Sanne in’t Hof²

¹ Care to Move Deventer, ²Etty Hillesum Lyceum Deventer- Netherlands

Introduction: Spinal deformation and degeneration of the lower spine are posture dependent. According to official data the youth in the Netherlands is facing increasing problems (> 40% back pain and injury chance) in the musculoskeletal system, where sedentary life will be an important causative factor. About the effects of sitting (flexion) in the development of posture and function of locomotion (stiffness) during growth little is known. To understand epidemiological data on increasing posture dependent problems own research with relevant clinical examination is started.

Material and methods: A cohort of adolescents (15-18 years) on a secondary school was checked on postural deviations while bending. 248 children filled a questionnaire and test was decreased. The study was done by their own peers. With the Straight Leg Raising test “hamstring-tightness” was measured. Dorsoflexion of ankle/foot measurement was done to assess the tightness of calf muscles/Achilles tendons. All children were photographed from lateral performing Adam’s bending test (dressed). The finger-to-floor distance was assessed and classified in able (flexible) and not able (stiff) reaching the floor. The photographed spinal profiles while bending were classified as arcuate (normal, mild, serious) or angular kyphosis (mild or serious).
Results: Hamstring tightness in both legs was present in 62.1%. Unilateral tightness in 18.2%. Achilles tendon tightness in both legs 5 was present 59.3%. Unilateral short calf muscle-tendon tightness in 19, 4%. Activities with descending presence of stiffness (finger floor distance): football; running; no sports; field hockey; tennis; dance; gymnastics. 93.5% of the soccer players has tight hamstrings in both legs and 0.0% of those performing gymnastics! The correlation of the finger floor distance test with tight hamstring is 73.2%. So there is a link between the hamstring and the lack of flexibility at bending. The inter-and intra-observer variability in judgment of kyphosis on photo turned out to be higher in doctors than students. Around 80 of 248 spines were rated by all as pathological deformed.

Conclusion: evidence is obtained, that the youth in general will encounter serious problems in growth, as is to be expected in the current generations with their impressive sedentary lifestyle and will have its manifestation of discongruent neuro-osseous growth relations in serious neuromuscular tightness and spinal deformations.

O23.60 Improvement of trunk muscle endurance in Adolescent Idiopathic Scoliosis (AIS) patients undergoing ScoliBrace and Scientific Exercise Approach to Scoliosis (SEAS) treatment.

Jeb McAviney, Angela Vitucci, Sophie Lewis, Michelle McAviney, Juan Du Plessis.
Scolicare - Australia

Introduction: It is believed that scoliosis braces cause trunk muscle weakness, although little research on this topic exists. ScoliBrace uses a 3D inversion of the scoliosis alignment, not 3 point pressure, to correct the spine in-brace. In theory this should preserve muscle function as movement is not as restricted. This brace in combination with SEAS was used for the treatment of a group of AIS patients and the results of their muscle endurance during treatment is reported.

Objectives: This study aimed to assess trunk muscle endurance in AIS patients treated with ScoliBrace in conjunction with a SEAS program.

Methods: 21 AIS cases, with informed research consent, were retrospectively analysed. Inclusion criteria: AIS, combined ScoliBrace and SEAS treatment. Exclusion criteria: spinal surgery, scoliosis >60 degrees. Average age was 14 years. Average Cobb was 39.6°. Sorensens was used to assess trunk extensor endurance (TE), and a modified abdominal endurance (AE) test was performed. 180 seconds (sec) was the cut off for both tests. Standard error measurement for TE was 20 sec, for the AE it was 35 sec. Follow up assessments were car-
ried out at an average of 6.6 weeks and at 24.4 weeks. Statistical analysis used IBM SPSS Statistics 23.

**Results**: Table 1 shows the initial and follow up test results. When the patients that had achieved max result at the initial test were excluded, at the first follow up, after treatment TE improved by +52.2 sec, AE improved by +58.8 sec. 11 patients achieved max TE and 12 achieved max AE. At second follow up, TE improved by +76.1 sec from initial and AE improved by +68.4 sec from initial. 14 patients had achieved max on TE test and 16 max on AE. Results reflecting 95% confidence intervals are shown in Figs 1 & 2. Excluding patients with max 180 sec results at initial, improved results between initial and follow up 1 are shown in Figs 3 & 4.

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<th>Table 1. Summary statistics for test results and differences in them are presented in the table below.</th>
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<td>Trunk extensions 2 (TE2)</td>
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<td>Difference in abdominal test 3 (AE3) and abdominal test 2 (AE2)</td>
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Changes in test results are shown using mean plots with error bars reflecting 95% confidence intervals in figures below.

As data was non-parametric, Wilcoxon sign-rank test was used to calculate significance (Table 2).

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<th>Table 2. The results of the Wilcoxon sign-rank tests are presented in the table below.</th>
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Differences between follow-up tests were statistically significant (p<0.05), except for the difference between AE3 and AE2 (p=0.240). This is explained by the fact that 12 patients got a maximum AE result at AE2 and 11 managed to repeat this result at AE3. It is likely they may have improved their result if not limited to 180 seconds. Paired samples t-test confirmed the results of the Wilcoxon sign-rank test (Tables 3 & 4). More than 90% of patients improved their test results from one measurement to the next.

**Discussion**: Patients using the ScoliBrace in conjunction with SEAS improved trunk extensor endurance by an average of 105% and their abdominal endurance by 79%. Whether this result can be specifically attributed to the brace design or the exercises can not be determined in this study. Future research will aim to answer this question.
Conclusion: AIS patients treated with both ScoliBrace and SEAS improved their trunk muscle endurance at both the 7 and 24 week marks. These results were substantial, statistically significant and show good confidence. Using this combination treatment approach, trunk muscles did not get weaker and improved during treatment.

Significance: This study shows trunk muscle endurance can be improved during scoliosis bracing treatment with the ScoliBrace and SEAS rehabilitation. It’s unknown if the brace design or exercises improved muscle function, but for clinicians it gives confidence that during this treatment muscle function will not deteriorate and can be improved with this approach.

O24.50 Technical errors of the photographic method for body posture assessment

Łukasz Stolinski 1,2,3, Dariusz Czaprowski4,5, Mateusz Kozinoga1,2, Krzysztof Korbel1,2, Katarzyna Poliarczyk2,3, Piotr Janusz1,2, Paweł Glowka1,2, Marcin Tyrańkowski6, Nobumasa Suzuki7, Tomasz Kotwicki1.

1 Department of Spine Disorders and Pediatric Orthopedics, University of Medical Sciences, Poznan, 2 Rehasport Clinic, Poznan, 3 Rehasport Clinic Licensed Rehabilitation Center, Skierniewice, 4 Department of Physiotherapy, Józef Rusiecki University College, Olsztyn, 5 Center of Body Posture, Olsztyn, 6 Department of Orthopaedics, Pediatric Orthopaedics and Traumatology, The Centre of Postgraduate Medical Education in Warsaw, 7 Scoliosis Center, Medical Scanning Tokyo 1-6 Poland, 7 Japan

Introduction: 2D digital photography is a reliable, simple, generally available and low cost method for documentation and assessment of body posture. There exist important requirements for the standardization of performing photographic documentation.

Objectives: The aim of the study was to analyze technical errors related to the subject or camera positioning noticed during photographic documentation of body posture of children aged 7-10 years.

Methods: 9,319 children (4,470 girls, 4,849 boys) aged 7-10 years (mean 8.3 ±1.2), were assessed in 68 primary schools (Poznan city, Poland), by 122 physiotherapists and physicians in the frame of a local prevention program “Poznan focuses on health”. Children were assessed clinically and photographed in spontaneous standing posture using standardized procedure for photographic body posture evaluation. The undressed child (only with the underwear) was barefoot with knees extended and feet hip-width apart. The feet were placed on longitudinal and crosswise lines marked on the ground, so that their lateral
malleoli were over the crosswise line, and feet were parallel to the longitudinal line. Children were looking forward at eye level. In order to uncover sagittal contour of the back, the upper limbs were slightly flexed in gleno-humeral and elbow joint at an angle of approx. 10-20° and 20-30°, respectively. The flexion in gleno-humeral joint was performed slowly to avoid any trunk movement. Four digital photos were taken: front, left side, back, right side and the fifth in actively corrected posture from the right side. In total, 46,595 photos were adopted to the photographic evaluation process.

**Results:** The technical errors were observed in 538 children (5.8%). The errors were related to (in order of frequency): covered gluteal cleft (5.3%), the child positioning through the elevation or protraction of the shoulders (4.6%), malposition of the head and eye level (2.3%), position of upper limbs and feet (2.3%), incorrect leveling of the camera on the tripod (0.6%), out of focus photography (0.6%), ears covered with hair (0.3%), different position of two upper limbs (0.3%), lack of communication with the child (0.1%), asymmetrical loading of the legs - “one leg standing” (0.1%). More than one technical error appeared in some children.

**Conclusions and significance:** A significant number of technical errors was observed during photographic evaluation of body posture performed by a large number of physiotherapists and physicians. Although proposed technique can be successfully used by trained professionals, its use during school screening postural programs requires staff education in order to achieve strict respect to technical standards.

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**O25.46 Variability of the parameters determined sagittal profile of the trunk assessed using photography**

Lukasz Stolinski\(^1\,^2\,^3\), Dariusz Czaprowski\(^4\,^5\), Mateusz Kozinoga\(^1\,^2\), Krzysztof Korbel\(^1\,^2\), Katarzyna Politarczyk\(^2\,^1\), Pawel Ulman\(^6\), Pavel Cerny\(^7\), Nobumasa Suzuki\(^8\), Tomasz Kotwicki\(^1\).

\(^1\) Department of Spine Disorders and Pediatric Orthopedics, University of Medical Sciences, Poznan. \(^2\) Rehasport Clinic, Poznan. \(^3\) Rehasport Clinic Licensed Rehabilitation Center, Skierniewice, \(^4\) Department of Physiotherapy, Józef Rusiecki University College, Olsztyn, \(^5\) Center of Body Posture, Olsztyn, \(^6\) Department of Statistics, University of Economics, Cracow, \(^7\) Department of Physiotherapy and Occupational Therapy, University of West Bohemia, Pilsen, \(^8\) Scoliosis Center, Medical Scanning Tokyo.

**Introduction:** Sagittal profile of the trunk is an important determinant of human posture. Digital photography may be a standard technique for sagittal profile assessment. Photographic parameters measurement is used to document and quantitatively assess the body posture.

**Objectives:** The aim of the study was to analyze the variability in time (zero time, after one hour, after one week) of five 2D photographic parameters: sacral slope (SS), lumbar lordosis (LL), thoracic kyphosis (TK), chest inclination (CI) and head protraction (HP).

**Methods:** Thirty asymptomatic children (13 girls, 17 boys) aged 7-10 years (mean 8.2 ±1.0) were examined by one researcher in standing spontaneous position using standardized procedure for photographic posture evaluation. The undressed child (only with the underwear) was barefoot with knees extended and feet hip-width apart. The feet were placed on longitudinal and crosswise lines marked on the ground, so that their lateral malleoli were over the crosswise line, and feet were parallel to the longitudinal line. Children were looking forward at eye level. In order to demonstrate sagittal curvatures
of the spine, upper limbs were slightly flexed in gleno-humeral and elbow joint at an angle of approx. 10-20° and 20-30°, respectively. The flexion in gleno-humeral joint was performed slowly to avoid a movement of the trunk. Digital photographs of the left side of the body were taken: (1) three one after the other, (2) three after one hour and (3) three after one week in 5 seconds intervals each of them. In total 270 photos were assessed. Five photographic parameters were calculated on each photo. The statistical tests (analysis of variance, homogeneity of variance, normality of distribution and post-hoc tests) were used to examine the variation of five parameters in time.

Results: There were no significant differences between measurements (p>0.05) for all sagittal photographic parameters in zero time, after one hour and after one week. In the case of SS and CI - the one week measurement differed from the zero and the one hour measurement (average values for subsequent measurements were as follows: 24.66, 25.28, 26.79 and 27.13, 27.58, 29,30 in the case of SS and CI, respectively), although differences were not statistically significant (using analysis of variance and post-hoc tests). The results of the measurement of the two parameters increased with time so the largest difference was between measurement carried out in time zero and one week after (24.66 relative to 26.79 for SS and for CI 27.13 relative to 29.30). In case of the remaining three parameters (TK, LL, HP) we could not find such a trend.

Conclusions and significance: The variability of the body posture of children over time was observed in the study, but the results did not affect significantly the values of all five sagittal profile parameters. Only the one week measurement differed from the zero and the one hour measurement for SS and CI angles, but without significance. Digital photography can be considered for postural screening.

O26.68 Method of measuring axial pelvic rotation – pilot study

Pavel Cerny 1,2,3, Lukasz Stolinski, Dariusz Czaprowski, Ivo Marik, Tomasz Kotwicki

1Faculty of Health Studies, University of West Bohemia, Pilsen, 2Faculty of Physical Education and Sport, Charles University, Prague, 3ORTOTIKA, s. r. o., the complex of the Faculty Hospital at Motol, Prague - Czech Rep

Introduction: Clinical examination, together with antero-posterior (AP) and lateral spine X-rays are standard examination of scoliosis. Rotation of the spinal column is usually identified by measuring axial rotation angles of individual vertebrae from AP X-ray. The position of the pelvis significantly influences the local or regional readings obtained from measuring the axial rotation of vertebrae from AP X-rays, particularly in the lumbar section.

Objectives: The aim of the study was to develop a method to identify the axial rotation of the pelvis from PA photograph.

Methods: A purely graphic principle which does not require the use of any other aids was developed and used to measure axial pelvic rotation form the patient photograph. The method uses the contour of the width of the patient’s hips and the position of the proximal part of gluteal crease. The digital scans were processed using a freely available software “SCODIAC”.

Results and discussion: The method of measuring pelvic rotation using the widths of projections of pelvic blades was successfully used to identify pelvic rotation from a photograph. In the first stage examination of the photographs comprised six persons (2 males, 4 females), aged 11-58 years. The relevant
readings were measured in a physiological posture of the pelvis for the pelvic rotations ranging from 0° to 30°; SD = 1.8.

The method of reading the photographs requires a visible contour of the patient’s hips, including the proximal part of the gluteal crease. Using the presented method it is easy to identify the axial pelvic rotation. Examination of the axial position of the pelvic appears to be effective particularly when examination of the same patient over successive time segments is performed.

The method will be gradually checked on more representative group of individuals.

Conclusion and significance: The study presents the possibility of measuring axial pelvic rotation using photographs. The models, measurements and description show that this is relevant, simple and relatively accurate method, which can also be applied in combination with other commonly used methods in clinical practice in patients who exhibit axial pelvic posture variability over time.

O27.59 Cortical sensorimotor information processing associated with postural control in adolescents with idiopathic scoliosis and in healthy adolescents: preliminary results

Jean-Philippe Pialasse, Martin Simoneau, Inga Sophia Knoth, Sarah Lippé, Carole Fortin.

Université de Montréal - Canada

Introduction: The etiopathogenesis of adolescent idiopathic scoliosis (AIS) still remains unclear with multifactorial hypothesis including central nervous system abnormalities. Interestingly, altered sensory cortical processing and abnormal connectivity of cortical network were found in AIS compared to controls by Cheng’s group. Previously our group showed poorer balance control during sensory alteration, and difficulty in reweighting sensory inputs suggesting a dysfunction of the central mechanisms performing sensorimotor processing in AIS. Recently, electroencephalography (EEG) has been used to study cortical sensorimotor information processing associated with postural control. This study uses alpha band event-related desynchronization (ERD) to assess cortical activation patterns associated with postural control in AIS and in healthy adolescents (HA).

Objectives: The general objective of this project is to measure cortical activation patterns, using EEG, associated with sensorimotor information processing related to postural control in different sensory conditions in adolescents with AIS compared to HA.
Methods: 12 girls with a 15 to 45° idiopathic scoliosis (13±1 years, 162±7 cm, 51±10 kg) and 11 age-matched HA girls (13±1 years, 160±4 cm, 51±8 kg) were recruited on two sites. Participants stand quietly on a force platform. They underwent, with their eyes closed, 25 trials lasting 30 s in three equal length epochs: 1) baseline: quiet standing, 2) sensory manipulation: ankle proprioception altered by deep tendon vibration at 80Hz and 3) sensory reintegration after the end of vibration. EEG data were registered from an Electrical Geodesic system. Data were processed using Matlab and EEGLAB. After EEG signal preprocessing, isolation of alpha waves was done from epochs based on 1s before and 2s after the beginning and the end of vibration to single out brain activation during sensory transition. Signal was filtered using a FIR bandpass filter at 8-12Hz, then was squared before doing the mean of all epochs. ERD were calculated as a negative value of percentage of (signal - baseline)/baseline *100.

Results: In the sensory manipulation condition, both groups experienced alpha ERD (-46 to -61%) at C3 and C4 peaking at 250-350 ms after the beginning of the vibration, but no statistical difference between groups. In the sensory reintegration epoch, patients presented a more pronounced alpha ERD at C3 and C4 compared to HA (C3-ERD: AIS: -56%; HC: -35%, p=0.02; C4-ERD: AIS: -54%; HC: -42%, p=0.047) at about 250 ms.

Conclusions and Significance: A primary analysis of the cortical activities shows group difference in the alpha ERD while ankle proprioception is altered. Furthermore, the same situation was observed when stopping the vibration, with a more pronounced alpha ERD for AIS patients with AIS. This represents a more important neural activity to maintain balance suggesting a link between scoliosis and somatosensory transformation impairment.

O28.28 Test-retest repeatability of the upright standing posture among adolescents with idiopathic scoliosis

Pierre-Henri Heitz¹, Jean-François Aubin-Fournier ², Eric Parent³, Carole Fortin¹.

¹Université de Montréal, École de réadaptation, ²Centre de réadaptation Marie-Enfant du CHU Sainte-Justine, ³Department of Physical Therapy, University of Alberta, Edmonton, Alberta, T6G2G4 - Canada

Introduction: Posture asymmetry is a major consequence in idiopathic scoliosis (IS). Posture asymmetry can lead to curve progression and also, psychosocial and physical impairment among adolescents with IS. Therefore, it is important to assess posture and posture evolution through time or following treatments. Yet, reproducibility of posture in time among adolescents with IS remains unknown.

Objective: The purpose of this study was to assess test-retest reproducibility of the upright standing posture among adolescents with IS using the clinical photographic postural assessment tool (CPPAT).

Methods: Thirty participants with IS between 10 and 17 years old, a Risser lower than four and a Cobb angle between 15 and 45° were recruited at the CHU Sainte-Justine of Montreal and the Stollery Children’s Hospital of Edmonton. Each participant had their upright standing posture assessed at two occasions. Assessments were separated by five to ten days. Posture assessment was realized using the CPPAT developed and validated by Fortin and al. (Spine, 2010 and Physiotherapy, 2012). Twenty-five posture indices of the head and trunk were obtained. Generalizability theory was used to determine sources of variance (G study) and estimate test-retest reliability (D...
study) with dependability coefficients (DC) computed with one occasion, absolute standard error of measurement (SEM) and minimal detectable change (MDC90). Trials were fixed (mean of two trials) since test-retest repeatability was the objective of the study.

**Results:** The main source of variance was generated by subjects (50 to 99%) for all posture indices. Interaction between subjects and trials and, the residual error were important sources of variance for sagittal gaze angle, sagittal trunk list and frontal pelvic tilt. Variation components for test occasion, trials and interactions between trials and occasions were lower than 2% for all posture indices. All posture indices had good level of reliability (DC> 0.80) except sagittal trunk list (DC = 0.50). The SEM’s values ranged from 0.4 to 2.6 degrees for angle measurements and 3.4 to 9.6 millimeters for linear measurements. The MDC90 values ranged from 0.9 to 6 degrees for angle measurements and 7 to 23 millimeters for linear measurements. The MDC90 values were larger for left sagittal trunk list and left gaze. The most reproducible posture indices were frontal pelvic tilt and waist angle asymmetry.

**Conclusion:** Most posture indices are reproducible among adolescents with IS indicating a good reproducibility of head and trunk posture in time. Values of MDC (90) calculated in this study may be used to objectively assess the effects of physiotherapy interventions on posture in adolescent with IS using the CPPAT. Future studies will demonstrate if these findings are useful to quantify the impact of physiotherapy interventions or to scoliosis progression on posture.

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**O29.77 Normative data of 3D back shape in asymptomatic subjects**

Josette Bettany-Saltikov¹, Gokulakannan Kandasamy¹, Sanja Schreiber ᵃ, Łukasz Stolinski ³, Dariusz Czaprowski ⁴, Julian Warren ¹.

¹Teesside University - UK, ²University of Alberta - Canada, ³University of Medical Sciences, Poznan- Poland, ⁴Kierownik Centrum Postawy Ciała Wydział Fizjoterapii Olszynska Szkoła

**Introduction:** Abnormalities of posture are a common cause of pain and disability. The range of effect from discomfort to incapacitating disability is related both to the severity as well as to the persistence of the faults. Objective measurement systems for postural evaluation are not widely accessible in the UK. Within physiotherapy practice one of the most common methods of assessing posture or back shape is by visual observation which is prone to error and lacks objectivity. However, little is known on normative values of back shape parameters.

**Objective(s):** The study has sought to produce normative values for back shape and posture indices in young asymptomatic adults using the 3D accurate Middlesbrough Integrated Digital Assessment System (MIDAS).

**Methods:** A descriptive observational study was conducted using a convenience sample of 100 students. Ethical approval was granted by Teesside University. The MIDAS system were used for acquiring a static 3-D computer recording of a physical object. Data collection involved the tester touching the MIDAS stylus tip to each of the marked points in a standardized order dictated by the software and pressing the foot pedal of the MIDAS to store the position on the computer. Data was analysed using the dependant and independent ‘t’ test.
Results and Discussions: There were 59 females and 41 males. In the frontal plane the only differences found were between the two sides of the back in females where the distance between the acromion and the inferior scapular angle differed. The right side distance being significantly smaller than left. The distance between the inferior angle of the scapula and the apical thoracic vertebrae was also significantly greater on the right side of the back than the left. No other significant differences in distances between key landmarks were found in female and male subjects. The mean frontal plane angles values showed that overall healthy young females have relatively straight spines with the thoracic spinal value and lumbar curve recorded as 2.38° and 1.65° respectively. In the horizontal plane (rotation) the left inferior angle of the scapula in females was found to be rotated anteriorly in comparison to the right shoulder. No other statistically significant differences were found. Average sagittal plane curvatures values for female subjects were 29.37° for thoracic kyphosis and -37.7° for lumbar lordosis. Overall young adults are very symmetrical. Results will provide a normative database for clinicians (physiotherapists, chiropractors, spinal surgeons) who routinely assess back posture.

Conclusions and Significance: The method of assessment will also provide an evidenced based objective alternative to other crude methods of assessment or just “eyeballing” back posture during clinical evaluation. Accurate recording of intervention or efficacy of treatment, if scientifically based on reliable measures can be used to credibly validate treatment effectiveness.
more balanced and involves a lower degree of muscle activity in terms of sEMG signals compared to their circumstances prior to the training. More importantly, 7 out of 12 of the subjects demonstrate a decrease in their spinal deformity after the training. Four have spinal curvature that is under control, and 1 has a progression of spinal curvature that is more than 5°.

Conclusion: It is concluded that the sensors accommodated tank top can motivate patients to adopt a more active role, thus more effectively improving their control and coordination of movement and daily posture.

O31.27 Does conservative treatment affect postural stability in adolescent idiopathic scoliosis?

Gozde Gur 1, Yavuz Yakut 2

1 Hacettepe University, 2 Hasan Kalyoncu University- Turkey

Introduction: Postural stability organizes orientation and equilibrium of the body in upright posture and functional activities. Previous researches found poorer postural stability in patients with adolescent idiopathic scoliosis (AIS) compared with healthy children. We hypothesized that conservative treatment may affect postural stability in patients with AIS.

Objectives: The aim of this study was to investigate the effects of one-year conservative treatment including bracing and exercise therapy on postural stability in patients with AIS.

Methods: Eighteen female patients with AIS (mean age 14.1±0.9 years, Risser sign 2.6) were included in this study. All patients had double curves (right thoracic and left lumbar) and average Cobb angle of patients was 25.1±7.6° for the thoracic and 22.5±8.7° for the lumbar regions. Patients received one year treatment program comprising bracing and exercise. The postural stability was tested with sensory organization test protocol of Computerized Dynamic Posturography Device. The measurements were conducted at baseline and at the end of the one-year treatment period. Results were analyzed using the Wilcoxon Signed Rank Test to compare repeated measurements at two different time points.

Results: Greater equilibrium scores were found in the “eyes closed, stable support”, “eyes closed, swayed support” and “swayed vision, swayed support” conditions (p < 0.05). Composite equilibrium scores statistically improved with treatment (p < 0.05).

Conclusions and Significance: This study demonstrated that conservative treatment, combination of bracing and exercise therapy, provided improvement in postural stability in AIS patients with double curves. Further studies are needed to investigate the effects of different therapies on postural stability in AIS.
O32.29 Spine Posture Detection and Correction Using Active and Passive Biofeedback

Jorge Caviedes¹, Anthony Pivonka ²

¹Arizona State University, School of computer and energy engineering. ²Pivonka Chiropractic, USA

Introduction: Scoliosis, or the sideways curvature of the spine, is a condition that requires lifelong treatment with a variety of options depending on the extent, age, and fitness of the patient. Diagnosis is based on radiological and muscle-skeletal assessment. Among the non-invasive approaches, active methods are exercise based, while passive methods use bracing. This proposal addresses the need to monitor therapeutic exercise execution and posture using a stretch sensor array, and enabling a biofeedback mechanism.

Design and Objective: The three main system components are: (i) a triangular stretch sensor array with vertices at the shoulder blades and the lower back near L3-L4, (ii) a wireless data collection app, and (iii) off-line data analysis and evaluation tools. The objective of the design is to monitor corrective exercise therapy and provide biofeedback during and at the end of the exercise. Typically exercise is done pre-bracing as a corrective therapy, under therapist supervision or in conjunction with bracing.

Materials and Method: The sensor array consists of 3 fabric sensors connected to a wireless transmitter. The sensors are 120mmx20mmx2mm with 10mm Velcro at each end. The array is worn attached to a light garment made of elastic bands which allow attaching the vertices of the sensor array over the shoulders and lower back. The wireless data communication captures data every 0.01Sec, and writes a log which can be imported by other software for analysis.

The corrective exercise we tested is for a patient presenting a double curve, upper to the left and lower to the right consisting of the following four movements:

1. The first movement is a right lateral bend in the lumbar spine which also raises the left shoulder. The dominant effect is a stretch of the between lower spine and left shoulder.
2. The second movement is lower rib cage rotation to the right (clockwise looking from the top). This puts some mild stretch on the sensor between the right shoulder and the lower back.
3. The third movement rotates the upper rib cage to the left against lower rib cage. This causes stretch of the sensor between the shoulders.
4. And the last movement is a left lateral bend in thoracic spine to level the shoulders.

Results and Discussion: The sensor data exhibits a visually recognizable pattern, and a high correlation among correct instances, which suggests that the temporal pattern across time can be used to provide feedback during execution.

A mathematical function termed scoliosis correction coefficient was also investigated. SCC is a function of the 3 sensor values, and can be designed to reflect the geometrical properties of the triangle such that an ideal target value can be set for each patient.
Conclusion and Significance: Scoliosis exercise therapy and postural training are crucial methods without which interventional approaches such as hard and soft bracing may not succeed as they enable the patient to develop corrective habits that need to become lifetime routines. A wearable system based on stretch sensors which can be built into regular garments with wireless communication to mobile devices including smart phones would be an important development, considering its potential to provide biofeedback during and at the end of the exercise, as well as postural correctness during regular activity. Initial results suggest the viability of such method. There is also high potential to develop a smart coaching assistant based on short and long term trends as well as prognosis in terms of expected health benefits.

O33.90 Rigo system Chêneau brace in adolescent idiopathic scoliosis: radiographic predictors of curve progression

Anas Minkara, John Tunney, Michael Vitale
Columbia University - USA

Introduction: The Rigo System Cheneau (RSC) is a three-dimensional correctional brace which allows for detorsion and sagittal plane normalization, leading to correction in all three planes. Although the effectiveness of bracing for patients with AIS was shown by the BRAIST study, radiographic predictors of curve progression have not been well-described.

Objective: The purpose of this study was to determine whether radiologic parameters can predict curve progression in patients with AIS treated with RSC.

Methods: This is a retrospective cohort study including patients with AIS who underwent bracing at an academic institution between September 2013 and August 2015. The SRS Committee on Bracing and Nonoperative Management inclusion criteria were utilized: age ≥ 10 years, Sanders stage 4 or less, and a primary curve angle between 25 degrees to 40 degrees. Progression was defined as an increase in curve magnitude >5 degrees. Radiologic parameters including major and minor coronal curves, coronal balance, overall balance summation (OBS, defined as net lateral deviation of all curves from the central sacral line), sagittal balance, lordosis, kyphosis, and pelvic obliquity were collected prior to bracing, at 3 months, 6 months, and 1 year, and 1.5 years. The Spinal Deformity Study Group Measurement manual definitions were utilized.

Results: A total of 50 consecutive patients who received RSC bracing were identified. The mean age was 13.0 (10.1 - 16.7) and 76% were female. Curve progression was observed in 36% (18) at 6 months and 1 year, and 40% (20) at 1.5 years. Pre-bracing coronal balance and OBS was not correlated with major curve progression at any time interval. However, an OBS >10 was significantly associated with minor curve progression at 1 year and 1.5 years (p=0.041, p=0.007 respectively). No sagittal parameters, including pelvic incidence or sagittal balance, were associated with curve progression at any time interval.

Conclusion and Significance: OBS, a novel measurement which quantifies the net lateral deviation of all curves in the coronal plane in relation to the central sacral line, is not correlated with major coronal curve progression in patients with AIS undergoing bracing. Other coronal and sagittal radiologic parameters, including coronal balance and pelvic incidence, are not correlated with curve progression. Further studies with long term follow-up will assess the utility of these radiographic variables in determining curve progression and progression to surgical intervention.
O35.79 A novel 3D imaging, mobile and surface topography APP for measuring 3D back and body shape: an intra and inter-rater reliability study

Gokulakannan Kandasamy, Josette Bettany Saltikov, Iain Spears, Teesside University - UK

Introduction: Spinal pain is an extremely common musculoskeletal symptom caused by multiple factors. Postural/spinal deformity is one of the cause that contributes to spinal pain for example: scoliosis, hyper kyphosis as well as marked back asymmetries. These lead to abnormal stress and loading on spinal musculoskeletal structures. To date numerous non-radiographic surface measurement methods for the detection of back shape and posture have been developed e.g. Quantec and ISIS 2. However most of this equipment either laboratory based, very expensive, heavy to move, and can only measure the back. There is demand for a low cost, portable, mobile back shape measurement system. This will allow an extended assessment of full back shape measurement in all planes within the clinical environment.

Objective(s): The objective of this study is to present a novel and highly portable method for assessing whole body posture. A further objective is to present the reliability and repeatability of the system to determine its applicability for assessing back and full body shape in normal subjects and patients with spinal deformities.

Method(s): Healthy adults (n=16) participated in this study. Instrumentation: In this study we have used the commercially available IPad based 3D mobile scanning tool ‘Structure SensorTM’ to capture the shape of the back as well as the whole participants’ body. This sensor consists of two different cameras (Color video (red-blue-green) and the depth camera). This sensor along with the normal IPad camera provides real-time anatomical landmarks and reconstructs the whole back and body shape using the triangulation method.

Procedure: For each subject, three trials of standing back and body posture were individually measured by two raters on two separate occasions. The data was then processed in the open source software and back shapes was manually measured by both the raters.

Results and Discussion: Pearson’s Correlation test estimated the reliability and standard error of measurement for the overall, test–retest and inter-rater designs. Bland and Altman’s method was used to document agreement between sessions and raters. Good intra and inter reliability was found.

Conclusions and Significance: Given that it is inexpensive, extremely portable and very simple to setup, this tool has got a high potential to be used within clinical practice for monitoring spinal deformity. This will reduce dependence on serial radiography and reduce radiation exposure to patients with postural disorders and spinal deformities.
O36.25 Reliability of curve angle and vertebral rotation measurements from 3D ultrasound images of patients with AIS performing Scoliosis-Specific-Exercises

Alex Su1, Eric C. Parent1, Edmond Lou2,3

1Department of Physical Therapy, University of Alberta, Edmonton, Alberta, 2 Department of Surgery, University of Alberta, Edmonton, Alberta, 3Alberta Health Services, Edmonton, Alberta, Canada.

Introduction: A validated 3D ultrasound (US) imaging protocol to non-invasively quantify spinal alignment allows studying the immediate effects of exercise. The center of laminae (COL) method yields reliable spinal curvature and rotation measurements from images acquired in standing with a stabilizing frame. Reliability should also be determined for other acquisition positions before studying scoliosis-specific exercises (SSE).

Objectives: To determine the intra-rater reliability of curve angle and vertebral rotation (VR) measurements from 3D US images of patients with AIS performing prone and sitting SSE.

Methods: In a single imaging session, 10 consecutive female volunteers with AIS, ages 15±3 years, recruited from an exercise trial, presenting eight 4CP, one 4C, and one 3CP Schroth curve type, were imaged in three positions using a 3D US imager with orientation tracking. Inclusion criteria were: 10 to 18 years of age, completion of at least three months of Schroth exercise training, Cobb angles of 10 to 45 degrees, and with or without a brace. Exclusion criteria were having undergone any torso, or lower limb surgery. Images were acquired in: natural standing using a stabilizing frame, prone with passive and active Schroth auto-corrections with psoas activation, and sitting with active auto-corrections with psoas activation. A certified Schroth therapist guided exercises. Images were analysed using custom Matlab software by a novice rater digitizing the COL to extract the curve angle and VR above, at, and below the apex of each curve. Images were analyzed twice with one week separation. Reliability was estimated using intra-class correlation coefficient (ICC[3,1]) and standard error of measurement (SEM).

Results: Four images in sitting, none in standing or prone, were excluded due to sagittal discontinuity motion artifacts. Seven, ten and six thoracic, and nine, four and five lumbar curves were identified for standing, prone, and sitting positions, respectively. Mean curve angles in standing were 19.5±8.6 degrees for thoracic and 23.3±10.9 degrees for lumbar curves, respectively. The intra-rater ICCs for the thoracic and lumbar curve angles were high and SEMs small in all three positions (ICC=0.97-0.98, SEM=0.9-1.5 degrees). High intra-rater ICCs and small SEMs were also observed for VR measurements in all three positions above, at, and below the level of the apex for both thoracic and lumbar curves (ICC=0.91-1.00, SEM=0.4-1.4 degrees); the only exception was the level above the thoracic apex in sitting (ICC=0.78, SEM =1.1 degrees).

Conclusion: In all but one images without motion artifact, reliability estimates were sufficiently high for use with individual patients (ICC>0.90) and all were adequate for research on the immediate effect of SSE (ICC>0.70). The exception may have been due to difficulty in landmarking the COL due a local motion artifact not detected in the sagittal profile. Significance: Non-invasive 3D US imaging provides adequate reliability to study the immediate effects of conservative interventions for AIS. Repeated scans may minimize motion artifact issues.
O37.66 The immediate effect of Schroth Scoliosis-Specific exercises in prone position in trained adolescents with idiopathic scoliosis measured using 3D ultrasound imaging

Eric C. Parent1, Alex Su1, Edmond Lou2,3, Sanja Schreiber1

1Department of Physical Therapy, University of Alberta, Edmonton, Alberta; 2Department of Surgery, University of Alberta, Edmonton, Alberta; 3Alberta Health Services, Edmonton, Alberta, Canada.

Introduction: Physiotherapeutic scoliosis-specific exercises (PSSE) show promise to prevent curve progression in adolescents with idiopathic scoliosis (AIS). PSSEs require complex auto-corrections and there is skepticism about the amount of auto-correction that patient can achieve. Immediate in-brace correction is predictive of long-term outcomes and this may also be true with exercises. A novel validated 3D ultrasound (US) imaging protocol allows to non-invasively quantify spinal alignment while performing exercise.

Objective: The aim was to determine the immediate effect of Schroth PSSE performed in the prone position on curve angles in participants with AIS previously trained in PSSE.

Methods: Ten consecutive female volunteers with AIS were recruited from those having completed at least three months of exercise training in the Schroth Exercise Trial for Scoliosis (SETS). SETS trial inclusion criteria were: 10 to 18 years of age, Cobb angles of 10 to 45o, and with or without a brace. Exclusion criteria were having undergone any torso, or lower limb surgery. Participants were imaged using a 3D US imager with position and orientation tracking during a single session in natural standing (using a frame stabilizing shoulders and pelvis), and prone position (passive and active Schroth corrections and psoas activation). A US scan was performed along the spinous processes from C7 to L5. A Schroth therapist guided exercises. Images were analysed using custom software. A novice rater trained with test images before digitizing the center of the laminae to extract the curve angle for each curve. Differences between positions were compared using paired T-test. Percent correction was estimated for each curve.

Results: Mean age was 15±1 (range 12-21) year old at time of testing. All but one participant also received brace treatment. Schroth curve types included: 4CP (n=8), 4C (n=1) and 3CP (n=1). Eight thoracic, and 9 lumbar curves measured over 10o in standing. Nevertheless, a thoracic and lumbar curve was measured for all 10 participants. Thoracic curve angles in standing (16±9o) were significantly (p=0.047) reduced with the prone exercise (7±14o) by a median of 31% (range +10%; -257%). Lumbar curve angles in standing (21±12o) were significantly (p<0.001) reduced with the prone exercise (2±12o) by a median of 77% (range 44%; 290%). All but 2 participants achieved over 50% lumbar curve correction with the prone exercise.

Conclusion: This study provided preliminary evidence of the validity of Schroth PSSE prone exercise positioning and active correction instructions by demonstrating that all patients achieved at least 50% correction for at least one curve. Significance: Studying immediate correction achievable using exercise instructions will help refine how we teach exercises to patients and therapists to achieve optimal correction. Future research will determine if the ability to autocorrect at different stages of the exercise therapy predicts long-term outcomes.
O38.45 A Reliable Ultrasound Imaging Method to Determine Curve Flexibility to Estimate In-Brace Correction

Edmond Lou 1, Doug Hill 2, Rui Zheng 1, Andreas Donauer 2, Melissa Tilburn 2, Jim Raso 2

1 University of Alberta, 2 Alberta Health Services - Canada

Introduction: Spinal flexibility affects both the in-brace correction and consequently how orthotists design braces for children with adolescent idiopathic scoliosis (AIS). More flexible spines should be better corrected in a brace which in turn should lead to better long term outcomes. However, there is no standard method to assess spinal flexibility, especially for brace candidates. Recently, ultrasound (US) spinal imaging has been shown to be capable of measuring proxy Cobb angles accurately and reliably.

Objectives: To determine how spinal flexibility measured used US techniques correlates with in-brace correction.

Methods: Nine AIS participants who were prescribed full-time TLSO participated in this on-going study. All the participants satisfied the inclusion criteria specified by the SOSORT brace management guidelines. Local ethics approval was received and all participants signed consent forms prior to participation. During the casting clinic, participants were scanned with ultrasound in standing, prone, left bending prone and right bending prone positions. For prone bending, participants were asked to bend maximally to each side while keeping their hips level and both shoulders in contact with the bed. Left and right sides bending was used to assess flexibility of left and right sided curves, respectively. An in-house program was used to reconstruct, display and measure proxy Cobb angles in real-time. Correlation and linear regression methods were used to analyze the inbrace correction and ultrasound-based spinal flexibility: 1) the change from standing to prone Cobb angle (lying flexibility) and 2) the change from normal prone to the maximal side bending prone (bending flexibility).

Results: Nine girls (age 10 to 14.2 years old) with 15 curves ranging from 21º to 43º (29.4º ± 6.8º) participated. The correlation of the lying and bending flexibilities with the in-brace correction were 0.44 and 0.75, respectively. From the linear regression analysis, both the lying and bending flexibility showed statistically significance with p < 0.05 and the adjusted r² was 0.75. The linear regression found an equation: in-brace correction (%) = 0.280 + 0.667 * lying flexibility (%) + 0.346 * bending flexibility (%) with significance of 0.0003. The residual of the in-brace correction was 0.0±8.7% with ranging from -15.0% to 14.6%.

Conclusions: Although the sample size is small, initial results show that the in-brace correction was highly correlated to the spinal flexibility. Using both lying and bending flexibilities information could estimate the in-brace correction reliably. Significance: Knowledge of the potential in-brace correction influences how a spine brace is designed and when it should be modified to improve correction. Ultrasound imaging provides radiation-free real-time measures of spinal flexibility which can be used to accurately estimate the in-brace correction.
O39.15 Diurnal variation of body height in children with idiopathic scoliosis

Dariusz Czaprowski 1, Marcin Tyrakowski 2, Justyna Bloda 1, Jakub Was 1, Anna Dembinska 3, Paulina Ewertowska 1, Tomasz Kotwicki 4

1 Department of Physiotherapy, Józef Rusiecki University College in Olsztyn, 2 Department of Orthopedics, Pediatric Orthopedics and Traumatology, 3 Department of Rehabilitation, The Voivodeship Rehabilitation Hospital For Children, 4 Department of Spine Disorders and Pediatric Orthopedics, University of Medical Sciences, Poznan - Poland

Introduction: The measurement of body height (BH) is an important part of clinical evaluation of children with idiopathic scoliosis (IS) as its progression is defined based on the observation of the growth spurt. The reliability of the assessment of the height may be limited by the high measurement error. One of the important source of measurement error is physiological diurnal variation of body height.

Objective: The aim of the study is to assess diurnal variation of body height in children with idiopathic scoliosis.

Methods: The study included 98 consecutive non-operatively treated patients with IS (82 females, 16 males, age 9-18 years, mean 14.4±1.8, Cobb 10°-52°, mean 21.2°±9.9). There were 22 patients with right thoracic (T), 35 with left thoracolumbar (TL), 20 with left lumbar (L) and 21 with double-curve thoracic and lumbar (DTL) scoliosis. BH was measured using a wall-mounted stadiometer in standardized standing and sitting positions. The measurements were performed 4 times a day: (1) just after getting-up between 7:00 and 8:00 - M1; (2) between 11:00 and 12:00 - M2; (3) between 15:00 and 16:00 - M3 and (4) between 19:00 and 20:00 - M4. All of the measurements were performed by the same observer. The subjects did not participate in any type of therapy or physical activity on the day of measurements. In the statistical analysis the description statistics and repeated measures ANOVA were used. The value alpha<0.05 was adopted as the level of significance while CI for estimates was 0.95%.

Results: A significant decrease in BH was observed in the entire group of patients: 164.7 ±10.7 cm (M1) vs. 164.2 ±10.7 cm (M2) vs. 164.1 ±10.6 cm (M3) vs. 164.0 ±10.7 cm (M4), p<0.001 and 85.9 ±5.6 cm (M1) vs. 85.5 ±5.7 cm (M2) vs. 85.3 ±5.6 cm (M3) vs. 85.2 ±5.5 cm (M4), p<0.001 for standing and sitting positions, respectively. The daily differences in BH ranged from +3.0 cm to -4.0 cm and from +2.5 cm to -1.5 cm, for standing and sitting, respectively.

The highest decrease in height was observed between measurements performed just after getting-up (7:00-8:00) and measurements carried out in the evening (19:00-20:00). For standing, the mean loss of height was 0.72 cm (±0.7), which equals 0.43% of initial standing height, while for sitting the mean decrease in height was 0.69 cm (±0.7), which stated 0.79% of initial sitting height.

The same pattern of changes in BH was observed for T, TL, DTL (standing and sitting, p<0.001) and L (standing, p<0.001). Only BH measured in sitting position in patients with L the differences were insignificant (86.4 ±6.3 cm vs. 86.1 ±6.4 cm vs. 85.9 ±6.4 cm vs. 86.1 ±6.4 cm, p=0.09).

Conclusions and significance: The body height decreases in children and adolescents with IS during daytime. Due to diurnal body height variation the time of the day should be recorded when measuring patients with idiopathic scoliosis. Study design: A cross sectional study, Level of evidence: IV
O40.84 Diurnal variation of angle of trunk rotation in children and adolescents with idiopathic scoliosis

Justyna Bloda¹, Dariusz Czaprowski², Jakub Was², Paulina Ewertowska³, Anna Dembinska⁴, Tomasz Kotwicki⁵

¹ Department of Physical Education, Józef Piłsudski University of Physical Education, Warsaw, ² Department of Physiotherapy, Józef Rusiecki University College, Olsztyn, ³ Department of Rehabilitation and Kinesiology, Jędrzej Śniadecki University of Physical Education, Gdansk, ⁴ The Voivodeship Rehabilitation Hospital for Children in Ameryka, ⁵ Department of Spine Disorders and Pediatric Orthopedics, University of Medical Sciences, Poznan, Poland

Introduction: The measurement of angle of trunk rotation (ATR) is a basic clinical parameter for monitoring idiopathic scoliosis (IS) history and evaluation of treatment effects. It is also an important element of screening for children and adolescents in early detection of IS. Measurement error need to be taken into account during ATR results interpretation. One of factors effecting a value of ATR measurement may be time of the day of examination. The purpose of this study was the assess of diurnal variation of ATR in children and adolescents with idiopathic scoliosis (IS).

Methods: The study included 124 children (104 females, 20 males) aged 9-18 years (mean 14.4 ±1.9). All children were diagnosed with IS with mean Cobb angle 22.0°±11.8° and 19.2° ±9.1° for thoracic and thoraco-lumbar/lumbar curvature, respectively. Overall number of curvatures was: 64 for thoracic and 92 for thoraco-lumbar/lumbar part. ATR was measured using Bunnell scoliometer during trunk flexion performed in standing position (Adams test). Maximal value of ATR was evaluated in proximalal thoracic (Th1-Th4), main thoracic (Th5-Th12) and lumbar spine (L1-L5).

ATR measurement was made 4 times a day: (1) 7:00-8:00, (2) 11:00-12:00, (3) 15:00-16:00, and (4) 19:00-20:00. During this day children were free from any exercises and physiotherapy.

For each subject and at each level of the spine (proximal thoracic, main thoracic and lumbar) the differences (changes) between values of ATR for each of 4 measurements were calculated. The maximum difference was designated as maximum daily variability of ATR (Δ ATR).

Result: The pilot study revealed excellent reliability of the measurements for proximal thoracic (ICC 0,925), main thoracic (ICC 0,991) and for lumbar spine (ICC 0,985). The error of measurement was 1,3°, 2,0° and 2,1° for proximal thoracic, main thoracic and lumbar spine, respectively.

There were no significant differences between values of change of ATR for each of 4 measurements for proximal (p=0,234) and main thoracic spine (p=0,406). Significant differences between values of change of ATR during the day were observed for lumbar spine (p=0,004).

In 58,1% of subjects Δ ATR was equal to or greater than 3°. There were no significant differences between Δ ATR for: (1) single and double curve scoliosis (p=0,253), (2) thoracic and thoracolumbar/lumbar curve (p=0,266), (3) scoliosis smaller than 25° and equal to or greater than 25° according to Cobb (p=0,933), (4) the value of Risser test 0-2 and 3-5 (p=0,853).
Conclusion: The time of day doesn’t affect the value of ATR in proximal and main thoracic spine. Significant changes of value of ATR during the day occur in the lumbar spine. Diurnal variation of ATR is not related to scoliosis parameters such as: number of curvatures, type of scoliosis, Cobb angle value and skeletal maturity.

Significance: In most subjects differences between measurements are equal to or greater than 3° therefore it is necessary for clinical practice to take into account the time of day at which ATR measurements are taken.

O41.16 What happened in 2 years after so-called skeletal maturity

Toru Maruyama, Yosuke Kobayashi, Yusuke Nakao
Saitama Medical University - Japan

Background: By the Scoliosis Research Society (SRS), skeletal maturity is defined when <1cm change in standing height has occurred on measurements made on 2 consecutive visits 6 months apart.

Design and Objectives: Retrospective database analysis. In order to verify the validity of this SRS’s definition, characteristics of the patients at skeletal maturity defined by the SRS and what happened in 2 years after skeletal maturity were investigated

Materials and Methods: Subjects of the study were patients with adolescent idiopathic scoliosis (AIS) who were undergoing brace treatment, scoliosis specific exercise treatment, or observation. The age, Risser sign, body height, and Cobb angle of the patients when they reached skeletal maturity and at 2 years after skeletal maturity were investigated. Additionally, the age of the patients when they were diagnosed as Risser IV or V for the first time was investigated.

Results: A total of 160 AIS patients were included in the analysis. There were 149 females, 102 of them underwent brace treatment and 11 males, 7 of them underwent brace treatment. At the time when the patients reached skeletal maturity, their median age was 14.7 years (female 14.5 years and male 16.4 years) and Risser sign was 0 in 2, I in 8, II in 10, III in 2, IV in 77 and V in 61 patients. Of whom 62 patients (59 females and 3 males) could be followed for more than 2 years after skeletal maturity. During about 2 years after skeletal maturity, body height changed from 156.5 cm to 157.5 cm, and Cobb angle changed from 34.8 degrees to 35.3 degrees. Cobb angle of 7 patients (all female, four of them underwent brace treatment) increased in more than 5 degrees during this period. On the other hand, 6 patients (all female, all underwent brace treatment) decreased in more than 5 degrees during the same period. Body height of 12 patients (11 females and 1 male) increased in more than 2 cm in 2 years after skeletal maturity: Risser sign of these 12 patients at skeletal maturity was I in 1, II in 3, III in 1, IV in 6 and V in 1 patient. The age when the female patients were diagnosed as Risser IV or V for the first time was, 13.8 years and 15.4 years, respectively.

Conclusions: Definition of skeletal maturity by the SRS was valid in general, but body height still increased in 1 cm after that. An attention should be paid for the patients whose curve still progresses even after skeletal maturity.
O42.72 Non-fusion Growth Modulation with Anterior Vertebral Body Tethering for Adolescent Idiopathic Scoliosis: A Promising Minimal Invasive Alternative to Traditional Treatment

Barbaros Ömer Cebeci1, Gokhan Ergene2, Nuray Sogunmez3, Ufuk Ozsoy2, Caglar Yilgor4, Ahmet Alanay1

1Acibadem University School of Medicine, 2Acibadem Maslak Hospital, Department of Thoracic Surgery, 3Comprehensive Spine Center, Acibadem Maslak Hospital, 4Acibadem University, Department of Orthopedics and Traumatology -Turkey

Introduction: Anterior vertebral body tethering (VBT) is a thoracoscopic minimal-invasive approach where screws are inserted on the convexity of vertebral bodies and a polyethylene tether is attached and tightened. Convexity curve compression inhibits growth at this site while allowing concave growth according to Heuter-Volkmann principle. As such, VBT modulates spinal growth providing additional spontaneous curve correction during follow-up (f/up) in patients with remaining growth potential. Objective: To report the single surgeon experience of the first 12 cases that had undergone VBT.

Methods: A descriptive analysis was done on prospectively collected data. VBT indications were; <60° progressive major thoracic curves and Risser ≤3. Coronal and sagittal measurements were done in pre-operative and post-operative first-erect, 6-weeks, 3, 6, 9, 12, 18, 24 and 36-months f/up radiographs. Surgical correction %, additional f/up correction % and final f/up correction % were calculated. HRQoL was analyzed using SRS-22 questionnaire.

Results and Discussion: 12 female patients with minimum 6-months f/up were included. 9 patients had progression despite brace treatment while 2 were incompliant and one was not convenient due to severe hypokyphosis. Mean f/up was 14.9 months (7-36). Mean age was 12.2 years (11-13). Mean pre-operatively thoracic and lumbar Cobb angles were 46o (35o-59o) and 27.6o (8o-35o) respectively. Post-operative first-erect x-rays revealed a 52% main thoracic curve correction with a mean Cobb of 22o (12o-26o) (p<0.05). An average of 3.9o (-6o – 14o) additional correction was attained during f/up resulting in an average of 61% correction. Compensatory lumbar curves showed a similar pattern with an average of 43% surgical and 7% f/up correction adding up to an average of 50% correction (mean 14o, range 2o-27o). Mean pre-op kyphosis was 34.8o (15o-59o). The mean early post-operative thoracic kyphosis showed slight decrease after surgery (mean 27.1o, range 10o-57o), but reached back to initial values during f/up (mean 30.1o, range 19o-49o). Average length of hospital stay was 3.5 day (3-5). Average return to school was 11 days (7-15). No neurologic, infectious, or hardware-related complications were recorded. Two patients experienced atelectasis that resolved with pulmonary physical therapy. Mean SRS subtotal score was 3.7 (3-4.2) preoperatively and 4.3 (3.6-4.8) at final f/up.

Conclusion and Significance: VBT is a growth- and motion-sparing minimal-invasive technique that modulates spinal growth with a significant correction in both major and compensatory curves. Remaining growth potential of the child urges more growth on the concavity thereby lessening the deformity. Therefore, the initial correction is tailed by additional correction attained during f/up. VBT is a promising alternative to instrumented fusion for immature adolescent idiopathic scoliosis. It may also be an alternative to bracing for incompliant or contraindicated patients.
O43.82 SRS22 questionnaire factor analysis in adult scoliosis patients

Anne Mannion, Achim Elfering, Juan Bago*, Montse Domingo-Sabat, Alba Vila-Casademunt, Ferran Pellise, Frank Kleinstueck, Francisco J Perez-Grueso, Ibrahim Obeid, Emre Acaroglu, Ahmet Alanay

*Hospital Vall d’Hebron. Barcelona

Introduction: The SRS-22 questionnaire was designed for patients with adolescent idiopathic scoliosis, but it is currently used to evaluate adult scoliosis (AD) patients. There are no studies confirming the four-factor structure (pain, function, body image and mental health) in AD. The aim of this study is to determine whether the Spanish, French, German and Turkish versions of the SRS22 show the same four-factor structure as the original instrument as well as if this structure varies over the follow-up time.

Method: 880 patients with AS (297 surgical, 583 non-surgical) recruited for the ESSG database completed the SRS22 questionnaire when enrolled in the study and at 12 months follow-up. An unifactorial factorial analysis (FA) and a confirmatory FA were performed. The observed differences in item loading between baseline and follow-up data were analyzed. Differences among Spanish (n = 409), Turkish (n = 221), French (n = 66) and German (n = 184) data were also analyzed.

Results: SRS22 factorial structure does not fit to an unifactorial solution but does so to the proposed four-factor solution (RMSEA = 0.04, CFI 0.87). This four-factor model is similar across four languages and between baseline and follow-up data. Item 15 loading (Function: “economic difficulties”) was generally low in all languages. Three other questions (item 11 “pain medication”, item 17 “days out of work”, and item 14 “personal relationships”) showed higher loadings in Spanish and Turkish than in French and German. Analysis of a “trimmed” 16 remaining questions version of the instrument, showed a good fit for the baseline data (RMSEA = 0.04, IFC = 0.92).

Conclusion: The four-factor structure proposed by the instrument designers shows an adequate fit. The SRS22 questionnaire appears as a valid instrument for assessing AD. To improve instruments psychometric properties, some modification could be considered.

O44.39 PEAK scoliosis brace can reduce pain in adults with painful scoliosis: 6 months results from a prospective cohort pilot study

Fabio Zaina¹, Martina Poggio¹, Sabrina Donzelli¹, Francesca Di Felice¹, Stefano Negrini²

¹ ISICO, ² Don Gnocchi Foundation - Brescia University- Italy

Introduction: Adult scoliosis is sometimes associated to back pain and severe curves can progress over time. The main approach for these patients is the surgical one, however surgery is not appropriate for all patients, and certain patients do not accept surgery. Despite scoliosis has been estimated to affect up to 68% of the population over 60, there is scant literature about conservative treatment for adult scoliosis. A recent paper showed the possibility for braces to reduce scoliosis progression during adulthood, but no data about pain control and quality of life were published. Recently we tested a new brace (Peak™ Scoliosis Brace - Aspen Medical Products) designed to alleviate pain for adult patients with chronic pain secondary to
scoliosis showing some pain relief at one month, but no longer follow up are available.

**Aim:** to test the efficacy of the Peak™ Scoliosis Brace in reducing pain in adult scoliosis patients at six months.

**Materials and Methods:** Design: follow up of prospective experimental cohort study. Population: 20 adults (age 67.8±10.5, curve 61.9±12.6° Cobb) with back pain secondary to Idiopathic Scoliosis. The sample size calculation was based on unpublished data collected in clinical practice. Inclusion criteria: Adults affected by Idiopathic scoliosis of 30° Cobb or more and chronic low back pain (cLBP). Exclusion criteria: secondary scoliosis. Outcome measures: GRS, Oswestry Disability Index (ODI), Roland Morris Questionnaire (RM), COMI. Statistical analysis: paired t-test and non parametric tests. Protocol: patients were evaluated at baseline immediately before starting with the brace and after 6 months. The brace must be worn for at least 2 hours per day.

**Results:** All parameters showed a short term improvement at one month. At six months, worst pain, leg pain and back pain were significantly improved: from 7.15 to 5.60, from 5.65 to 4.35 and from 6.55 to 5.25 (p<0.05). Sixty five percent of patients achieved the minimal clinically important difference of 2 points for worst pain and leg pain, 55% for back pain. RM and COMI improved (p<0.05), no differences for ODI.

**Conclusion:** The Peak Scoliosis brace showed a significant improvement at 6 month of worst, leg and back pain in the majority of patients in a group of adult women with scoliosis and cLBP. Some changes were noticed at one month, but at long term this effect was increased. The quality of life didn’t change in a clinically significant way even if the patients reported satisfaction with the treatment. It’s possible that a higher dosage would guarantee a better effect, and it would be important to determine the features of responders with respect to non responders in a larger study.

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**O45.99 Evaluating quality of life changes using an adjustable orthosis in an adult spinal cord injury patient with scoliosis: A case study**

Michelle Dwyer¹, Patrick Flanagan¹.

¹Michelle Dwyer Physical Therapy, ²ONPInnovations - USA

**Background:** Clinical manifestations of adult scoliosis can have a significant impact on a patient's quality of life. Clinicians and patients face additional challenges when addressing scoliosis secondary to spinal cord injuries. The Aspen Peak Scoliosis brace is an adjustable, unloading brace designed to relieve pain and improve quality of life in adult scoliosis patients.

**Aim:** The aim of this study is to assess the changes in quality of life in an adult scoliosis patient with an incomplete spinal cord injury (SCI) using the Aspen Peak Scoliosis brace.

**Methods:** A 64 y/o female patient with an incomplete SCI was referred to physical therapy for evaluation for the Aspen Peak Scoliosis brace. This patient was already independent and compliant in scoliosis specific exercises using Schroth and SEAS principles prior to brace fitting. The patient had concerns regarding her decreasing ability to perform recreational and activities of daily living without pain. The patient was fitted with the Aspen Peak Scoliosis brace and provided with specific wearing instructions. The patient was seen in the clinic for follow up appointments at 2, 9, 12 wks, and one year. The Visual Analogue Pain Scale (VAS) was given at each appointment and the SRS-22 was given at the initial and final appointments.

**Results:** Results of the 12 month follow up indicated a decrease in Pain from 8/10 on the VAS to 3/10. The SRS-22 re-
revealed significant improvements in the following areas: pain, mental health, self image, and satisfaction of the intervention.

**Conclusion:** In the case presented, the Aspen Peak Scoliosis Brace improved quality of life measures most significantly in the area of pain reduction and mental health. The Aspen Peak Scoliosis brace could be a viable option in addressing scoliosis in adult patients with incomplete spinal cord injuries.

### 046.1 Effectiveness of the Rigo Cheneau versus Boston-Style Orthoses for Adolescent Idiopathic Scoliosis: A Retrospective Study

Miriam Minsk, Kristen Venuti, Gail Daumit, Paul Sponseller

*The Johns Hopkins Hospital - USA*

**Introduction:** Adolescent Idiopathic Scoliosis (AIS) is a lateral curvature of the spine that develops with the onset of adolescence. Growing children with curves that present at or progress to 25 degrees Cobb angle are best treated with bracing. The goal of bracing is to prevent further deformity, ultimately preventing the need for surgical intervention. There are numerous brace types available. Bracing can effectively treat AIS, but patient outcomes have not been compared by brace type.

**Objective:** To compare outcomes of adolescent idiopathic scoliosis (AIS) patients treated with Rigo Chêneau orthoses (RCOs) or custom-molded Boston-style thoracolumbosacral orthoses (TLSOs). Methods: We reviewed patient records from 1 scoliosis center from 1999 through 2014. Patients were studied from initial treatment until skeletal maturity or surgery. Inclusion criteria were a diagnosis of AIS, initial Cobb angle between 25º and 40º, use of an RCO or TLSO, and no previous scoliosis treatment.

**Results:** The study included 108 patients (93 girls) with a mean (± standard deviation) age at brace initiation of 12.5 ± 1.3 years. Thirteen patients wore an RCO, and 95 wore a TLSO. Mean primary pre-brace Cobb angles were 32.5º ± 4.6º in the RCO group, and 31.4º ± 4.4º in the TLSO group (P = 0.473). Mean brace wear time was similar between groups.

Mean differences in primary Cobb angles from baseline to follow-up were 0.2º ± 10.5º in the RCO group and 6.9º ± 12.1º in the TLSO group (P = 0.052).

Percent changes in primary Cobb angles from baseline to follow-up were 1.8% ± 32.7% for the RCO group and 21.8% ± 38.8% for the TLSO group (P = 0.066).

No RCO patients and 34% of TLSO patients progressed to spinal surgery (P = 0.019). At follow-up, primary Cobb angles improved by 6º or more in 31% of the RCO group and 13% of the TLSO group (P = 0.100).

**Conclusions:** Patients treated with RCOs compared with Boston-style TLSOs had similar baseline characteristics and brace wear time, yet significantly lower rates of spinal surgery. Patients with RCOs had lower mean and percent primary curve progression versus those with TLSOs, although not statistically significant. Significance. Our study is an important addition to the research because it is one of the first to compare outcomes after RCO use versus general Boston-style TLSO bracing.
O47.11 Analysis of interphase force distribution & balance in subjects with adolescent idiopathic (AIS) scoliosis using Boston brace


The West Bengal University of Health Sciences/NILD - India

Background: The update definition of scoliosis (AIS) is a three dimensional (3-D) deformity of the spine caused by lateral curvature and vertebral rotation. Effectiveness of spinal orthosis for AIS is still controversial.

Aim: To find the interface forces & balance in subjects with adolescent idiopathic scoliosis using Boston brace.

Method: This is pre-post experimental study design. 10 AIS subjects using Boston brace. Study by convenience sampling method. Group (N=10, M-5, F-5, age-12.900 ± 2.51 year; weight-35.694±12.294kg, height-142.800±24.4895cm, Cobb’s angle-30.800±3.1903). Pre-post data were taken with electronic force measuring instrument, Pressure measuring system for force data of Boston brace. & COP data for balance were taken with Kistler force Plate (Type- 9260AA6, dimension- 600 X 500 X 50 mm, weight- 8.6 kg). The comparison of the various variables between pre-brace and post in brace was done for statistical analysis.

Results: Several parameters is analysed. These are force of trochanter force, lumber pad force and thoracic pad force in various posture, COP Parameters – Range (AP &ML), Mean distance (AP& ML), COP range, COP RMS , Romberg Ratio.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Mean</th>
<th>St. dev</th>
<th>P-value</th>
<th>T-value</th>
<th>F-value</th>
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</thead>
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<tr>
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<td>WithBrace EE/min</td>
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<td>4.7951</td>
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<tr>
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<td>0.9336</td>
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<td>WithBrace VCO2</td>
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<td>22.1332</td>
<td>0.0836</td>
<td>0.0070</td>
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<tr>
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<tr>
<td>WithBrace O2 exp</td>
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<td>4.1241</td>
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<td>0.2582</td>
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<tr>
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</tr>
</tbody>
</table>

Table 1. Mean value of EE, VCO2, O2 exp & HR.

Discussion & Conclusion: M. S. WONG et.al,(1998) et al. state that the corrective force the curve have an effect on correctional forces. Eshaqi et. al (2012) states that the displacement of the COP is maintain stability. Both are accordance with this study. Boston brace with stranded force application is effective in curve correction and improvement of balance in Adolescent idiopathic scoliosis. The Boston Brace provides an actual force system resulting in improvement of balance.
O48.41 Carbon brace and 3D scoliosis correction

Jean Claude Bernard, Eric Berthonnaud, Emmanuelle Chaleat-Valayer
Centre des Massues, Lyon - France

Background: The upper view of the scoliosis is analysed by the 3D reconstruction, which shows the spatial position of vertebrae as well as the global balance of the spine in the space. This 3D reconstruction of the scoliosis does not reflect neither the frontal radiograph nor the lateral radiograph but the overlapping of these two radiographs; this explains the difficulty of analysis of the scoliosis and, sometimes, the uncertain results of the conservative treatment.

The aim of this study is to compare the 3D reconstruction of 31 scoliosis with and without carbon brace, based on the correction of the rotation of the regional planes.

Material and Methods: The sample is composed of 31 scoliosis (30 girls, 1 boy) ; the mean age is 12.7 years old, +/- 1.3 [11 – 15].

The scoliosis are classified by Lenke : 1 ( 2 patients ) ; 2 (3) ; 3 (7) ; 4 (5) ; 5 (7) ; 6 (7). The pelvic parameters : Pelvic Incidence = 46.8° +/- 10.0° ; Pelvic Tilt = -7.3° ± 5.3°.

The spinal parameters before treatment are analysed by regional planes. The numbers of regional planes vary from 2 to 4 : 2 regional planes for 2 scoliosis ; 3 regional planes for 22 scoliosis; 4 regional planes for 7 scoliosis.

The rotation of the first 3 regional planes is : Plane 1 : ROT = 32.5° ± 16.7° (Cobb angle in regional plane = 47.1° ± 12.0°) ; Plane 2 : ROT = 48.6° ± 29° (Cobb angle in regional plane = 38.1° ± 9.9°) ; Plane 3 : ROT = 40.1° ± 26.2° (Cobb angle in regional plane = 23.5° ± 9.4°).

Results: The results are expressed comparing the value obtained in brace, to the same value obtained without brace at the beginning of the treatment.

Pelvic Tilt : PT = -0.1° ± 3.6° (p=0.943). No significant change.

Plane 1 : ROT = -10.9° ± 19.6° (p=0.016) Significant decrease of the rotation ; Cobb angle in regional plane = -10.1° ± 17.7° (p=0.014) Significant decrease of the angle.

Plane 2 : ROT = -11.7° ± 21.0° (p=0.017) Significant decrease of the rotation ; Cobb angle in regional plane = -8.7° ± 6.8° (p<0.001) Significant decrease of the angle.

Plane 3 : ROT = 2.6° ± 32.6° (p=0.712) No significant change; Cobb angle in regional plane = -5.9° ± 21.7° (p=0.220) No significant change.

Discussion: These results show that with the 3D reconstruction during the planning, we obtain a significant correction of the rotation of the planes in brace, with a mean of 11° for the plane 1 and of 12 ° for the plane 2. The results also show that a component of the correction always produces a flattening effect of the curvatures of the planes 1 and 2 (10 ° and 9 ° respectively).

Conclusion: The 3D analysis with the regional planes during the scoliosis orthopaedic treatment is essential to obtain the real spatial representation of the deformation using the upper view. This approach is difficult because it does not take into account the Cobb angle measured in the frontal plane but the one measured in the regional plane. It is the correction of the rotation of the regional plane which matters the most and not the correction of the Cobb angle in the frontal plane.
O49.92 Rigo System Chêneau brace: Higher in-brace correction and lower risk of 6-month curve progression compared to TLSO

Prachi Bakarania, Nicholas Feinberg, Anas Minkara, Jennifer Hope, John Tunney, Hagit Berdishevsky, Kelly Grimes, Hasani Swindell, Julie Yoshimachi, David Roye, Michael Vitale

Columbia University - USA

Introduction: In-brace correction is a key prognostic indicator of the success of bracing treatment. The Rigo System Cheneau (RSC) is a non-cylindrical custom-shaped brace which allows for three-dimensional curvature correction and corrective breathing techniques. Thoracolumbar sacral orthosis braces (TLSO) are traditional cylindrical braces which provide counterforce vectors on the chest wall and abdomen.

Objective: The purpose of this study was to compare immediate in-brace major coronal curve correction at six weeks and curve progression at 6 months between patients who received Rigo System Cheneau (RSC) brace and TLSO.

Methods: This is a retrospective cohort study of patients with idiopathic scoliosis who underwent brace treatment between 2013-2015 with a major coronal curve greater than 25° and Sanders score of 4 or less. Curve progression was defined as an increase in curve magnitude greater than 5 degrees. The percent in-brace correction of major coronal curve at 6 weeks and risk of curve progression at 6 months were calculated as outcomes.

Results: A total of 66 patients were identified, with a mean age of 13.1 (range 10.8-16.0) at bracing. 64% of patients were female. 51 patients received RSC bracing and 15 patients received TLSO. Gender, age, Sanders scores, and baseline coronal curvatures were similar. The RSC brace achieved greater in-brace correction (37%) compared to the TLSO brace (30%) at 6 weeks. At 6 month follow-up, 17% of RSC patients experienced curve progression compared to 20% of TLSO patients.

Conclusion and Significance: Compared to the traditional TLSO brace, the Rigo System Cheneau brace is associated with increased in-brace spinal curvature correction at 6 weeks and a lower risk of curve progression at 6 months. The initial in-brace correction of a patient’s brace is important to the efficacy and success of this non-surgical treatment. Further analysis will assess patients for curve-progression at 1 year and determine brace compliance rates.

O50.75 The new Lyon ARTbrace versus the historical Lyon Stagnara brace: a matched pair control of in-brace correction of 264 adolescent scoliosis of more than 40°

Fanio gagliano¹, Jean Claude de Mauroy ², Stéphane Lecante³ Sophie Pourret³

¹Clinique St Charles, Lyon, ² Clinique du Parc, Lyon, ³ Lecante Group, Lyon - France

Background: The first studies of the new Lyon brace: ARTbrace reports an excellent in-brace correction of the Cobb angle of 70% in adolescent scoliosis of more than 20° treated since May 2013, a value of correction 40% higher than the former Lyon Stagnara brace or historical Lyon brace and higher than anything that has been published to date in the literature including retrospective studies.

The aim of this study is to evaluate the in-brace correction results in 132 consecutive scoliosis more severe over 40° treat-
ed with ARTbrace, compared with a retrospective case series of 132 scoliosis of more than 40° treated with the historical Lyon brace method.

**Design and level of evidence:** Case-controlled matched-pair prospective cohort study without randomization but quasi experimental (all patients included since May 2013). OCEMB level 2

**Material and Methods:** All the 132 adolescent scoliosis patients of more than 40° cobb angle to which it was proposed a conservative orthopaedic treatment with ARTbrace were selected in our prospective database. This group is compared with a retrospective similar case series of 132 scoliosis more than 40° treated with the historical Lyon method (initial Cast-brace followed by Lyon Brace). All patients were evaluated radiographically both immediately in the brace and after 6 months of treatment without brace. Data were transcribed immediately with Excel 2013 and confirmed by the statistical package SPSS v20

**Results:** 132 patients were included in the ART brace group, and 132 in the historical Lyon Brace method group. No differences were noted for gender (20 males for each group), age (14 years ± 2.12).

An independent-samples t-test was conducted to compare Cobb angles before brace, in-brace and at 6 months without brace.

There was not a significant difference Cobb angle before brace (CAST 45.841 ± 6.16 vs ART 46.568 ± 7.80, t(262)= 0.84, p = 0.2020).

In-brace correction results were slightly better for ART, but there was not a significant difference: ART : 24.186 ± 8.22 vs CAST 24.288± 9.17, t(262)=0.05, p=.346

CAST Rate = 46,70 % | ART Rate = 48,04 %.

On the other side, for ART-brace there was a significant difference for curves 40°-49° and > 50° (Curves 40°-49°: 21.594± 6.00, Curves >50°: 24.486± 8.67, t(130)=2.167, p=.032

Curves 40°-49° Rate: 49,98 %, Curves >50° Rate: 44,08 %.)

At 6 months this study found that the angulation without brace had statistically significant lower angulation for the ART (31.48° ± 7.39°) compared to the CAST (36.22° ± 9.67°), t(138) = 3.238, p = 0.002.

The result is also statistically significant if we compare the difference between Cobb in-brace angulation and Cobb without brace after 6 months: ART (9,90° ± 5.66°) compared to CAST (14,33° ± 7.27°), t(138) = 4.001, p = 0,000.

The improvement in results at 6 months could be explained by the lower effectiveness of the old Stagnara Lyon brace compared to plaster cast.

**Conclusion:** This study confirms a maximal in-brace correction effect of new Lyon ARTbrace also in scoliosis more severe over 40°, like the old plaster CAST. This effect is confirmed, further improved and becomes statistically significant at 6 months, on an X-ray without brace. So, ARTbrace allows to avoid the use of the initial plaster cast for these severe scoliotic curves >40°, without having to make a new brace after the cast.
**O51.78 In-brace correction of Vertebral Rotation and Global Torsion for 20 patients with AIS treated with the new Lyon ARTbrace**

Jean Claude de Mauroy\(^1\), Olivier Fantino\(^1\), Lydie Journoud\(^2\), Stéphane Lecante\(^2\)

\(^1\)Clinique du Parc, Lyon et \(^2\)Lecante Group, Lyon - France

**Introduction:** Although we often talk about 3D Correction, primary results in the transverse plane are never published, or are considered non-existent, regardless of the measurement method used: MRI for (Chu 2006) and EOS for (Donzelli 2016). The only significant result is that of (Lebel 2013), using also EOS, who shows that following the brace treatment, apical vertebra rotation was significantly improved by the Asymmetrical polyethylene Chêneau type brace compared to the Symmetrical polyethylene Boston type brace [average change of 8.2 vs. 4.9, respectively (P = 0.02)].

The new Lyon ARTbrace is a detorsion brace. The aim of this study was to verify the immediate transverse plane in-brace correction in a sample of patients treated with the new Lyon ARTbrace.

**Method:** This was a retrospective case study of 20 patients with adolescent idiopathic scoliosis who had orthogonal AP and lateral X-rays without a brace and in-brace. A 3D image of the spine was reconstructed. Axial spine parameters were measured before bracing and then on the first post-brace X-ray: Maximal vertebra rotation, usually at the apex of the curve and global torsion which is the average of all the vertebral rotations included in the curvature. The statistical analysis was carried out using SPSS 20.

**Results and Discussion:** Maximal Vertebra Rotation: Initial (M=11.55, SD=7.81) and In-brace (M=5.525, SD=7.02) Correction rate (52.16%)

Global Torsion: Initial (M=7.45, SD=5.24) and In-brace (M=3.72, SD=5.35) Correction Rate (50.07%)

Cobb Angle: Initial (M=33.3, SD=11.04) and In-brace (M=6.05, SD=9.75) Correction Rate (81.83%)

Maximal Vertebra Rotation and Global Torsion were significantly correlated, \( r = .652, p = .002 \).

There was a nonsignificant correlation of \( r=.373 \) (\( p = .105 \)) between detorsion and Cobb correction.

This work on a sample of patients with a good coronal Cobb correction (82%) was performed to better show the changes in the transverse plane. The correction percentage in the transverse plane is less than the correction in the frontal plane. The Maximal Vertebra Rotation is correlated with the Global Torsion. Either measure can therefore be used.

We were surprised to find that there is no correlation between the frontal plane and the transverse plane. There are frontal deviations without rotation and rotations without frontal deviations. That is why we prefer global detorsion to the classic 3-point system.

**Conclusions:** By utilizing the EOS 3D reconstruction technology, we can confirm that an asymmetrical brace like the new Lyon ARTbrace is really a Detorsion brace in the transverse plane. Deviations in the frontal and transverse plane are not correlated.
The relationship between spinal rotation and lung function in patients with scoliosis

Georgina Frere, Charlotte Kydd, Jason Black, Erika Maude, David Glynn

Introduction: Scoliosis is a three-dimensional condition that causes deformity in the coronal, transverse and sagittal planes. Pulmonary function has been widely documented as a factor that can be affected by scoliosis. A handful of studies have been completed to evaluate lung function in patients with scoliosis primarily relating to coronal measurements. It has been revealed that lung function impairment tends to be common in patients with scoliosis who present with severe curvatures (i.e. Cobb angle > 70 degrees), however there has been little to no research that examines pulmonary function in relation to deformity due to scoliosis in the transverse plane.

Objective: The aim of this retrospective cohort study was to determine the relationship between spinal rotation as measured by angle of trunk rotation (ATR) and lung function in patients with scoliosis.

Method: A total of 179 patients with thoracic scoliosis were included in the study. Spinal rotation was measured using the angle of trunk rotation (ATR) using a Scoliometer. The patients’ lung function was measured using Forced Vital Capacity (FVC) using CareFusion Spirometry PC Software. The data was previously collected during routine assessment of all patients between the periods of January 2015 to August 2016. Statistical methods were used to analyse the relationship between the ATR and patients’ FVC values in relation to the normal predicted FVC of each patient using a formula derived by Falaschetti et al. (2004).

Results: The ages in the sample ranged from 7 to 75 with a median age of 16 years old. Of the sample set, 84% of patients were female. Before treatment the average thoracic ATR of the patients was 9 degrees (SD = 4.9) and the average percent of predicted FVC was 79% (SD = 13%). Before treatment there was a significant negative relationship between ATR and percent of predicted FVC with a 1 degree decrease in ATR associated with a 0.74% increase in predicted FVC (p<0.001). There was a statistically significant increase in FVC of 1.67% after treatment (p=0.002), however this was not all attributable to a change in ATR. The relationship between the change in ATR and the change in FVC as a result of treatment is still negative but much smaller and no longer statistically significant; a 1 degree decrease in ATR was associated with a 0.13% increase of FVC (p>0.05). This suggests that other factors explain this improvement in FVC other than reducing ATR. These factors could be the regular exercise associated with treatment or practice using the Spirometer.

Conclusion and Significance: There is a strong relationship between ATR and FVC in patients prior to treatment. Those who have a high ATR tend to have lower FVC compared to their predicted FVC in the general population. FVC is shown to be improved with ScolioGold therapy; however these improvements cannot be fully attributed to improving ATR.
O34.18 Incidence of cancer and infertility, in patients treated for adolescent idiopathic scoliosis 25 years prior

Ane Simony, Mikkel Osterheden Andersen, Leah Yacat Carreon

Sector for Spine Surgery & Research, Middelfart Hospital - Denmark

Introduction: Adolescent females with idiopathic scoliosis are exposed to substantial amounts of radiation during treatment and follow-up for AIS. The purpose of this study was to determine the amount radiation exposure patients received during treatment for AIS and report the incidence of infertility and cancer in adulthood.

Method: 219 consecutive AIS patients treated at Rigshospitalet, Copenhagen between 1983 and 1990 were identified and requested to return for clinical and radiographic examination. The incidence of cancer was determined through chart review and follow-up interviews. In addition, the subjects and age-matched controls were queried regarding infertility, age at first pregnancy and spontaneous abortions.

Using X-ray reports that included patient position, mAs and kV used and the number of x-rays taken, a radiation physicist calculated the total radiation dose during treatment and follow-up adjusted for BMI and sex.

Results: 159 (78%) patients participated in the follow up study, and medical charts were available in 209 patients. 2 patients had passed away, one due to cardiac arrest and one to breast cancer. 8 patients had emigrated. Radiation information was available in 211 patients. The mean calculated mean total radiation exposure was 1.58 mSv (0.44-6.9). An average of 16.3 (range, 8-34) x-rays were taken during treatment.

The rate of infertility (10%) and spontaneous abortion (23%) is similar to the normal controls. The AIS patients had 1.4 children, which is 1 child less than the 2.5 children in the control cohort. 9 (4.3%) AIS patients developed cancer, mostly breast (3) and endometrial (4). The patients with endometrial cancers have a low BMI 16.4 (15.9-16.6) at first radiation exposure, and the patients with breast cancers were older with BMI 20.4 (18.0-22.4). The incidence of cancer in this cohort is 17 times greater than the incidence of 0.25% in an age-sex matched cohort from the Danish Cancer Society Annual Report.
Conclusion: The infertility and spontaneous abortion rate was similar between AIS patients and an age matched cohort. The cancer rate in the AIS patients is 17 times higher than expected compared to the age-matched Danish population. The pathology of cancers among the AIS patients are different from a Nordic cohort of Airline Pilots, exposed to an equal radiation dose during their adult period of life.

O63.53 Curve progression after long term brace treatment in adolescent idiopathic scoliosis: comparative results between under and over 30 Cobb degrees.

Angelo Gabriele Aulisia, Vincenzo Guzzanti, Francesco Falciglia, Paolo Pizzetti, Lorenza Aulisia,

1U.O.C. of Orthopedics and Traumatology, Children's Hospital Bambino Gesù, Institute of Scientific Research, Rome, Italy, 2 University of Cassino, Cassino, FR, Italy

Introduction: To date in the literature the factors that influence curve behaviour following bracing are not fully determined and there is no accordance if scoliotic curves stop progressing at skeletal maturity.

Objective: The objectives of this study were to evaluate the loss of the scoliotic curve correction in a cohort of patients treated with bracing during adolescence and to compare the outcomes of under and over 30 Cobb degrees at a minimum of 10 years post brace removal.

Methods: 93 (6 male) of 209 patients with AIS treated with the Lyon or PASB brace at a mean of 14 (range 10-35) years previously responded to long-term follow-up examination. All patients answered at simple questions (including work status pregnancy and pain) and had clinical and radiological examination. Patients were divided in 2 groups based on Cobb degrees (<30 and >30). Statistical analysis were performed.

Result(s) and Discussions: The patients underwent long-term follow up at a mean of 184.1 (Std 72.60) months after brace removal.

The pre-brace scoliotic mean curve was 32.28 (Std 9.4), at the end of weaning was 19.35° and increased to 22.12° at minimum 10 years since brace removal. However, there was no significant difference in the mean Cobb angle between end of weaning and long term follow up period (p = 0.105). The curve size of patients who were treated with a brace from the beginning was reduced by 13 degrees during treatment, but the curve size lost 3 degrees at the follow-up period. The Groups over 30° showed a pre-brace scoliotic mean curve of 46.54, at the end of weaning was 37.97° and increased to 40.94°; instead the groups <30° showed a pre-brace scoliotic mean curve of 29.63, at the end of weaning was 15.72° and increased to 18.87°. There was no significant difference in the mean progression of curve magnitude at the long-term follow up between <30 and >30 groups.

Conclusion(s) and Significance: Scoliotic curves did not deteriorate beyond their original curve size after bracing in both group at 14-year follow-up. These results are in contrast with the natural history that showed a progressive and lowly increment of curves at skeletal maturity in moderate curves. Bracing is effective treatment method with good long-term results also in moderate curves.
066.4 Effectiveness of Schroth exercises during bracing in adolescent idiopathic scoliosis: results from a preliminary study

Chun Shing Aldous Cheng 1, Yat Hon Kenny Kwan 2, Man Chi Kenneth Cheung 2

1 Physiotherapy Department, The Duchess of Kent Children’s Hospital in Sandy Bay, 2 Department of Orthopaedics and Traumatology, University of Hong Kong

Objective: The aim of this study was to evaluate the efficacy of Schroth exercises in AIS patients with high-risk curves during bracing.

Methods: A prospective, historical cohort-matched study was carried out. Patients diagnosed with AIS who fulfilled the SRS criteria for bracing were recruited to receive Schroth exercises during bracing. An outpatient-based program in which Schroth exercises were taught over four private training sessions in the first eight weeks. This was followed by home exercises with bimonthly-supervised sessions given thereafter. Data for these patients were compared with a 1:1 matched historical control group who were all treated with bracing and matched for age, gender, skeletal maturity and curve magnitude. A subgroup analysis of patients based on their compliance with the Schroth program was performed. Compliance was defined as >80% attendance and completion of at least 5 out of 7 days of daily home exercises per week. The assessor and the statistician were blinded. Radiographic progression, truncal shift, and Scoliosis Research Society (SRS-22r) scores were compared between cases and controls.

Results and discussions: Twenty-four patients (5 males and 19 females, mean age 12.3 ± 1.4 years) were included in the exercise group, and twenty-four patients (mean age 11.8 ± 1.1 years) were matched in the control group. The mean follow-up period for the exercise group was 18.1 ± 6.2 months. In the exercise group, spinal deformity improved in 17% of patients (Cobb angle improvement of ≥6o), worsened in 21% (Cobb angle increases of ≥6o), and remained stable in 62%. In the control group, 4% improved, 50% worsened and 46% remained stable. In the subgroup analysis, 31% of patients who were compliant (13 cases) improved, 69% remained static and none had worsened, while in the non-compliant group (11 cases), none had improved, 46% worsened and 46% remained stable. Analysis of the secondary outcomes showed improvement of the truncal shift, angle of trunk rotation, the SRS function domain and total scores in favour of the exercise group.

Conclusion: This is the first study to investigate the effects of Schroth exercises on AIS patients during bracing. Our findings from this preliminary study showed that Schroth exercise during bracing was superior to bracing alone in improving Cobb angles, trunk rotation and QOL scores. Furthermore, those who were compliant with the exercise program had a higher rate of Cobb angle improvement. The results of this study form the basis for a randomized controlled trial to evaluate the effect of Schroth exercises during bracing in AIS.
O68.57 Schroth Physiotherapeutic Scoliosis-Specific Exercises for Adolescent Idiopathic Scoliosis: How Many Patients Require Treatment To Prevent One Deterioration?

Sanja Schreiber¹, Eric Parent², Doug Hill¹, Doug Hedden², Marc Moreau¹, Sarah Southon¹

¹Alberta Health Services, ²University of Alberta - Canada

Introduction: Three recent randomized controlled trials (RCTs) support using physiotherapeutic scoliosis-specific exercises (PSSE) for adolescents with idiopathic scoliosis (AIS). All RCTs reported statistically significant results favouring PSSE but none reported on clinical significance. The number needed to treat (NNT) helps determine if RCT results are clinically meaningful. The NNT is the number of patients that need to be treated to prevent one bad outcome in a given period. A low NNT suggests that a therapy has positive outcomes in most patients offered the therapy.

Objective: To determine how many patients require Schroth PSSE added to standard care (observation or brace treatment) to prevent one progression (NNT) of the Largest Curve (LC) or Sum of Curves (SOC) beyond 5° over a 6-month interval.

Methods: This was a secondary analysis of a RCT. Fifty consecutive participants from a scoliosis clinic were randomized to the Schroth PSSE + standard of care group (n=25) or the standard of care group (n=25). We included males and females with AIS, age 10-18 years, all curve types, with curve magnitudes 10° - 45°, with or without brace, and all maturity levels. We excluded patients awaiting surgery, having had surgery, having completed brace treatment and with other scoliosis diagnoses. The local ethics review board approved the study (Pro00011552) registered with ClinicalTrials.gov (NCT01610908). The Schroth intervention consisted of weekly 1-hour supervised Schroth PSSE sessions and a daily home program delivered over six months in addition to the standard of care. A prescription algorithm was used to determine which exercises patients were to perform. Controls received only standard of care. Cobb angles were measured using a semi-automatic system with 2.2° error from PA standing radiographs at baseline and 6 months. The NTT was calculated as: NNT=1/ARR, where the absolute risk reduction (ARR) is calculated as the difference between the control event rate (CER) and the experimental event rate (EER). The CER and EER are the proportion of patients in the control and experimental group who deteriorated by >5°, respectively. We estimated 95% confidence intervals (CI) using the Wilson score method. Patients with missing values (PSSE group; N=2 and controls; N=4) were assumed to have had curve progression (worst case scenario).

Results: For LC, NNT=3 (95% CI 1.7 – 11.2), and for SOC, NNT=4 (95% CI 2.0 – 64.0). The corresponding ARR was 38% for LC and 26% for the SOC. Patients with complete follow-up attended 85% of prescribed visits and completed 82.5% of the home program. Assuming zero compliance after dropout, 76% of visits were attended and 73% of the prescribed home exercises were completed.

Conclusions and Significance: The short term PSSE intervention added to standard care provided a large benefit as compared to standard care alone. Results suggest that three (LC) and four (SOC) patients require treatment for the additional benefit of a 6-month long Schroth intervention to be observed beyond the standard of care in at least one patient.
O52.97 To use a thermal sensor in my brace or not – comparative thoughts from patients and parents.

James Wynne¹, M. Timothy Hresko²,

¹Boston Brace and ²Boston Children’s Hospital - USA

Background: Two recent studies on idiopathic scoliosis showed that success with bracing is dose related. A third study showed that if patients know they are being monitored and they are provided a report of their wear time, their adherence to the wear schedule increases. As part of our quality improvement program we want to know and compare how parents/patients, both those that decided to use the device and those that chose not to use the device, feel about the use of an adherence monitor in their brace so our clinicians can understand the impact of adding the device to a patient’s brace and develop better ways of communicating the results.

Hypothesis: Patients and parents that chose to use the device feel the monitor will help validate their wear time and will have a positive impact on brace wear.

Intervention: Since 2013, patients have had the option of adding a thermal sensor device to their scoliosis orthosis. All consecutive parents that opted to have the thermal sensor installed in their child’s orthosis and had provided their email were contacted and asked to complete an online parent survey. They were also asked to have their child complete a separate survey. The same request went to parents that decided not to have a thermal sensor added so we could compare results.

Results: 125 parents/patients opted to have the thermal sensor added to their orthosis, versus 974 that decided not to use the sensor. 31 Parents and 23 patients that decided to use the thermal sensor replied and 52 parents and 23 patients replied from the non-thermal sensor group. Patients for both groups agreed with their parent’s decision to use or not use the sensor. Neither group of patients felt the sensor was an invasion of privacy. The non-user group of patients did not feel the sensor would be helpful. The non-user group did not think that having a monitor in place would help them be more compliant, whereas the user group feels it is useful. Parents of non-thermal sensor patients would recommend the use to one to new parents but, if starting again, they still would not request the sensor for their child. Despite signage and discussion with clinicians about the use of a thermal sensor, non-user parents state one of the reasons for not using the device was lack of awareness.

Conclusion: Monitoring brace wear is a personal decision for parents and patients. Clinicians need to be aware that patients do not feel it is an invasion of their privacy, trust the device as being accurate, but do not see it as useful. Parents and patients inundated with information when first introduced to bracing. Every effort should be made to provide educational materials and spend time with parents/patients to ensure they are making informed decision.

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O53.98 Continuity of Care - does it impact patient outcomes

James Wynne

Boston Brace - USA

**Background:** Patient outcomes are continuously monitored and reported back to the clinicians and patients as part of our ongoing quality control program. At least annually patient outcomes are reviewed with each individual clinician. Concern was raised by clinicians that their outcomes were being negatively influenced by the fact that they did not always see patients they had evaluated. In a multi-clinician, multi-office facility, continuity of care was being compromised. In conducting a comparative report, it was found that patients that saw the same clinician for their evaluation, fitting and first follow up appointment had a better in brace result and wore their brace more than those seeing different practitioners.

**Hypothesis:** Continuity of care for idiopathic scoliosis patients has a meaningful and positive impact on outcomes.

**Intervention:** In an effort to accommodate patient’s schedules, patients are sometimes scheduled with a different practitioner in the same clinic. Consecutive patients seen from January 1, 2016 to September, 2016 were divided into two groups – those that saw the same practitioner, and those seeing multiple practitioners. Initial in brace curve reduction as well as brace wear time data were compared.

**Results:** Patients that saw the same practitioner for their evaluation, fitting and first follow up before in brace x-ray appointments had better in brace results and wore their brace more, than patients that saw multiple practitioners. This was especially true for patients nine to eleven years of age. Wear time was not as influenced by continuity for patients fourteen years of age or older.

**Conclusion:** Continuity of care is important for a successful outcome. Clinical staff and Parents need to be aware of its importance so proper scheduling can take place.

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O54.36 Adolescent idiopathic bracing success rates influenced by time in brace: Comparative effectiveness analysis of the BrAIST and ISICO cohorts.

Lori Dolan¹, Stuart Weinstein¹, Sabrina Donzelli², Stefano Negri², Fabio Zaina².

¹ University of Iowa Healthcare - USA, ²ISICO, Milan-Italy

**Introduction:** Studies of bracing effectiveness from North America have frequently shown worse outcomes than many studies from European centers. This could be due to sample characteristics or treatment approaches such as brace design, wear time, standard weaning protocols or concomitant physical therapy.

**Objective:** To compare bracing outcomes in prospective datasets from the BrAIST and the ISICO.
Methods: Sample: Braced patients, age 10-15, Risser< 3, Cobb angle 20 - 40°, observed to Cobb angle of ≥40° and/or ≥Risser 4. Risser grades and Cobb measurements were independently confirmed by the BrAIST team.

Comparators: Bracing per BrAIST (TLSO) and ISICO protocols (SPoRT rigid braces with or without SEAS exercises with cognitive-behavioral support); baseline characteristics (sex, age, body mass index (BMI), Risser grade, Cobb angle, and curve pattern) and average hours of wear per day. Other differences between programs (e.g. SEAS participation, type of brace, structured weaning protocol) were captured by a variable named “SITE.”

Outcome: Treatment failure (≥40 degrees before Risser 4).

Statistical analysis: Analyses comparing baseline characteristics, followed by analyses of the relationship between risk factors, treatment components and outcomes within and between the cohorts. Logistic regression was used to determine the factors associated with the outcomes in the combined cohort. The final model was chosen using the Akaike information criteria.

Results: 157 BrAIST and 81 ISICO subjects were included. Average Cobb angle, % with a thoracic apex and with low BMI were similar between SITEs. The ISICO sample had more boys (17 vs 8%) and was older (12.86 vs. 12.47 years) with a higher % at Risser 2 (19 vs. 10%). The average wear time was 18.31 in the ISICO and 11.76 hours in the BrAIST cohorts. 31% of the ISICO cohort participated in SEAS, and only 1 had a treatment failure, so the contribution of SEAS cannot be determined with these data.

12% of the ISICO and 39% of the BrAIST cohorts had treatment failure. The full logistic model included all baseline factors plus the treatment variables SITE and wear time. In order of impact, the final model included the variables wear time, Cobb, age, BMI, thoracic apex, and Risser. With these variables in the model, SITE was not a significant predictor.

The adjusted odds of failure were higher for those in the lowest 5th percentile of BMI (OR=19.25; 3.22-115.16), with a thoracic apex (OR=10.13; 2.48-41.45) and at Risser 0 (OR=2.24; 0.97-5.18); the odds increased with the Cobb angle (OR=1.23; 1.14-1.36), and decreased with age (OR=0.49; 0.34-0.69) and hours of wear (OR=0.84; 0.79-0.90).

Conclusion: The lower failure rate in ISICO patients was likely due to more hours of brace wear. BrAIST patients knew their doctors questioned the effectiveness of bracing. At many centers, the orthopaedic and orthotic teams were not highly integrated. The ISICO approach, however, emphasizes the essential role of bracing maximized by a cohesive team of physicians, orthotists and physiotherapists. These differences may have contributed to the lower hours of brace wear seen in the BrAIST cohort, and the associated difference in outcomes. Future studies involving larger samples are necessary to determine the independent effect of SEAS or other components of the ISICO approach on AIS outcomes.

Significance: This study corroborates previous studies on risk factors and provides additional evidence for wear time in preventing significant curve progression in high risk AIS patients.
O55.43 Cheneau brace treatment: comparison of compliant versus non compliant patients

Krzysztof Korbel, Mateusz Kozinoga, Łukasz Stolinski, Piotr Janusz, Paweł Główka, Katarzyna Politarczyk, Tomasz Kotwicki.

Department of Spine Disorders and Pediatric Orthopedics, University of Medical Sciences, Poznan, Poland, Rehasport Clinic, Poznan, Poland

Introduction: Rigid brace treatment combined with specific physiotherapy is accepted as standard treatment for moderate idiopathic scoliosis (IS). Results of the treatment depend on proper indication, brace quality and patient’s compliance with recommendations. Noncompliance during brace wearing is worsening clinical results.

Objective: To analyse the outcome of Cheneau brace treatment for IS according to patients compliance level.

Methods: Forty-eight girls with IS were included, all fulfilling SRS brace study criteria. They were divided into compliant and noncompliant group. The compliant group comprised full-time brace wearing patients (at least 20/24h including brace wearing at school). The noncompliant group comprised patients who were not wearing the brace at school, however the brace using time was at least 12/24h. The compliance of each patient was assessed consecutively during the whole treatment course. The outcome of compliant versus noncompliant group was compared at two years after the brace weaning.

Results: There were 31 girls in the compliant group versus 17 girls in the noncompliant group. The groups were comparable at the beginning of brace wear according to: age (12.5y.o. vs. 12.1y.o), age of menarche (12.8y.o. vs. 12.5y.o), primary curve Cobb angle (30.1º vs. 32.2º), age at the end of the brace wear (16.5y.o. vs. 16.1y.o), and time of brace wear (4.0 years vs. 4.0 years). The compliant group revealed significantly bigger angle of trunk rotation (ATR) at the primary curve level: 11.1º vs. 8.8º, p=0.0371.

The final primary curve Cobb angle was significantly smaller in the compliant group (34.9º vs. 42.2º, p=0.0197). The Cobb angle progression was 4.8º in the compliant versus 10.0º in the noncompliant group. Cobb angle progression of more than 5º was observed in 35.5% versus 58.8% of patients, respectively. At the final follow up, the ATR was comparable in both groups (9.4º vs. 10.6º), however due to initial values, there was significant ATR improvement in the compliant group versus worsening in the noncompliant group. Surgery was recommended in 12.9% of compliant versus 35.3% of noncompliant patients.

Conclusion: Patients presenting similar deformity and receiving similar Cheneau brace treatment revealed significant difference of outcome depending on compliance level. Compliant patients revealed smaller progression of Cobb angle than noncompliant patients. Compliant patients revealed ATR improvement, whereas noncompliant patients revealed ATR increase. Surgical indication was almost three times more frequent in the noncompliant patients.

Significance: The study confirms importance of the compliance during brace treatment.
O56.52 Physiotherapeutic Scoliosis Specific Exercise (PSSE) Utilizing the Schroth Method in Adolescent Idiopathic Scoliosis: 10 Sessions Predicts Higher Compliance and Home Exercise Duration

Amelia M. Lindgren, Anas A. Minkara, Kelly Grimes, Hagit Berdichevsky, Prachi Bakarania, Hiroko Matsumoto, David Roye, Michael G. Vitale

Columbia University - USA

Introduction: Physiotherapeutic Scoliosis Specific Exercise (PSSE), particularly the Schroth method, is a conservative approach for the management of adolescent idiopathic scoliosis (AIS) which aims to address the postural component of the scoliotic deformity in all three planes. Although there is currently Level I evidence regarding the effectiveness of PSSE in AIS, compliance in the teenage population remains in question.

Objective: This purpose of this retrospective cohort study was to determine the rate of compliance with prescribed home exercise programs (HEP), defined as 80 minutes/week, following completion of outpatient Schroth therapy. Additionally, the compliance rate of patients who followed Schroth training sessions to completion, defined as attending 10 sessions, was compared to those who completed less than 10 sessions.

Methods: Patient with AIS who were evaluated at our institution between 2014-2015 and completed a minimum of one Schroth therapy session following referral by an orthopedic surgeon were included. Patients with any history of prior spine procedures were excluded. A telephone survey was conducted to assess the adherence to Schroth HEP following the last formal session at 1 week, 3 months, and 1 year.

Results: From a total of 85 identified patients, 70 (82.4%) completed the survey at 1 week, 51 (60.0%) at 3 months, and 35% (28) at 1 year. The mean patient age was 12.9 years (range 8-18), and 85.9% were female. Overall, 35.7% of patients were compliant at 1 week, 27.5% at 3 months, and 17.8% at 1 year. Patients who completed PSSE training (51.4%) demonstrated higher compliance rates at each time interval, and higher home exercise duration at 1 week and 3 months. Completers of PSSE training demonstrated 82.4% compliance at 1 week (vs. 39.3% for non-completers), 53.8% at 3 months (vs. 29.2% for non-completers), and 28.6% at 1 year (vs. 18.8% for non-completers). The mean HEP duration in patients who completed PSSE training was 71 minutes at 1 week (vs. 59 minutes for non-completers), 60 minutes at 3 months (vs. 39 minutes for non-completers), and 27 minutes at 1 year (similar for non-completers). No significant difference in training completion or HEP compliance rates were found based on age, gender, ethnicity (minority status), adjusted gross income, or major coronal curve (p>0.05).

Conclusion and Significance: Patients completing PSSE training (≥ 10 sessions) maintained higher compliance rates with HEP at 1 week, 3 months, and 1 year compared to patients who did not. Although HEP duration was not statistically significant between the two groups, there was a clinically meaningful difference at 1 week and 3 months. There was an overall trend of decreased HEP participation the further out a patient progressed from formal training. This may suggest a role for regular supervise physical therapy check-ups. Compliance with HEP presents a significant impediment to studies which accurately assess the efficacy of PSSE in AIS.
O57.34 Quality of life of 98 non-adult patients with scoliosis treated with the new Lyon ARTbrace and evaluated by the Brace Questionnaire

Alith Hoang1, Jean Claude de Mauroy2, Stéphane Lecante1
1Lecante Group, Lyon, 2Clinique du Parc Lyon - France

Introduction: Since the validation of the BrQ in French, we have used it to evaluate the new Lyon ARTbrace. The improvement compared to the plaster cast seems obvious, but maintaining an asymmetric very high rigid brace during the whole treatment could have a greater impact on quality of life.

Methods: This is a case series study. We sent the BrQ by email to the first 500 patients of our prospective database, less than 1 year after the first ARTbrace was set up (first overall score). The statistical analysis was carried out using SPSS 20.

Results and discussion: The 98 patients had a mean Global score of (M=76.4236, SD = 10.86).

A one way ANOVA showed that the differences in BrQ scores between the global score (n = 98, M = 76.4236, SD = 10.86), is significant only for item 11 (You felt worried because of the brace) F(1,96) = 9.841, p = .002.

A factorial ANOVA was conducted to compare the global BrQ score and the interaction effect between the global BrQ score on the partial 8 domains scores.

4 interaction effects are significant:
1. School activity differed significantly from the global BrQ score, F(63,34) = 3.212, p <.000.

Patients are most satisfied with School activity (M = 4.27) compared to the global score (M=3.82)

2. Physical Functioning differed significantly from the global BrQ score, F(63,34) = 3.227, p <.000.

Patients are most satisfied with Physical functioning (M = 3.92) compared to the global score (M=3.82)

3. Social Functioning differed significantly from the global BrQ score, F(63,34) = 4.353, p <.000.

Patients are most satisfied with Social functioning (M = 3.91) compared to the global score (M=3.82)

4. Emotional Functioning differed significantly from the global BrQ score, F(63,34) = 3.020, p <.000.

Patients are less satisfied with Emotional functioning (M = 3.43) compared to the global score (M=3.82)

The four other domains: General Health perception, Self-esteem and aesthetics, Vitality, Bodily Pain, do not differ significantly from the general score.

The general mean of the BrQ score is higher than the first overall score mean = 61.89 (Vasiliadis 2006) of the first publication and comparable to the results published later in the literature: (Chan 2014) = 76.86.

Although the ARTbrace is an asymmetric brace, we find that domain 4 (Self-esteem and Aesthetics) does not differ significantly from the overall score.

Although the ARTbrace is a polycarbonate brace with very high rigidity, the domain 7 (Bodily pain) does not differ significantly from the overall score and the 3 domains (School activity, Physical Functioning, Social Functioning) are significantly better than the overall score.

The emotional functioning is significantly worse than the general score, so it is the psychological impact of wearing a brace more than the characteristics of the brace itself that will affect the quality of live. This evidence suggests that the concept of the “step by step” should be reevaluated with the
concept of “Best in-brace correction from the outset”. Indeed a very corrective brace will have no more impact on quality of life than another brace less corrective and apparently less constraining.

**Conclusion**: Asymmetry and very high rigidity of scoliosis bracing do not modify the first overall mean score of the BrQ compared with other polyethylene symmetrical braces. Bodily pain and school activity are not significantly changed and the major impact is more emotional than physical.

**O58.91 Social Anxiety Among Adolescents with Idiopathic Scoliosis: any relations with body image?**

Elisabetta D’Agata and Judith Sánchez-Raya.

1 Vall d’Hebron Hospital Research Institute, 2 Vall d’Hebron Hospital - Barcelona - Spain

**Introduction**: Social Anxiety (SA) involves a persistent fear of one or more social situations. Patients with scoliosis presented worst Body Image that consequently affects Quality of Life. No study determined the relation between Body Image and Social Anxiety (SA).

**Objectives**: To assess Social Anxiety in adolescent with scoliosis with relation to body image.

**Methods**: Consecutive adolescent patients consulting for scoliosis diagnosis were evaluated. Inclusion criteria: primary curve ≥ 15º; age between 10 and 19 years old. Social Anxiety Scale for Adolescents (SAS-A), SRS-22 and TAPS were used. SAS-A is a validated scale suitable for adolescents, made of 22 items, with three subscales: Fear of Negative Evaluation (FNE), Social Avoidance and Distress-New (SAD-New), Social Avoidance and Distress General (SAD-Gen).

**Results**: 50 adolescents (F 42, M 8) were assessed. Mean age was 14.2 (range 10-18) and Cobb angle mean 33.0 (range 15-79).

In regards to the tests, SAS-A total mean value was 45.52 (SD=11.2): FNE mean 19.2 (SD=6.1), SAD-New subscale mean 15.8 (SD=4.7) and SAD-Gen mean 7 (SD=3.2). Splitting the sample in two groups (cut point=43.17), 56% of patients presented low SA (M= 34.64, SD=6) versus 44% with high SA (M=52.55, SD=7.5).

SRS-function mean= 4.4 (SD=0.7), Pain mean = 4.2 (SD=0.74), Body Image mean= 3.6 (SD=0.62), Mental Health mean=3.8 (SD=0.65); Subtotal 3.4 (SD=0.5). TAPS mean=3.5 (SD=0.79).

SAS-A did not correlate with Cobb Angle, SRS-22 domains and TAPS (p>0.05). No differences were found for age group nor for treated group (p>0.05).

Patients with high anxiety (n=22) compared with patients with low-normal anxiety (n= 28) did not differ in any dimensions (Wilcoxon test, p>0.05).

**Conclusions**: Adolescent patients with Idiopathic Scoliosis presented a normal Social Anxiety level, compared with normative Spanish population, although almost half of the sample (44%) presented high level of anxiety. Further research will perform with a bigger sample.
O59.13 Preliminary study: sensitiviness to conservative treatment in adolescent with idiopathic scoliosis

Judith Sánchez Raya, Elisabetta D’ Agata, Joan Bago Granell, Antonia Matamalas Adrover

Hospital Vall d’ Hebron Barcelona - Spain

Introduction: Body Image in Adolescents with Idiopathic Scoliosis (IS) can reduce Health related Quality of Life. Brace treatment has been proven to be efficacy in scoliosis. There are no much studies about how brace treatment affects adolescent body image.

Objectives: This study is aimed to value changes in trunk deformity in patients with IS treated by brace.

Study desing: observational prospective case series.

Methods: Consecutive adolescent patients consulting for scoliosis diagnosis and with indication of brace were evaluated. Inclusion criteria: primary curve between 25º and 45º; ≥10 years old; Risser≤2; not previous treatment; if women, premenarche or 1 year after menarche.

Demographic data (age, sex) and curve-related (radiological magnitude, angle of rotation of the trunk ATR) were collected. All patients were given the TAPS questionnaire and had a clinical photograph of the back in standing positional back clinical photography: different morphological parameters (Shoulder height angle, Axilla height angle, Waistline asymmetry and right / left asymmetry by the trunk, shoulder and waistline area) were calculated.

Results: We included 24 patients (21 females) were treated during one year by brace. Mean age was 12.2 (range from 9 to 16). Initial Cobb Angle was 35.3º (range 17º - 47º) and mean Angle of Trunk Rotation (ATR) was 8.9 (5-21º).

Although one year later, mean Cobb Angle 32.6º, range 0º-56º) and TAPS 3.5 (2.3-4.7) improve no significance differences were found. In the same way, no statistically significant differences were found in the ATR or in the different morphological parameters evaluated in clinical photography at one year of brace treatment. TABLE 1 summarizes the analysis of
different variables. In TABLE 2, the change is calculated according to the variables considered.

Conclusions and Significance: Our results suggest that, in a small sample of patients treated during a period of one year with brace, doesn’t change significantly the clinical deformity of the trunk or that perceived by the patient.

O60.17 Boston Brace treatment in Adolescent Idiopathic Scoliosis

Ane Simony, Steen Bach Christensen, Mikkel Osterheden Andersen

Sector for Spine Surgery & Research, Middelfart Hospital - Denmark

Introduction: Boston brace treatment has been used for conservative treatment of Adolescent Idiopathic Scoliosis, since the 1970ies The treatment has been show to stop the progression of the deformity, in several long time studies.

Objectives: The purpose of this study was to examine the radiological curve characteristics in the patients, who progressed during brace treatment.

Method: 153 AIS patients were treated with Boston braces, at Rigshospitalet from 1983-1990. A retrospective study was performed, of the radiological characteristics of the brace treated patients. The original radiographs were lost, but the radiological database from the investigators MO and SB where used in this study. Curves were classified according to the King Moe classification, and apex was described. The curve magnitude was examined by Cobb measurement, The Harrington factor was calculated and the spinal rotation was described using Pedriolle.

Results: 138/153 patient completed their brace treatment and was included in this study. Mean age when brace treatment was initiated was 14.1 y (+/- 1.6 y), Time in brace 2.6 y (+/- 1.0 y) and Mean Cobb before treatment 39° +/- 10°. Brace treatment did not alter the spinal rotation (p> 0.3), age at start Brace treatment (p>0.8) or Age at menarche (p>0.05) was not correlated with progression during brace treatment. The curve correction was significant better in curves, with apex between Th11 and L1 (p< 0.0001). A correlation was seen in between the in brace correction and Cobb angle during side bending films pre-treatment (p< 0.002). No patients with Cobb< 11° during side bending films progressed during Brace treatment and needed surgical treatment. The Harrington Factor seems to correlate with progression during brace treatment (p< 0.001) and no patients with a Harrington Factor less than 5° progressed during Brace treatment.

Conclusion: Boston braces are effective in the conservative treatment of AIS. The risk of progression is very small if the apex is in the thoracolumbar area, and Harrington Factor is < 5°. Curves should be evaluated prior to brace treatment and close attention is recommended if risk factors are identified during the radiological evaluation.
O61.42 Outcome of Cheneau brace treatment for idiopathic scoliosis in adolescents

Krzysztof Korbel, Mateusz Kozinoga, Łukasz Stolinski, Piotr Janusz, Paweł Główka, Katarzyna Politarczyk, Tomasz Kotwicki.

Department of Spine Disorders and Pediatric Orthopedics, Poznan University of Medical Sciences, and Rehasport Clinic, Poznan-Poland

Introduction: Rigid brace treatment combined with specific physiotherapy is accepted as standard treatment for moderate idiopathic scoliosis (IS). Aims of conservative treatment are: to stop curvature progression, to reduce the curvature angle if possible, to reduce indications for surgical treatment, to improve respiratory function, to reduce pain if present, to improve the body posture aesthetics.

Objective: The aim of this study is to analyse the outcome of Cheneau brace treatment in IS patients with high progression risk according to Scoliosis Research Society (SRS) criteria.

Methods: Study design: retrospective analysis of prospectively collected database, consecutive cases, intend-to-treat analysis.

Inclusion criteria according to SRS were used: female gender, diagnosis of idiopathic scoliosis, age > 10 years, Cobb angle 25-40 degrees, Risser 0-2, no previous treatment, girls not older than one year after menarche, at least two-year follow-up after brace weaning.

Forty-eight girls were included into the study. The mean age at the beginning of bracing was 12.3 ± 1.3 years and at the brace weaning 16.3 ± 1.4 years. The initial major curve Cobb angle was 31.3° ± 4.3, the initial angle of trunk rotation (ATR) was 10.3° ± 3.7 and the initial Risser sign median was 0. The patients were treated by one team supervised by one physician (last author) while the results were evaluated by one independent observer (first author). Recommendation of full time brace wearing (at least 20h per day) was given to all patients.

Results: The final examination performed two years after the brace weaning revealed as follows: the mean Cobb angle was 37.5° ± 10.6, the mean ATR was 9.8° ± 3.8, the Risser sign median was 5. The comparison of the final examination to the initial examination revealed as follows: the Cobb angle decreased more than 5° in 6.3%, stabilized ± 5.0° in 50%, increased more than 5° in 43.7% and increased more than 10° in 29.2% of patients. The mean ATR decreased more than 3.0° in 18.8% of patients, stabilized ± 3.0° in 60.4%, and increased more than 3.0° in 20.8% of patients. 23% of patients reached the 45 degrees of Cobb angle while 16.7% of patients reached 50 degrees Cobb. Surgical recommendation received 20.8% of patients.

Conclusion: The natural history of idiopathic scoliosis at high risk of progression was modified by the treatment with Cheneau brace. However, 20.8% patients still received surgical recommendation, those with initially bigger curves and less compliant. More than half of patients showed stabilization or improvement of the spine curvature. The rigid brace treatment decreased or stabilized rib hump magnitude in more than 80% of patients. Significance: The study confirms the effectiveness of the treatment of progressive idiopathic scoliosis with the rigid brace.
O62.44 First end-term results of the Maastricht brace in the treatment of primary thoracic adolescent idiopathic scoliosis

Dirk Schrander, Chris Arts, Helma Voets, Mark van den Boogaart, Paul Willems, Lodewijk van Rhijn.

Department of orthopaedic surgery, Maastricht University Medical Center, Maastricht. Research School CAPHRI, Maastricht - Netherlands.

Introduction: The Maastricht brace (M-brace) was developed to improve patient compliance and associated efficacy of brace treatment in adolescent idiopathic scoliosis (AIS). The main features are an anterior closure, elastic thoracic pelotte and comfortable material use. The emphasis is on wearability and comfort for the patient, whilst retaining corrective pressure function. Initial pressure measurements in the M-brace revealed a higher corrective pressure as compared to the Boston brace, and a better patient reported quality of life as measured with the SRS 22 and Brace questionnaire. First results of the efficacy in terms of curve correction of the M-brace in AIS were promising, with an average in-brace curve correction of 24%. The aim of this study was to evaluate the end-term radiological results of the first group of primary thoracic AIS treated with the Maastricht brace, with a minimum of one year follow up after stop of brace wearing.

Methods: 26 patients (mean age of 16.5 years, 6 boys) with mild to moderate thoracic AIS, who had been treated with the M-brace since January 2011, were included in this retrospective single-center study. The correction effectiveness of the brace was evaluated by comparing the primary curves on standing postero-anterior full spine radiographs with- and without M-brace. The end-term correction of the Maastricht brace was defined as the primary curve measured on standard postero-anterior full spine radiographs taken one year after stop of brace wear. The success of bracing was defined as prevention of curve progression necessitating surgical intervention.

Results: There were 26 patients with a primary thoracic curve. The predominant Lenke classification was type 1 (19) and 2 (7). The average primary curve Cobb angle was $35.7^\circ \pm 9.8^\circ$. The average primary curve angle in bending x-rays was $15^\circ \pm 6.8^\circ$. In the M-brace the primary curve was $24.5^\circ \pm 8.9^\circ$. This is an in-brace correction of 31%. The average primary curve Cobb angle at end-term of bracing was $36.7^\circ \pm 11.4^\circ$. There were six patients in whom the curves progressed to surgical magnitudes during brace wear. Therefore, the success rate of bracing primary thoracic adolescent idiopathic scoliosis with the M-brace was 77%.

Conclusions and Significance: These preliminary end-term results demonstrate an adequate in-brace and post-brace correction with the M-brace. With a probably higher compliance because of a better wearing comfort, the M-brace may be a promising new brace treatment for adolescent idiopathic scoliosis.
O64.37 Bracing Idiopathic Scoliosis Greater than 40°

Amanda Whitaker¹, James Wynne ², Alexandra Grzywna ³, Michael Glotzbecker ², Daniel Hedequist ², John Emans ², Lawrence Karlin ², Michael T. Hresko ²

¹Nationwide Children’s Hospital - USA, ²Boston Children’s Hospital - Tufts University

Purpose: Due to mixed sentiment in the literature, we analyzed likelihood of progression and treatment outcomes of bracing for idiopathic scoliosis (IS) patients with large curves (>40°).

Methods: This is a retrospective review identifying 95 IS patients who presented with a Cobb angle >40° and were treated with a brace, with 72 followed to skeletal maturity. Age, MRI results, Cobb angle, Risser sign, in-brace correction, final curve on follow-up were recorded.

Results: Surgical correction was selected in 43/72 (60%) and 29 (40%) did not have surgery. Children who underwent surgery were younger at diagnosis and initial bracing (10.8 versus 12.7 years p<0.01), and had a greater major curve progression (20°, p<0.01). For those radiographs with Risser signs visible (62), Risser 0 was most common and underwent fusion most often (33/45, [73%], p<0.01). Double or triple major curves on presentation existed in 64% of operative curves, compared with 45% of nonoperative curves. For Risser 0 curves, brace treatment lasted an average of 2 years in both operative and non-operative groups. In the operative Risser 0 group, the major curve progressed 19° and brace treatment delayed surgery for 2.5 years. Only 10/27 (37%) of Risser 1-5 curves had surgery, with the major curve progressed 13° in the brace. Average surgical Cobb angle was 66° versus 46° in the nonoperative group (p<0.01). In-brace correction did not correlate with surgical correction, with 64% of those with >50% correction undergoing surgery and 62% with <30% correction undergoing surgery (p=0.86). More Lumbar C curves and well balanced double-major or lumbar-main thoracic curves did not have surgery when the curve was >50°.

Conclusion: Idiopathic curves >40° on presentation can be treated with a brace with 2/5 not undergoing surgery. Curve correction in the brace does not predict who will and will not have surgery. Risks for surgical intervention include Risser 0 at presentation, younger age, and larger curve progression. Significance: This is the largest series to skeletal maturity of bracing in >40° idiopathic scoliosis curves, describing curve patterns that did not have a spinal fusion and identifying risk factors for spinal fusion. There was a larger percentage of non-operative large curves than previously reported. Using the Risser grouping, improved patient education can be done regarding efficacy of brace treatment in large curves.
O65.54 Long-term results after brace treatment in adolescent idiopathic scoliosis: comparative results between types of curves.

Angelo Gabriele Aulisa¹, Vincenzo Guzzanti ², Marco Giodano¹, Paolo Pizzetti, Lorenzo Aulisa, 

¹U.O.C. of Orthopedics and Traumatology, Children’s Hospital Bambino Gesù, Institute of Scientific Research, Rome, Italy, ²University of Cassino, Cassino, FR, Italy

Introduction: In the literature, there is no accordance if scoliotic curves stop progressing at skeletal maturity. To date the factors that influence curve behaviour following bracing are not fully determined.

Objective: The aims of this study is to evaluate the trend of the scoliotic curve correction in a cohort of patients treated with bracing during adolescence and to compare the outcomes of lumbar curves versus thoracic and thoracolumbar curves at a minimum of 12 years post brace removal.

Methods: 99 (8 male) of 209 patients with AIS treated with the Lyon or PASB brace at a mean of 14 (range 12-35) years previously responded to long-term follow-up examination. All patients answered at simple questions (including work status pregnancy and pain) and had clinical and radiological examination. Patients were divided in 3 matched groups based on the type of curve. Statistical analysis were performed.

Result(s) and Discussions: The patients underwent long-term follow up at a mean of 184.1° (Std 72.60) months after brace removal. The pre-brace mean curve was 32.28° (Std 9.4). The mean cohort scoliotic curve increased by 19.39° to 22.12° at 14 years since brace removal. There was however no signifi-
O67.9 A Survey of Schroth Practitioners in North America

Sandra Kaplan, Marissa M. Muccio, Chintan A. Pancholi-Parekh.
Scoliosis Specialty Center - USA

Introduction: Schroth is one of the leading schools for Scoliosis Specific Exercise, developed by Katarina Schroth in Germany in the 1920’s. It has come to North America primarily as post graduate advanced certifications for physical therapists.

Objectives: First objective is to describe Schroth practitioners in terms of certifications, practice settings, and experience levels. Second objective is to begin to describe patterns in, referrals, interventions, outcome measurements and reimbursement for Schroth practitioners in North America.

Methods: This is a cross sectional survey study aimed at publicly listed Schroth certified practitioners. Each practitioner received an email with a Survey Monkey link containing informed consent, the survey questions, and an additional link for an incentive gift card raffle. An inclusion criterion was that practitioner contained in one of the Schroth provider lists publicly available. An exclusion criterion was if the practitioner was not a Schroth practitioner. IRB approval was obtained via Rutgers University and survey remained opened until May 31, 2016. NJ Health Foundation provided funding.

Results: From 175 publicly listed practitioners, 93 responded (53%). 99% of respondents are PTs, over 70% have been practicing as PTs >10 years, but practicing Schroth an average of 3.7 yrs with range spanning 2 months to 25 years. The mode is 2 years.

Over 72% of them certified by BSPTS. 56% of the respondents are providing Schroth 10-30 hours per week. 55% of the respondents were from USA Northeast and North Central. 85 % of the respondents participate in research, 83 % in academic teaching, and 93 % in professional education about scoliosis.

Over 63 % practice in private outpatient clinic, and over 26% in hospital based outpatient clinic. Lead referral source is direct access via Schroth PT directories/internet, 2nd source is surgeon referral, 3rd leading source is via other patient or support group.

Referrals are thought to be limited by: 1. Patient/family not aware of Schroth 2. No Schroth practitioner in geographical area 3. Limitations in insurance coverages. Practitioners are utilizing Schroth for primarily AIS, Adults with pain and degenerative scoliosis. The leading frequency of treatment is 1-2x per week with or without tapering. The leading duration is 45-60 minutes per session.

Most common total care is <20hrs for adults with pain and 21-40hrs for AIS. 98% review x-rays prior beginning care and COBB angle and Risser score are two leading calculation.

Conclusion: This cross sectional survey has demonstrated that despite Schroth’s origins, the patterns of practice in North America are beginning to resemble those of general physical therapy in interventions, outcome measures, and reimbursement. The demographics of the practitioners are rather homogenous, with the leading geographical areas representing the 2 earliest presence of Schroth in the US.

Significance: The current trends in the USA for the Schroth method are significantly modified from its origins. This is an important variable to consider as the efficacy research expands in the USA/ North America. Furthermore, the dosage, motor learning and response research needs to be expanded to ensure limited over and under treatment.
O69.48 Correlation between scoliosis deformity type and trunk symmetry before and after one week physiotherapeutic scoliosis specific exercises

Borislav Chongov¹, Venelin Alexiev², Evgenia Dimitrova¹, Mina Jelacic³, Krasimir Kalinov⁴

¹ Department of Physiotherapy, National Sports Academy, Sofia, ² Sofia Medical University Department of Pediatric Orthopedics, Sofia, ³ ScolioControl, Novi Sad, Republic of Serbia, ⁴ New Bulgarian University, Sofia, Bulgaria

Variety of the scoliosis deformities is large. They can differ in type and severity. Our interest is the effectiveness of teaching in corrective exercises. Our aim is to follow the dynamics of the posterior (POTSI) and anterior trunk symmetry index (ATSI) in relation to the type of scoliosis deformity according to Rigo classification.

Methods: For a period of 2 years and 8 months (April 2014 – November 2016) we accessed 128 children with adolescent idiopathic scoliosis with different severity – low 7.8%, low to moderate 20.3%, moderate 39.1%, moderate to severe 17.2%, severe 11.7% and very severe 3.9%. They were distributed in 4 groups according to Manuel Rigo: 3C (single thoracic or thoracolumbar) 29.6%, 4C (double major) 25%, N3N4 (scoliosis with good balance) 31.3% and G 1-2 (single lumbar) 14.1%. We made photos from anterior and posterior for calculating POTSI and ATSI in the beginning of therapy and the 5th day after exercises. All patients we taught to make exercises for correction according to Schroth method (BSPTS) after the initial evaluation. Teaching the patients included 5 consecutive days of 120 minutes in small groups of 2 children.

Results: The highest initial POTSI asymmetry was found in group 3C 42.14 ± 20, with lowest POTSI asymmetry in group N3N4 with 23.22 ± 11.38. With ATSI the highest initial asymmetry was in 3C 29.09 ± 12.73 and 4C 30.11 ± 13.49, with lowest asymmetry in G 1-2 20.41 ± 12.86. We have statistically significant improvement in all patients as for POTSI from initial 31.27 ± 17.1 to the end value of 23.08 ± 14.38 (0.634, p< 0.001), as also for ATSI from initial 27.09 ± 12.37 to end value of 22.9 ± 10.69 (0.501, p< 0.001). Statistically remarkable is the improvement of POTSI in group 3C from initial 42.14 ± 19.98 to end value of 27.36 ± 17.63 (0.607, p< 0.001), which could be explained with the higher initial asymmetry. In the other groups improvement of POTSI is with similar values: 4C from initial 29.72 ± 14.17 to end 26.23 ± 15.04 (0.704, p< 0.001); N3N4 from initial 23.22 ± 11.38 to end 17.09 ± 8.85 (0.480, p< 0.01); G 1-2 from initial 28.53 ± 14.49 to end 21.54 ± 10.71 (0.590, p< 0.1).

Conclusions and Significance: Improvement in the trunk symmetry does not depend on the severity and type of scoliosis, but only on the initial values. With PSSE we have statistically significant improvement in the symmetry indices (POTSI and ATSI) only for 5 days intensive training. Single thoracic and single thoracolumbar scoliosis leads to the most pronounced asymmetry in comparison to the scoliosis with good trunk balance.
O70.67 Preoperative Bracing Therapy for Surgical Patients with Adolescent Idiopathic Scoliosis

Ken Yamazaki¹, Takayuki Kikuchi ², Satoshi Yoshida ²

¹Iwate Spine & Scoliosis Center, ²Iwate Kitakamisaiseikai Hospital - Japan

Introduction & Objectives: Pediatric patient visits for spinal deformity are common. Appropriate management of scoliotic curve that do not meet surgical indication parameters is essential. To clarify the factors that had led patients with adolescent idiopathic scoliosis (AIS) to undergo surgery by examining the circumstances of the initial consultation, withdrawal from bracing therapy, and others.

Subjects and Methods: A total of 177 (16 males and 161 females with a mean age of 15.9 at the time of surgery) surgical patients treated by the author after 2001 were studied. Among these, 142 (80%) were referred by other facilities, and 35 (20%) directly visited our facility for consultation. An underarm, rigid thoraco-lumbar brace was used for all those treated with bracing therapy.

Results: The disorder was identified through school screening in 105 (59%). Among all surgical patients who underwent surgery, seventy-two patients (41%) were treated with a brace. Poor compliance with 52 (PC group) or withdrawal from 17 (W group) bracing therapy were observed in 69 patients treated by the author. In the case of W group, it ranged from 1 to 3 month. The mean Cobb angles of all groups on the initial consultation and before surgery were 38.6 and 55.6 degrees, respectively.

There was a significant different between the mean Cobb angle of W group (59.7 degrees) and PC group (51.6 degrees) before surgery (p<0.009).

The leading causes of both groups were as follows: daily life-related stress: 17(25%), environmental conditions of outpatient treatment (parent’s reasons, transportation problem (long distance, winter season), etc.): 15(22%), physical and mental disorders: 9(13%), athlete activity: 5(13%), bullying in their school life: 3(4%), unsuitable brace: 10(14%), others: 10(14%).

Discussion and Conclusion: In this study, the disorder was detected by measures other than school screening in 49%, indicating the necessity of further promoting the school screening for early detection of scoliosis. Furthermore, to reduce withdrawal from bracing therapy and improve compliance with it, it may be important to inspect orthoses frequently and carefully, while making environmental arrangements and providing mental care for patients.

O71.8 An Interim Analysis and Discussion into the Exploration of Physiotherapy Scoliosis Specific Exercise Based Therapy on Idiopathic Scoliosis using SRS-30 and Health Economic Measures - 6 Month Follow Up

Jason Black¹, Erika Maude ¹, Abbie Turland¹, David Glynn ²

¹Scoliosis SOS, London, United Kingdom, ²Independent, York, United Kingdom

Introduction: As there are seldom situations in which lifetime costs and QALYs can be observed directly in trials, eco-
Economic modelling is required to create estimates for decision making. In this study we report the first attempt to estimate the long term (6 month) effect of exercise based therapy on EQ5D. In addition to these measures we additionally analyse SRS-30 data at 6 months. We also investigate how long the effect of therapy persists by contrasting post treatment outcomes with six month outcomes. This analysis forms a basis for a future study which will model the cost effectiveness of exercise based therapy in the UK.

Objectives: This study aims to estimate the 6 month benefit from ScolioGold exercise based therapy using EQ5D and SRS-30.

Methods: Participants presenting at the Scoliosis SOS clinic filled out both SRS-30 and EQ5DSL questionnaires before, immediately after and at 6 months post treatment with ScolioGold method. Analysis of the effect of the treatment was carried out using regression models.

Results and Discussion: 330 patients were registered on the database as of 24/11/2016. Of this number 281 (85%) provided pre-treatment data for SRS-30 and EQ5D. 257 (78%) provided complete pre and post treatment EQ5D data and 264 (80%) provided this for SRS-30. For the EQSD measure, to date we have pre, post and 6 month data for 106 (32%).

O72.81 SRS22 Pain scale changes after surgical treatment in idiopathic scoliosis

Juan Bago1, Antonia Maramalas1, Elisa D’Agata2, Francisco J Perez-Grueso3, Ferran Pelisse1.

1Hospital Vall d’Hebron. Barcelona, 2Institut de Recerca Vall d’Hebron, 3Hospital La Paz Madrid - Spain

Introduction: The effect of surgery on perceived pain in patients with idiopathic scoliosis (IS) has not been fully analyzed.

Objective: To analyze and compare the quality of life between two groups of patients diagnosed with IE and surgically treated presenting with different levels of pain before surgery.

Material and Methods: 109 patients (mean age 18 years) (85.3% women) diagnosed with IS and surgically treated with an instrumented posterior fusion were included. Mean follow-up time was 20.5 months. 39 patients (35.8%) were included in the non-acceptable pain group (Pain Group, SRS22 pain subscale <3.8) and 70 patients (64.2%) in the acceptable pain group (No Pain Group, Pain subscale SRS22 ≥ 3.8). Statistical analysis included a comparison of preoperative, postoperative and mean changes in SRS22 Pain scale scores after surgical treatment between the two groups.

Results: Preoperative pain differed between two groups (Pain 2.64; No Pain 4.38, p<0.0001); higher improvement of pain was observed in the Pain Group (Pain 1.5; No Pain 0.18, p<0.0001). Nevertheless, at final follow-up NoPain Group has less pain (Pain 4.15; NoPain 4.56, p=0.003). In the No Pain group, 21% presented a worsening of pain and only 25.7% improved above the minimum clinically important difference (MCID); In the Pain group, only 7.6% reported a worsening of pain, while 92.3% of patients improved over MCID.
Conclusion: Patients with unacceptable preoperative pain (Pain Group) have a worse pain score and showed greater improvement after surgical treatment compared to the No Pain group. In this group, a greater percentage of patients improve above the MCID of the pain scale. However, at the time of follow-up, No Pain group continues to present better scores on pain.

Guide to Research Posters selected by the Scientific Committee
P3.76 Electrophysiological responses relates to visual perception in patients with adolescent idiopathic scoliosis (AIS)

Gonca Inanç ¹, Burçin Akçay Bayraktar ², Murat Ö zgören ¹, Ata Elvan ³, Ömer Akcalı ⁴, I. Safa Satoglu ⁴, I. Engin Simsek ³, Adile Öniz ¹.

¹ Department of Biophysics, Faculty of Medicine, Dokuz Eylul University, ² Dokuz Eylul University School of Physical Therapy and Rehabilitation, ³ Dokuz Eylul University School of Physical Therapy and Rehabilitation, ⁴ Department of Orthopedics, Faculty of Medicine, Dokuz Eylul University

Purpose: The aim of this study was to investigate the electrophysiological responses related to visual perception before and after conservative treatments in patients with AIS.

Methods: This study included 9 patients with AIS (1 boy, 8 girls; mean age: 12.80±2.00 years) and 9 healthy as a control (2 boys, 7 girls; mean age: 14.00±2.00 years). The Cobb angle values of AIS before the treatment were between 29°-39° (mean: 31.90°±3.17°) and between 8°-37° in-brace condition (mean: 17.10°±8.30°). During electrophysiology (EEG), all volunteers underwent a vertical visual perception experiment design. Prior to the EEG experiment the volunteers were asked to align a hand held laser line as much vertically as possible. Then, the difference between this line and the true earth vertical was taken as reference. For the EEG set-up a line shaped visual stimulus that had been randomized between ±15° of the reference value was used. Participants were asked to count on mind, if visual stimuli were vertical for herself (between ±2° of reference value). Same measurements were implemented pre and post treatment for AIS and only for one time for the controls. With this experimental design the responsiveness of the brain to vertical visual perception was evaluated objectively. For the analysis of the EEG results, POZ (parieto-occipital mid-zone) electrode data and P300 component which is a positive directional response component that is generated during conditions such as discrimination and attention processing, were used.

Results: Electro-physiological brain responsiveness of AIS and controls were compared pre and post treatments. For the target conditions, P300 component amplitude –generated mean 358.00±32.00 ms later after stimulus and related to cognitive process- was measured as a mean 8.79±4.76μV for pre-treatment, post-treatment latencies and amplitude were measured as mean 320.00±4.00 ms, 9.17±4.48μV, respectively. For the non-target conditions, pre - post treatment means of latencies and amplitudes were 336.33±34.47 ms and 11.45±3.01 μV and 338.10±29.00 ms and 9.55±3.46μV, respectively. In controls latencies and amplitudes of target condition means values were 387.33±37.20 ms and 5.99±2.84 μV; non-target condition values means were 350.00±44.45 and 8.03±2.32 μV. There was no significant difference in latencies in any of the conditions and in amplitudes in the target condition between the groups. But post-treatment P300 component amplitudes in non-target conditions improved %16, this result was significantly different and these values were closer to the values of controls (p<0.05).

Conclusion: The improvement in P300 component amplitude in false vertical condition after the treatment of patients with AIS, indicated an increase in processes related to directing attention after the treatment. Healthy controls may focus on vertical line of earth, whereas AIS patients may focus on false vertical line because of a possible faulty segmental alignment of their body compensating for the curvature. This preliminary study focused on only one EEG electrode. This is the early results of a larger study focusing on one electrode for the analysis. Data related to the remaining other electrodes are still under analysis for a more integrated explanation with the clinical progression data obtained by long-term follow-up.
P4.103 Back pain among children and adolescents study in highly urbanized city

Bozena Glinkowska¹, Wojciech Glinkowski²

¹Department of Sports and Physical Education, Medical University of Warsaw, ²Center of Excellence of Telediagnostics and Treatment of Injuries and Disorders of the Locomotor System “TeleOrto” Medical University of Warsaw - Poland

Introduction: The back and neck pain in children and adolescents is becoming a public health concern. Reports in the scientific literature and popular publications have suggested that children and adolescents suffer back and neck pain almost as frequently as described for the adult population.

Objectives: To study the prevalence of back and neck pain among children and adolescents using web-based survey.

Methods: Internet-based surveying system was utilized for a study assessing the prevalence of back and neck pain among children and adolescents in selected schools, in the highly urbanized city (capital city of Poland, Warsaw). The survey was shared through the link revealed by school teachers due to a back pain in children and adolescents project.

Results: One thousand three hundred and sixty-four school pupils responded the survey delivered by the secure web-based system, 687 (approx. 50%) females and 677 males, in the age from 10 to 19. Girls were 14 years old (STD 2.2), weight 50.6 (25-120, STD11.8). Height 161 (132 -190; std 8.8) ; BMI AVG 19.3 (11.4-45). Boys were an average 14.7 years old (STD 2.5). Their weight was average 60.4 kg (25-122; STD 17.3) and height 169.5 cm (127 -200; STD 13.9). The average BMI in this group was 20.7 (11-45). 42.5 % girls and 30.5% boys were underweighted. 2.8% girls and 3.9% boys were overweighted, and the obesity BMI over 30 was found in 1.6% girls and 3.25% boys. The total 62% of study group suffered a back pain (72% girls and 52% boys). Neck pain was reported by 35.7% girls and 22% boys. The thoracic pain was declared by 23.6% girls and 12.4% boys. Low back pain (LBP) was noted in responses from 34.4% girls and 26.8% boys. 28.1% girls and 48.4% boys were neck and back pain-free. The odds ratio for being neck and back pain-free was almost 2.5 times higher (OR=2.4; 95%CI 1.9 – 3 p<0.0001). Twenty-two percent of the respondents had a medical consultation because of the back pain. 24% of girls and 21% of boys carry their backpacks with extreme difficulties, 22% of girls and 13% of boys carry their backpacks with difficulties, and 49% of girls and 40% of boys carry their backpacks with some difficulties. The weight of the backpacks significantly influenced the back pain (CH2(3)=65.8; p<0.0001). The odds ratio for back pain diminishes along with the lighter backpack from 45% (OR=0.553, 95% 0.402 – 0.761) through 76% in a case of heavy backpack and by 69% (OR=0.315, 95% 0.218 – 0.455) in a case of extremely heavy backpack. Index c for the model = 0.62.

Conclusions and Significance: The back and neck pain remains a permanently occurring problem among children and adolescents. Public debates about heavy backpacks that are carried by pupils remain unsolved in the study region. The web-based survey focused on neck and back pain problems shall be used continuously to evaluate symptoms occurrence in the age groups. Appropriate countermeasures should be implemented to reduce the occurrences of back pain in schoolchildren.

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P5.107 Spine Health and Ergonomics in a sample of Australian High School Students

Larry Cohen, Shana-lee Abkin, Brian Condon

UprightCare Physiotherapy, Australia

Introduction: High school students throughout the world are having to deal with an increasing exposure to Information technology (IT) and this is especially so in first world countries such as Australia. The potential consequences of this exposure, such as back and neck pain, are causing concern to health stakeholders especially when considering, unlike the adult workforce, there is no government legislated obligation to comply with standardized ergonomic occupational health and safety (OH&S) requirements. Given that there are copious amounts of IT related OH&S recommendations freely available, Australian high school students have sufficient information on healthy IT work behavior. Australian Work Safety and OH&S guidelines require adult workstations to contain an adjustable chair, a desk, a footrest if needed and IT accessories including a keyboard and a mouse. The student health policy developed by the NSW education department advises that students should never work with their laptop on the laps. We elected to conduct a pilot study to determine whether a sample of Sydney based high school students were voluntarily adopting best practice OH&S work environments.

Methods: We conducted an online cross sectional survey of high school students (n=300) based on a previously published survey of Brazilian high school students (Filho 2015). The 35 question survey collected information detailing demographic, working and sedentary IT environment and postures, back pain and spine knowledge associated questions.

Results: According to our results, most students use a laptop computer (93%) compared with students who use a personal computer (pc) (1%) (P<0.001) for at least two hours per day (90%). In relation to ergonomic equipment, most students never use an external mouse (79%), never use an external keyboard (74%) and never use a footstool (80%). Ergonomic chair utilization whilst using a laptop was only 50%. Our research found that 157/275 (56%) of students sat at a desk whilst using a laptop and that, despite the NSW education department’s recommendation, 25% of respondents reported working on their device while holding it on their laps. Only 41/275(14%) of students reported working in an ergonomically correct posture while on their laptop. In addition to spending time on their laptop 53% of students also reported that they spent 2 or more hours per day on a small screen device.

The prevalence of back pain was reported to be 69% among respondents (188/273). Among the students that reported having back pain, 90% experienced some level of lower back pain, and 86% students reported feeling Upper Back pain and 77% respondents suffered Mid Back pain. Despite the high reported levels of back pain among the respondents only 25% reported taking any medication for their pain.

Conclusion: The results from our pilot study indicate that Australian High school students are not adopting best practice Occupational Health and Safety into their workplace environment. Further research is needed to determine the long term effects of these poor ergonomic postures in Australian High School Students. A suitable OH&S policy may be required for High School Students to help students comply with industry standards for workplace environments. The level and frequency of back pain among this population is a very worrying statistic and requires further investigation.
P6.12 Scoliometer validity in a Brazilian school screening scoliosis

Patricia Jundi Penha¹, Bárbarah Kelly Gonçalves de Carvalho¹, Rodrigo Mantelatto Andrade¹,², Nárima Lívia Jundi Penha¹, Silvia Maria Amado João¹

¹ Department of Physical Therapy, Speech and Occupational Therapy, University of São Paulo, ² Catholic Pontifical University of São Paulo - Brazil

The scoliometer is a non-invasive and radiation-free method that measures the asymmetries between the sides of the trunk in axial rotation degrees. Although the validity and reliability of the scoliometer are good, few studies have evaluated these characteristics in School Screening Scoliosis (SSS).

Purpose: To estimate the sensitivity, specificity, and predictive value of the scoliometer in a Brazilian SSS.

Methods/Analysis: We measured 2,562 adolescents (1,490 female and 1,072 male) aged between 10 to 14 years age. The adolescents studied in public schools belong to Education Regional Board of Mogi Mirim/São Paulo/Brazil. The radiographic examination and the Cobb angle were measured only in adolescents with angle of trunk rotation (ATR) ≥ 7°. The ART was measured at 45°, 60°, and 90° forward bending test in standing position. Sensitivity and specificity were evaluated using radiograph criteria for referral: Cobb angle of 10° and ART of 7°.

Results: Scoliometer sensitivity was better at 45° forward bending test (53.8% (95% CI: 43.7 – 64)), and the specificity and positive predictive value were better at 60° (75% (95% CI: 66.2 – 83.9)) and 78.4% (95% CI: 70 – 86.8), respectively. The worst values were found at 90° (sensitivity: 40% (95% CI: 30-50), specificity: 59.7% (49.7-69.7), and positive predictive value: 21.6% (95% CI: 13.2-30).

Discussion and Conclusions: Scoliometer accuracy was better at 60o forward bending test. The impairment of scoliometer validity at 90o may be related to a lack of flexibility both spinal and hamstring muscles. Significance: There are few studies about the scoliometer validity in SSS. Most of the studies evaluated the validity of the scoliometer in clinics. Although the standing position for forward bending test is the most used in SSS, it is believed that the sitting position may improve the validity of the scoliometer by eliminating lack of flexibility. Future studies may investigate the validity of scoliometer in sitting position in SSS. Key words: scoliosis, adolescent, mass screening, sensitivity and specificity.

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Ethics Approval: This study was approved by Ethics Committee of School of Medicine of the University of São Paulo (Research protocol number: 254/12)

Patricia Jundi Penha: Physiotherapist, Doctor Degree of Rehabilitation Sciences in the School of Medicine, Department of Physical Therapy, Speech and Occupational Therapy, University of São Paulo, Professor of Physical Therapy Course, Catholic Pontifical University of São Paulo, São Paulo, Brazil. E-mail: patriciapenha@usp.br

Bárbarah Kelly Gonçalves de Carvalho: Physiotherapist, Master Degree Student of Rehabilitation Sciences in the School of Medicine, Department of Physical Therapy, Speech and Occupational Therapy, University of São Paulo, São Paulo, Brazil. E-mail: barbarah_kelly@hotmail.com

Rodrigo Mantelatto Andrade: Physiotherapist, Master Degree of Rehabilitation Sciences in the School of Medicine, Department of Physical Therapy, Speech and Occupational Therapy, University of São Paulo, São Paulo, Brazil. E-mail: rodrigomantelatt@hotmail.com (presenter)

Nárima Lívia Jundi Penha: Researcher member, Department of Physical Therapy, Speech and Occupational Therapy, University of São Paulo, São Paulo, Brazil. E-mail: narimapenha@hotmail.com

Silvia Maria Amado João: Professor of Department of Physical Therapy, Speech and Occupational Therapy, School of Medicine of the University of São Paulo, São Paulo, Brazil. E-mail: smaj@usp.br
P7.85 Cobb Angle Measurements on Digital Radiographs Using Bunnell Scoliometer: Validation of the Method

Marcin Tyrakowski ¹, Dariusz Czaprowski ², Michal Szczodry ³, Kris Siemionow ³

¹ Department of Orthopedics, Pediatric Orthopedics and Traumatology, The Centre of Postgraduate Medical Education in Warsaw, Poland, ² Department of Physiotherapy, Józef Rusiecki University College, Olsztyn, Poland, ³ Department of Orthopedic Surgery, University of Illinois at Chicago, USA

Introduction: Radiographs on films are being superseded by new digital radiographs. Electronic rulers on computer screen are used to measure the Cobb angle instead of traditional methods with rulers, protractors and pens. The variety of software used to assess radiographs might make the Cobb angle measurements cumbersome in everyday clinical practice.

Measurements of Cobb angle on traditional radiographs by use of the Bunnell scoliometer have been reported as fast and easy even for non-experienced operators. Since the majority of radiographs nowadays are digital employing the scoliometer for Cobb angle measurements on computer screen might be clinically relevant. However, no data validating such measurements exists.

Objectives: The aim of the study was to verify the method of Cobb angle measurements on digital radiographs using Bunnell scoliometer.

Methods: Eighty patients with idiopathic scoliosis examined with standing long-cassette postero-anterior digital radiographs were retrospectively enrolled into the study. Cobb angle of each curve, both structural and compensatory, in all 80 patients was measured by use of Centricity software (reference method) and Bunnell scoliometer.

Cobb angles on 30 randomly chosen patients were measured 3 times by one researcher using only Bunnell scoliometer. Three researchers with various experience measured Cobb angles on the same 30 radiographs using Bunnell scoliometer.

Intraclass correlation coefficient (ICC) and median error for a single measurement (SEM) were used to verify agreement between Centricity software and scoliometer in Cobb angle measurements and for intra- and interobserver reliability of measurements.

Results: The mean Cobb angles of 224 curves measured in 80 patients by use of both, Centricity and scoliometer, were 29° ± 12.2° (range: 7 - 65°) and 28° ± 11.7° (range: 8 - 59°), respectively. The ICC for agreement between the 2 methods was 0.96 with SEM of 1.7°. Excellent intra- and interobserver reliability of Cobb angle measurements with Bunnell scoliometer was noted: ICC of 0.96 with SEM of 1.4° and ICC of 0.93 with SEM of 1.9°, respectively.

Conclusions and Significance
The study revealed excellent reliability of Cobb angle measurements on digital radiographs of patients with IS using the Bunnell scoliometer. Excellent intra- and interobserver reliability of the method was found.
P8.106 The development of a tool for assessment of sagittal spine shape literacy

Larry Cohen, Milena Simic, Sarah Dennis, Kathryn Refshauge, Evangeols Pappas

The University of Sydney - Australia

Introduction: The sagittal shape of the spine is an important factor in the non-operative, peri-operative and post-operative management of back pain. The aim of this project was to develop a novel yet simple tool for assessment of general population knowledge of a correct sagittal spine shape.

Methods: Two graphical tests were developed; one involving spine shape selection (SSS) from nine possible variations, while the other was a freehand drawing (SSD) on a printed stick figure. Participants were asked to select and draw what they considered to be the “correct” spinal shape. The tests were prospectively administered in a randomised crossover design to 250 adult participants (mean age: 40 years, SD: 18, 53% female) recruited through broad based and targeted recruitment strategies. The participants also completed demographic and back pain related questions. Additional secondary outcomes such as confidence in their correct response and possible reasons for discrepancy between drawing and shape selection were asked. The tests were scored by two independent raters and preliminary descriptive and inferential statistical analysis is presented.

The rating scale that was used to assess knowledge of the lumbar and thoracic curves (lordotic, straight or kyphotic) ranged from 0 (least correct: kyphotic lumbar and lordotic thoracic curve) to 8 (most correct: lordotic lumbar and kyphotic thoracic curve).

Results: A significantly greater proportion 74/249 (30%) of the SSD participants drew the correct shape of the spine when compared with the SSS participants 52/250 (21%) (p=0.02). When evaluating the lumbar spine shape independently, the lumbar lordosis was correct for 91/249 (37%) participants in the SSD assessment and 82/250 (33%) participants in the SSS assessment (p=0.12). Self-reported confidence was greater for the SSS (6.1/10, SD: 2.25) assessment than the SSD (5.7/10, SD: 2.29) assessment (p<0.001). Although 177/248 (72%) self-reported selecting and drawing the same shape only 104/249 (42%) were rated as doing so (p<0.001). Only 11/71(15%) of the participants who self-reported a difference in their drawing and selection assessments recorded that it was due to difficulty with drawing. There was weak (W= 0.11) agreement between SSD and SSS assessments when including the nine score options but this agreement improved to moderate (W=0.4) when stratifying the results into two score options: correct (score of 8) and incorrect (score below 8).

Conclusions

Fisher’s exact tests were used to evaluate differences in responses for the SSD and SSS assessments. Normal distribution was confirmed for self-reported confidence and differences between the assessments were assessed with a paired t test. Agreement between the two tests was assessed by Kendall’s coefficient of concordance (W).

Results: A significantly greater proportion 74/249 (30%) of the SSD participants drew the correct shape of the spine when compared with the SSS participants 52/250 (21%) (p=0.02). When evaluating the lumbar spine shape independently, the lumbar lordosis was correct for 91/249 (37%) participants in the SSD assessment and 82/250 (33%) participants in the SSS assessment (p=0.12). Self-reported confidence was greater for the SSD (6.1/10, SD: 2.25) assessment than the SSD (5.7/10, SD: 2.29) assessment (p<0.001). Although 177/248 (72%) self-reported selecting and drawing the same shape only 104/249 (42%) were rated as doing so (p<0.001). Only 11/71(15%) of the participants who self-reported a difference in their drawing and selection assessments recorded that it was due to difficulty with drawing. There was weak (W= 0.11) agreement between SSD and SSS assessments when including the nine score options but this agreement improved to moderate (W=0.4) when stratifying the results into two score options: correct (score of 8) and incorrect (score below 8).

Conclusions

A simple graphical ordinal rating scale, developed and administered to a large sample, demonstrated that 70% of the general population is unable to reproduce or select the correct shape of the sagittal spine. Although there is currently little evidence to suggest that the assessments are interchangeable further analysis to compare the tests is planned. However, these test concepts, especially the SSD, can be immediately and easily translated into clinical practice to help with patient education and treatment.
P11.105 Inter-rater reliability of sagittal balance measurements by orthopedists using Web-based tool for assisted x-ray image analysis

Wojciech Glinkowski¹, Jerzy Narloch¹, Robert Gasik², Thu Huong Dao³, Jakub Kamola, Mahmoud Osman³, Ida Jokisz³

¹Department of Medical Informatics and Telemedicine, Center of Excellence of Telediagnostic and Treatment of Injuries and Disorders of the Locomotor System “TeleOrto” Medical University of Warsaw // Polish Telemedicine Society, Warsaw, ²National Institute of Geriatrics, Rheumatology and Rehabilitation, Warsaw, ³Polish-Japanese Academy of Information Technology, Warsaw - Poland

Introduction: Recently, an increasing recognition of the clinical importance of the sagittal plane alignment of the spine is frequently reported in the literature. The physiological spinal sagittal balance should serve as a baseline for the evaluation of pathological conditions associated with abnormal angular parameter values namely: sacral slope (SS), pelvic tilt (PT), pelvic incidence (PI), lumbar lordosis (LL), thoracic kyphosis (TK), sagittal vertical axis (SVA), global tilt GT, spinosacral angle (SSA).

Objectives: The aim of the study was to assess the reliability of the ArrowSpine application based on the set of 10 radiograms determined by physicians specialized or specializing in Orthopaedics. We hypothesized that the sagittal balance radiographic assessment would have acceptable interrater reliability.

Methods: The Sagittal balance measurements principles were presented during the conference organized by Eastern Chapter of the Polish Society of Spinal Surgery. Some of the participants were familiar with sagittal balance principles. Web-based tool for assisted x-ray image analysis (ArrowSpine/PJATK) is a database-backed web application written to support the diagnostic measures of the spinal radiograms. The application was created to address the need for the spine specialists to have a single tool to store patient scans, analyze them, and to save the results. The central and most important component of the application allows for analyzing x-ray scans using four calculation methods - Cobb's Angle, Centroid Angle, Vertebral Heights, and Sagittal Balance measures. Physicians were invited to use the application and perform measurements of ten cases. Full spine lateral standing view radiographs of 10 patients (5 scoliosis and 5 kyphosis due to the osteoporotic vertebral fracture) were uploaded to the system and used as the study material. The ArrowSpine measurement system was used. The radiographs were independently assessed by 10 orthopaedic surgeons using the sagittal balance measurement instructions incorporated into the application. Interrater reliability was evaluated using the intraclass correlation coefficient (ICC) for the same raters model to assess absolute agreement.

Results: Fifty eight testers were invited to the study. Finally, only ten Orthopaedic surgeons completed the study. The average time per scan was 90.38 sec. (from 18 to 520; St.Dev. 80.58). The degree of absolute agreement among measurements for single measures of Intraclass Correlation Coefficient for selected parameters were: 0.40 (95%CI 0.19 – 0.71) of PI; 0.23 (95%CI 0.07-0.55) of PT; and 0.008 (95%CI -0.05-0.21) of SVA. The estimates the reliability of averages of k ratings for average measures of Intraclass Correlation Coefficient were: 0.87 (95%CI 0.69 – 0.96) of PI; 0.72 (95%CI 0.42 – 0.91) of PT; and 0.07 (95%CI -1.06 – 0.72) of SVA.

Conclusions and Significance: The overall interrater reliability was not satisfactory enough. These findings suggest that multiple raters may score the same radiographs differently using the same instructions. Several influencing factors can be considered including computer skills for radiographic measurements and difficulties in recognizing anatomical landmarks of all sagittal balance parameters. Insufficient recognition of the clinical importance of the sagittal plane alignment of the spine shall improve with adequate education.
P12.26 The correlations among Cobb angle, Axial Trunk Rotation angle and Surface Electromyography activities of paraspinal muscles in adolescent Idiopathic Scoliosis patients

Wangshu Yuan

**Study design:** Exploratory study of surface electromyography (SEM) activities in adolescent idiopathic scoliosis (AIS) patients.

**Background:** Scoliosis was reported to have effects on the paraspinal muscle activities, however the correlations among paraspinal muscle activities, Cobb angle and axial trunk rotation (ATR) angle have not been published in detail.

**Objects:** The aim of this study was to assess the SEMG activities on paraspinal muscle, and to evaluate the correlations among the Cobb angle, ATR angle and SEMG activities of paraspinal muscles in AIS patients.

**Methods:** This study involved 89 AIS patients who were on average 14.78 years old(±2.20 years). Cobb angle, ATR angle and Value of Root Mean square (RMS) were collected for the study. Analyzed the RMS of the paraspinal muscles, and evaluated the correlations of the three indexes.

**Results:** RMS value on the convex side was greater than the concave side, the difference was significant (P<0.05, P=0.022). In all the subjects, the correlation between Cobb angle and the ATR angle was r=0.613 with p<0.01, and the correlation between ATR angle and the RMS Ratio was r=0.269 with p<0.05. In the thoracolumbar and lumbar curves with small and mild Cobb angle, the correlation between ATR angle and the RMS Ratio was r=0.449 with p<0.01, and the correlation between Cobb angle and the RMS Ratio was r=0.431 with p<0.01.

**Conclusions:** The SEMG activities of paraspinal muscles on the convex side were greater than the concave side in AIS patients. The RMS ratio of paraspinal muscles had better correlation with the ATR angle than with the Cobb angle in AIS patients. The Cobb angle and SEMG activities of paraspinal muscles in the thoracolumbar and lumbar curves with small and mild Cobb angle has the best correlation in all curves and Cobb angles.


Beatriz Rodriguez

*CorpoSchema Pilates & Rehab, Inc, USA*

**Introduction:** Large congenital melanocytic nevi (LCMN) are pigmented skin lesions > 11 cm in diameter that are present at birth in 1:20,000 newborns, or may develop shortly after birth. Congenital nevi have been associated with diverse musculoskeletal conditions including scoliosis. Treatment of LCMN typically consists of multiple surgical excisions over time involving tissue grafting and skin expansions. There is no information available regarding the efficacy of BSPTS Schroth
based exercises on patients with idiopathic scoliosis (IS) after undergoing surgery for excision of LCMN on central body areas. This case report demonstrates improved quality of life and overall posture in an adolescent with IS treated with Schroth based exercises after surgical excision of LCMN.

Objectives: The aim of this study is to report the effects of Schroth based exercises on one adolescent patient with IS who had undergone multiple surgical excisions of LCMN.

Methods: A 15-year-old female had undergone 14 surgeries since birth for excision of large nevi on the upper trunk and head regions. She initiated individualized Schroth based exercises for aesthetic reasons and back pain 4 months after the last surgery. The patient was diagnosed with IS at age 13 and had not received any previous treatment. X-rays confirmed a Risser stage 4, a single left thoracolumbar curve of 30, and increased sagittal view curves. She was seen regularly in outpatient clinic by a BSPTS Schroth therapist for 1 hour long sessions 3 days per week for 3 months, and was educated on a home exercise program to be practiced using wallbars at home. The following parameters were assessed at initial evaluation (IE) and 3 months after treatment: angle of trunk rotation (ATR) using the scoliometer, sagittal plane alignment measured on the body with a digital inclinometer, vital capacity using a spirometer, seated trunk height, standing height, ribcage circumference expansion, and timed single limb balance. The SRS-22 questionnaire and visual analog scale (VAS) were used at IE and post treatment. Postural photographs were taken before, during, and after treatment.

Results and Discussion: (ATR) at the thoracolumbar apical level decreased by 4 after 3 months. Standing height increased by 1.2 cm after 3 months. Seated trunk height increased by 0.6 cm post treatment. Vital capacity improved from 2500 cc at IE to 3600 cc post treatment. Ribcage circumference expansion after 3 months increased by 0.5 cm, 1.2 cm, and 0.8 cm at the axilla, xiphoid, and waist levels, respectively. The lumbosacral angle changed from 55° pre-treatment to 43° post-treatment. Standing lumbar lordosis decreased from 60° pre to 52° post-treatment. Standing thoracic kyphosis decreased from 48° to 38° post treatment. The SRS-22 questionnaire revealed a mean score of 3.7 upon IE as compared to 4.5 post treatment. Timed single limb stance after 3 months increased by 18 seconds on the left and by 15 seconds on the right. Pain level decreased from 6/10 at IE to 1/10 after 3 months. Digital photographs in standing showed improved overall posture after 3 months of treatment.

Conclusion and Significance: A regular practice of BSPTS Schroth based exercises had a positive outcome on one adolescent patient with IS after surgical excision of LCMN. Despite the rarity of LCMN, it is important to consider further research on the effect of physiotherapy scoliosis specific exercises (PSSE) on this unique patient population also appearing to be affected by idiopathic scoliosis.
P18.67 Preoperative Bracing Therapy for Surgical Patients with Adolescent Idiopathic Scoliosis

Ken Yamazaki ¹, Takayuki Kikuchi ², Satoshi Yoshida ²

¹ Iwate Spine & Scoliosis Center, ² Iwate Kitakamisaiseikai Hospital - Japan

Introduction & Objectives: Pediatric patient visits for spinal deformity are common. Appropriate management of scoliotic curve that do not meet surgical indication parameters is essential. To clarify the factors that had led patients with adolescent idiopathic scoliosis (AIS) to undergo surgery by examining the circumstances of the initial consultation, withdrawal from bracing therapy, and others.

Subjects and Methods: A total of 177 (16 males and 161 females with a mean age of 15.9 at the time of surgery) surgical patients treated by the author after 2001 were studied. Among these, 142 (80%) were referred by other facilities, and 35 (20%) directly visited our facility for consultation. An underarm, rigid thoraco-lumbar brace was used for all those treated with bracing therapy.

Results: The disorder was identified through school screening in 105 (59%). Among all surgical patients who underwent surgery, seventy-two patients (41%) were treated with a brace. Poor compliance with 52 (PC group) or withdrawal from 17 (W group) bracing therapy were observed in 69 patients treated by the author. In the case of W group, it ranged from 1 to 3 month. The mean Cobb angles of all groups on the initial consultation and before surgery were 38.6 and 55.6 degrees, respectively. There was a significant different between the mean Cobb angle of W group (59.7 degrees) and PC group (51.6 degrees) before surgery (p<0.009).

The leading causes of both groups were as follows: daily life-related stress: 17(25%), environmental conditions of outpatient treatment (parent's reasons, transportation problem (long distance, winter season), etc.): 15(22%), physical and mental disorders: 9(13%), athlete activity: 5(13%), bullying in their school life: 3(4%), unsuitable brace: 10(14%), others: 10(14%).

Discussion and Conclusion: In this study, the disorder was detected by measures other than school screening in 49%, indicating the necessity of further promoting the school screening for early detection of scoliosis. Furthermore, to reduce withdrawal from bracing therapy and improve compliance with it, it may be important to inspect orthoses frequently and carefully, while making environmental arrangements and providing mental care for patients.
P19.94 Schroth, Sagital Alignment, and Vertebral Body Tethering

Marissa Muccio¹, Kate Mitchell²

¹ Scoliosis Specialty Center, ² Rutgers School of Health Related Programs, USA

Introduction: According to the 2011 SOSORT Guidelines, scoliosis is a 3-dimensional torsion deformity of the spine and trunk. The knowledge of the 3-dimensional component of scoliosis signifies that scoliosis not only is a frontal place lateral curvature and horizontal plane axial rotation but also a disturbance of the sagittal plane normal kyphosis and lordosis curvatures. “Schroth specific scoliosis treatment is a 3-dimensional approach to treating various deformities and static changes of the scoliotic trunk in addition to the curved spine.” (Lehnert-Schroth, 1992).

Objectives: The objective of this case report was to describe the effect of Schroth based physical therapy on the sagittal plane deformity and pain of a girl with scoliosis and kyphosis.

Methods: Patient is a 17yo with a R N3N4 C1 with a D modifier. Cobb angle of 36 thoracic, 31 lumbar, 20 D-modifier, 46 degrees of kyphosis and Schmorl’s nodes. She has a Risser 4 with chronic pain daily in multiple locations 6/10 on subjective pain scale, SoB with negotiating stairs, and occasional “numbness” in midback. Physician recommended spinal fusion.

17 hours of Schroth PT, 60 min sessions at a frequency of 3x/week faded to 1x/week due to band camp.

Treatment consisted of scoliosis and kyphosis education, therapeutic exercise, neuro-muscular re-education, Schroth motor training, myofascial release, postural training with drum brace for marching band, and kinesiotape.

Results: After Tx, physician x-ray measured thoracic and lumbar cobb angles at 41 and 33 respectively and kyphosis decreased from 46 to 34. PT Inclinometer thoracic decreased from 63 to 41. Pain decreased to 0-2/10. The patient achieved independence in most of the positions. Observed independence was noted at: 9th hour for all pelvic corrections, 8th hour for set up of supine, 10th hour for set up and alignment of prone on knees, 15th hour for set up and alignment of sidelying with independence of activations after faded cues. Independence was not observed in set up and self-alignment with kyphosis board exercise until 10 minutes of practicing.

Conclusions: Schroth based physical therapy improved sagittal posture and bony alignment. It also decreased pain and increased recreational function during marching band.

Significance: For this patient and family the still intermittent pain and concerns for future resumed the question of surgery. However now, the resulting changes in sagittal alignment allowed her to qualify for vertebral body tethering rather than the more invasive posterior spinal fusion.
P20.38 Comparison of Two Different Methods in Supporting Abdominal and Back Muscles of Physically Disabled Table Tennis Athletes

Inanoglu D. ¹, Yakut Y. ²

¹: Master of Degree Physiotherapist, (Student of Phd), ²: Hasan Kalyoncu University, Institute of Health Sciences, Physiotherapy and Rehabilitation Department - Turkey

The aim of this study was to compare the effects of kinesio taping and elastic corset on sports related physical performance and trunk muscle endurance when used in supporting abdomen and back muscles of physically disabled table tennis athletes with scoliosis.

Twenty-two advanced level physically disabled table tennis athletes who playing actively sports for at least 2 years, with 11 sitting on wheel chair, and 11 standing athletes were included in the study.

Kinesio taping, soft orthosis and none of the above (free) applications were applied to each of the players before training.

Pain assessment, joint motion range, modified functional elongation test, manual muscle test, modified sit-ups test, modified abdominal endurance test, special multifidus muscle test, modified push-ups test, number of ball strikes in 60 seconds with forehand-backhand (1-1) combination technique, and with “enter short-exit long” forehand combination technique were applied and recorded in all players.

When comparing the data evaluated after free, kinesio taping, and orthoses applications were statistically significant (p<0.05). Soft orthoses application was found more effective than kinesio taping and free applications on decreasing of pain during performance, and enhancement of body muscle endurance, and ball striking performance in the final analysis (p<0.05). Kinesio taping was found more effective than free and orthoses application in improvement modified functional elongation and joint motion range (p<0.05).

This study showed that soft orthoses is most effective in decreasing pain, enhancement of muscular endurance, and sports related physical performance on disabled athletes with scoliosis.

We suggest that further and broader studies evaluating the long term effects of pain, muscle endurance, and sports related physical performance are needed.

P21.108 Multi-modal Spine Strengthening Exercise Program to Reduce Hyperkyphosis in Older Adults: Results from the SHEAF Study

W.B. Katzman¹, D.M. Kado², E. Vittinghoff³, F. Lin¹, A. Schafer¹,⁵, R.K. Long¹, S. Wong¹, A. Gladin³, N.E. Lane⁴

¹University of California, San Francisco, CA; ²University of California, San Diego, CA; ³Kaiser Permanente Northern CA; ⁴University of California, Davis, CA; ⁵San Francisco Veterans Affairs Medical Center

Hyperkyphosis in older adults is associated with reduced physical mobility, quality of life and health status, but there is no standard intervention to reduce age-related kyphosis progression. We performed the Study of Hyperkyphosis, Exercise and Function (SHEAF) to investigate the efficacy of a targeted spine strengthening exercise and postural training program, compared with no exercise intervention, among community-dwelling older men and women on the primary outcome Cobb...
angle of kyphosis and secondary clinical measures of kyphosis, physical function and health-related quality of life (HRQoL).

Ninety-nine men and women aged ≥60 years with thoracic kyphosis ≥40° were randomized to exercise or attentional control groups. Study performance sites included one academic medical center and one local community medical center. The intervention included exercise and postural training, delivered by a physical therapist in groups of 10, consisting of 1-hour classes, 3 times a week for 6 months. Controls received monthly health education meetings in groups of 10 with monthly calls to monitor physical activity. The primary outcome was change in Cobb angle of kyphosis measured from standing lateral spine radiographs at baseline and 6 months. Secondary outcomes included change in clinical measures of kyphosis (Debrunner kyphometer), physical function (Modified Physical Performance Test, Timed Up and Go, Time Loaded Standing, Six-minute Walk and spinal extensor muscle strength) and HRQoL (PROMIS health and function questionnaires), and Scoliosis Research Society SRS-30 (self-image domain). ANCOVA was used to assess effects of the intervention on change from baseline to 6 months in primary and secondary endpoints.

Participants (70 women, 29 men) were 70.6±0.6 years old with baseline Cobb angle of kyphosis 57.4± 12.5 degrees. Subject characteristics in both groups did not differ at baseline. There was a significant between group difference in change in Cobb angle of kyphosis of -3.0 degree (95%CI: -5.1, -0.8), p<0.001. There was a significant change in Cobb angle of kyphosis in the active group, -3.8 degree (95%CI: -5.7, -2.0) and a non-significant -0.9 degree (95%CI: -2.8, 1.0) change in the control group (Table 4). There were no significant between or within group differences in other musculoskeletal or physical function outcomes, p>0.05. Of the quality of life measures, there was a significant 0.43 point (95% CI:0.24, 0.61) difference between groups in change in SRS-30 self-image score, p=0.001. There were no significant changes in other quality of life measures, p>0.05. There were no adverse events reported.

A 6-month targeted spine strengthening exercise and posture training program reduced both radiographic and clinical measures of kyphosis. Participants who received the exercise intervention also improved their self-image and satisfaction with their appearance. Results suggest that targeted spine strengthening exercise and postural training is an effective treatment option for older adults with hyperkyphosis.

P22.109 Modern conservative scoliosis treatment based on a multidisciplinary concept

Axel Hennes

MVZ Centre for spinal deformities, Bad Sobernheim, Germany

Introduction: Conservative scoliosis treatment mainly has concentrated on observation, physical therapy specific exercises and orthosis (braces). The questions remain: When should the therapy start, which means should be used passive support pro-active approaches, what is the appropriated dosage.

The answers for these questions in many countries around the world is given by the physician or by the or-
thopedic surgeon. He is the one who makes the decision according to his expertise, experience, scientific know-how and the availability for typical therapeutic features. Recommendations are given by the big scoliosis societies SRS and SOSORT and other experts in the field.

**Objective:** The author has defined three working hypothesis regarding the effectiveness of a combination of PSSE and braces together with advantages of a team approach. Additionally it will be given a recommendation for standardized processes and therapy elements.

**Methods:** The following paper describes an example of application a multidisciplinary team approach in which experienced experts in the scoliosis filed work together in a centre for spinal deformities (MVZ- Bad Sobernheim) providing a patient-centered scoliosis and kyphosis therapy including educational and practical elements (S-C-S Spine Concept Sobernheim and S-C-S Brace).

Thesis 1: The out-patient conservative scoliosis and kyphosis therapy will be more effective and evident when provided by a multidisciplinary competence team.

Thesis 2: Standardized therapeutic processes provides an advantage when the basics of the therapy plan, as well as of the medical progress documentation and of the result documentation are well coordinated and harmonized.

Thesis 3: The effects of braces and physical therapy scoliosis specific treatment approach are mutually supportive or inhibit one another.

**Results:** In the S-C-S Spine Concept Sobernheim a team of scoliosis experts has defined treatment guidelines, using a combined classification for ISST-Schroth (International Schroth 3 dimensional Scoliosis Therapy). Although this team has developed the S-C-S brace and has integrated a bundle of standardized therapeutic elements.

Teams especially generated for scoliosis and kyphosis treatment consisting of orthopedic surgeons, orthopedic technicians and physical therapists, with long experience and fundamental know-how, designed for short distance communication, with common terms and explanations regarding therapeutic means and goals enables patients to participate at a high effective therapy approach. Located under one roof this could demonstrate interactive exchange and personal competence focusing on the individual situation of the patient.

Relevant medical and physical examination reports, changes, assessments regarding the prognosis, evaluation of the risk of progression and personal experience could be exchanged in short terms and help to improve the clinical reasoning.

Impairments, limitations, compliance, commitment and adherence to treatment could be recognized and evaluated early in order to adapt the treatment strategy.

For patients it is time and cost effective because the decision making process will be accelerated and therapy (bracing, exercises) could start at an earlier stage. Interdisciplinary counselling and support help patients to understand and accept to bear their share of responsibility, avoiding non-realistic expectations and further frustration. The goal is to have patients fully committed playing an active role in the therapy process.

The number of scoliosis patients per year is about 1500 cases. The number of scoliosis braces handled and supervised within the S-C-S are about 1000 including 85% children and adolescent scoliosis patients, 10% sco-
scoliosis patients after reaching skeletal majority and 5% of kyphosis patients.

**Conclusion and Significance:**

After the recommendations and guidelines for conservative scoliosis treatment given by the SOSORT in 2011 the S-C-S is an example for trying to realize a patient centred team approach which combines a physical therapy approach based on the worldwide accepted Schroth therapy with a brace concept based on Cheneau and Rigo principles.

Both elements are embedded in an educative concept which provides information, counselling and training for patients as well as for professionals. The idea is to improve the quality of the conservative scoliosis treatment.

For the future the results of the S-C-S treatment approach has to be investigated according the study designs from the SRS and SOSORT.

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**P24.70 How does the conservative treatment affect postural control mechanisms in patients with adolescent idiopathic scoliosis?**

Burçin Akcay Bayraktar ³, Ata Elvan ³, Gonca Inanç ¹, Adile Öniz ¹, I. Safa Satoglu ⁴, Ömer Akçali ⁴, Ibrahim Engin Simsek ²

¹ Department of Biophysics, Faculty of Medicine, Dokuz Eylül University, ² Dokuz Eylül University School of Physical Therapy and Rehabilitation, ³ Dokuz Eylül University School of Physical Therapy and Rehabilitation, ⁴ Department of Orthopedics, Faculty of Medicine, Dokuz Eylül University

**Introduction**: There are studies indicating that in adolescent idiopathic scoliosis (AIS) dynamic and static postural control mechanisms are affected positively by conservative treatment.

**Objective**: The aim of this study was to investigate the effects of conservative treatments on postural control parameters in individuals with AIS. Method: The study included 20 patients with AIS; 10 subjects (group 1) with AIS between the ages of 11-15 years (2 males, 5 females with a mean age of 13±24 years), 10 subjects (group 2) with AIS between the ages of 10-15 years (10 females with a mean age of 12,7±1,7 years) and 7 healthy subjects (control group) between the ages of 12-16 years (2 males, 5 females with a mean age of 14±2 years). Conservative treatment protocol consisted of brace treatment, Schroth exercises and dynamic balance exercises with Balance Master System (NeuroCom Int. Inc. Clackamas, OR, USA) ver. 8.1 (BMS). All patients with AIS wore full time rigid brace (Cheneau) and performed Schroth exercises. Group 1 performed only Schroth exercises, second group performed Schroth exercises in addition to balance exercises with BMS. The exercise treatment consisted of 18 sessions with a duration of 90 minutes per day for 3 days per week for 6 weeks. The Cobb angle values of AIS were recorded. Also, with the help of BMS static and dynamic balance responses were recorded for three groups (pre-post treatment for the group 1 and group 2 but once for the control group). Static balance test consisted of standing with eyes open on a firm surface (firm EO), standing with eyes closed on a firm surface (firm EC), standing with eyes open on a foam surface (foam EO), standing with eyes closed on a foam surface (foam EC). In dynamic balance test the limit of stability (LOS) was measured. LOS tests were: reaction time (RT), movement velocity (sway), endpoint excursion
(EXE), maximal endpoint excursion (m-EXE) and directional control (CD).

**Results:** Cobb angle values were between 24°-40° (mean: 32.9±4.95) in group 1 and 23°-46° (mean: 31.3±7.27) in group 2; while with brace were between 8°-37° (mean: 18.5° ±9.15°) in group 1, (-8)°-30° (mean: 15,1° ±11,39°) in group 2. In group 1 for firmEC condition and in group 2 firmEO condition, sway velocity of centre of gravity (CoG) was observed as it increased post-treatment when compared to pre-treatment measurements. In foamEO and foamEC condition, sway velocity of CoG was observed as it improved after treatment in both groups (group 1 improved in foamEO condition %4, group 2 improved in foamEO condition %33 and foamEC condition %15 ) compared with controls there was significant difference (p<0,05). Also group 1 couldn’t reach to control’s values, but group 2 was able to reach to the control’s values. For all groups sway velocity of CoG values were measured as the top values in foam surface-eyes closed condition. EXE and m-EXE improved after treatment, although there was no significant difference. RT and DC improved significantly in group 2 compared with controls (RT p=0.042; DC p=0.033; p<0.05).

**Conclusion:** Our treatment results indicated that conservative treatment may ensure improvement on static and dynamic control mechanisms in AIS. According to results of this study it could be noted that conservative treatment affects the postural control positively, also dynamic balance treatment could ensure additional improvement on postural control. Conservative treatment of AIS may include dynamic balance exercises in addition to scoliosis specific exercises and brace treatment.

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**P25.74 Behavioral level changes of brain asymmetries in AIS patients after conservative treatment: a preliminary study**

Burçin Akçay Bayraktar ², Gonca İnanç ¹, Ata Elvan ², Adile Öniz ³, I. Engin Simsek ³, I.Safa Satoglu ⁴, Ömer Akçali ⁴, Murat Özgören ⁴

**Introduction:** Brain studies have previously shown asymmetrical cortical hyper-excitability in patients with adolescent idiopathic scoliosis (AIS) and found volumetric differences in 22 brain regions.

**Objective:** The aim of this study was to evaluate the behavioral level of changes of brain asymmetries in AIS patients after conservative treatment.

**Method:** The study included 20 patients with AIS. Group 1 consisted of 10 subjects (mean age: 13.00±2.40 years), Group 2, 10 subjects (mean age: 12.70±1.70 years) and 9 (mean age: 12.00±2.00 years) healthy controls. All subjects were right handed. Cobb degrees in Group 1 were between 24°-40° (mean: 32.90±4.95°) and mean in-brace were 18.50°±9.15°. Cobb degrees in Group 2 were between 23°-46° (mean: 31.3°±7.27°) and mean in-brace were 15,1° ±11,39°. All AIS patients wore full time rigid brace (Modified-Cheneau) and performed Schroth exercises. Group 2 performed balance exercises in addition to Schroth exercises using Balance Master System ( NeuroCom Int. Inc. Clackamas OR USA) ver 8.1.
The exercises were conducted for 6 weeks (18 sessions, 1.5 hours each session). Before and after the treatments, the dichotic listening (DL) paradigm was used to evaluate brain asymmetries. In the DL test, syllables were used as an auditory stimuli (ba, da, ga, ka, pa, ta). The stimulus was different in the right-left sides. Subjects chose the one that was heard first then pushed the button held in their hands. 36 syllable pairs were presented in different conditions: no attention directing (non-forced, NF), directing attention to the right ear (forced-right, FR), directing attention to the left ear (forced-left, FL). Declarations of the heard syllable were recorded with a recently developed electronic system. In statistical analysis, repeated measurements of Kruskal-Vallis variance analysis was used.

**Result:** Pre-post treatment results for Group 1 in directing attention to right ear (REA) the means were: 15.30 (±3.60) – 14.80 (±4.66) in NF, 12.55 (±2.69) - 13.00 (±5.49) in FR, 13.90 (±4.90) – 13.00 (±5.49) in FL. Results of Group 1 in directing attention to left ear (LEA) were 7.00 (±2.30) – 7.60 (±4.24) in NF, 5.70 (±2.83) – 6.60 (±2.60) in FR, 7.70 (±3.50) – 9.70 (±5.50) in FL. Pre-post results for Group 2 REA were 12.90 (±3.28) – 14.40 (±3.37) in NF, 13.55 (±4.91) - 14.30 (±5.70) in FR, 8.60 (±4.80) – 11.50 (±4.50) in FL. Group 2 LEA were 8.90 (±1.60) – 8.80 (±2.40) in NF, 6.60 (±4.30) – 8.00 (±2.70) in FR, 9.60 (±4.40) – 11.60 (±5.54) in FL. For the control group REA were 12.14 (±5.80) in NF, 13.60 (±7.60) in FR, 1114 (±5.60) in FL. For the control group LEA were 10.40 (±5.80) in NF, 9.60 (±6.60) in FR, 11.40 (±4.15) in FL. In all of the conditions the rate of REA was found to be greater than controls and the rate of LEA was lesser than controls, although there were no significant differences in any of the conditions. Post-treatment rate of REA increased in group 1 and especially in group 2, but there were still no significant differences. In previous studies, more hemispheric lateralization was detected in AIS than controls in the DL and a positive correlation between perceptual asymmetry and convex side was observed. Our results showed that there seems to be a hemisphere dominance in AIS, but it does not correlate with the degree of curves or curve patterns.

**Conclusion:** AIS subjects seem to have hemispheric dominance. Conservative treatments, especially balance exercises may increase behavioral level of changes in AIS patients. Our results warrants further studies including more subjects and long followup periods prior to generalization.

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**P26.21 Comparison of EDF casting with Risser body casts in infantile scoliosis**

Channing Tassone ¹, Xue-Cheng Liu ¹, John Thometz ¹, Benjamin Gundlach ¹, Sergey Tarima ²,

¹ Dept. Of Orthopaedic Surgery, Children’s Hospital of Wisconsin, Medical College of WI, ² Institute for Health and Society, Medical College of Wisconsin - USA

**Introduction:** The use of casting as a corrective force to treat scoliosis has long been utilized clinically. There are two types of casting techniques applied in our institution in the correction of spinal curves, including Elongation-derotation-flexion (EDF) casting and Risser Body Cast (RBC). EDF casting requires an AMIL frame to provide three-dimensional corrective forces along three axis of the spine, while RBC is applied with more translational force on the apex and gentle derotation molding using a hip spica table. Given the evidence of the treatment of EDF or RBC in the literature, both of them have been
considered as an effective approach to treating early-onset-scoliosis (EOS). However, few studies reported comparison of effectiveness of these two casting techniques directly.

**Objective:** The goals of this study were: 1) to compare changes in Cobb angle, thoracic height and other clinical features between EDF and RBC casting technique before and after 6 months; 2) to assess Cobb angle and thoracic height at 6 month post-EDF or post-RBC as compared to the baseline.

**Methods:** This retrospective study was approved by IRB committee of Children's Hospital. Nine children with infantile idiopathic scoliosis were treated by EDF serial casting with anterior and posterior windows and followed for at least 12 months. Seven children with the same diagnosis were applied by RBC with usually an anterior window and followed up at least 6 months. All of them had x-ray measurements at 0, 6 months, and 12 months (only for EDF). Casts were changed every 2-4 months. Clinical data was collected, including age, Cobb angles in AP view, thoracic height, the number of casts, and time at the treatment. Independent t-test was performed to compare these clinical data between two casting techniques in 6 months. Paired t-test was performed to compare them between 0 and 6 months. ANCOVA model was used to predict the effect of Cast type on Cobb angle change over 6 months with controlled variables.

**Results and discussion:** There were no significant differences for age at the initial treatment, Cobb angle at 0 and 6 months, reduction of Cobb angle, thoracic height at 0 and 6 months, and growth of thoracic height between the two casting techniques (P>0.05) (Table 1). However, age at initial diagnosis and the number of casts were significantly different between the two castings (P=0.03), where children with EDF were younger at diagnosis (13.4 months vs.19.1 months) and tended to receive 2 to 3 more castings than those with RBC (6.75 vs.4 casts). EDF provided significant correction of Cobb angle at 6 months (P=0.048), while RBC did not (P=0.11). Both casting techniques allow significant growth of thoracic height at 6 month (P<0.01). Overall ANCOVA model did not show pronounced effect difference of Cobb angle changes between the two casting technique when integrating controlled variables (e.g. age, a number of casts etc.) but affirmed continue longitudinal growth effect on the thoracic height.

**Conclusion and significance:** Both EDF casting and RBC are successful as a delay tactic for surgical intervention. They are effective in the treatment of infantile idiopathic scoliosis, with an improvement of Cobb angles coupled with continuous growth of the trunk height. Whereas EDF casting tends to be more aggressive at a younger age, with two or three more casts than those in RBC receivers. Patients with RBC are more likely to have shorter follow up than those with EDF.
P27.51 Segment modifications of corrective spinal orthoses.

Pavel Cerny¹, Petr Kawczyk², Ivo Marik¹

¹ Faculty of Health Studies, University of West Bohemia, Pilsen. ² Faculty of Physical Education and Sport, Charles University, Prague.

Introduction and methods: We have been for a long time using in-depth forming of scoliotic braces, based on certain modifications of the original shapes of Cheneau braces. At the beginning of the 90s, we developed a dynamic spinal orthosis, allowing inclinations while preserving the correction effects. Vertical stability is ensured by a mechanism with a lumbar pad and nowadays commonly used hole for the iliac wing below the lumbar pad.

Another modification of the basic shell was the possibility of step-by-step elevation of the left axilla in the course of growth. In order to elevate the left axilla line in this manner, we performed a special cut in the shell that was subsequently heated to modify the shape. This temporary solution was later replaced with the installation of a special splint, whereby the height of the shell could be modified merely by shifting the splint.

After 2000, the preference has been steadily shifting towards night-wear spinal orthoses that are optimised for the application in lying position. For this reason, we have added a special splint which allows height setting according to the previous modification, thereby creating a two-variant spinal orthosis, which combines the elements of daytime-wear and night-wear braces. The final design of the splint has been achieved by adding a hinge that makes the adjustments easier.

Classic modification of the spinal brace by gluing in the pads has its limitations. Therefore we use the principle of suspended pads. That is why we have decided to segment the plastic shell with geared belts and fasteners, which enables us to easily modify the impact of the lumbar pad.

Results: Through the long-term applications of dynamic orthosis with inclinations, we have discovered that this type of orthosis is suitable only for a flexible spine with thoracic curve (King 3 or 5) and that it is not optimal for lumbar curves (King 1 and 2) and “C” type curve (King 4).

The two-variant brace is suitable in all cases where the night-time positioning is combined with any high type of a daytime-wear brace, on condition that the upper part of the brace is losed or sufficiently rigid.

The use of geared belts for the adjustment of the corrective pad is suitable primarily for lumbar curves, but under certain construction conditions can be applied for thoracic curves as well. The possibility of that adjustment very much facilitates the process of the patient’s adaptation to the new orthosis and his vertical compensation.

Discussion and conclusion: Practically each workplace uses its own brace modifications in order to provide its patients with the best treatment possible. These include not only the actual medical effects of the orthoses, but also the patient’s acceptance of the orthosis. Segmented shell has been commonly used on a long-term basis in different types of braces. Some of the presented adjustments of the plastic shells enable quick modifications not only at the orthotic workshop, but also by the patients themselves, who can easily set their orthosis in the prescribed mode. In the case of the two-variant brace, this applies to the axillar height adjustment and in the case of suspended pads this applies to the choice (step-by-step fastening) of the support belt impact. Although segmented structure of spinal orthoses is quite usual, this article describes certain additional possibilities of the technical solutions of brace issues in this field.
P28.49 Results of the conservative treatment of idiopathic scoliosis patients with risser stage 3 and 4

Tugba Kuru Çolak ¹, Hürriyet Yılmaz ².

¹ Marmara University, ² Haliç University - Turkey

According to the SRS criteria on brace studies for idiopathic scoliosis, inclusion criteria at the start of treatment Risser stage should be 0-2. However, our clinical observations indicate that conservative treatment is also effective in cases with risser stage 3 - 4. Therefore, we sought to determine effectiveness of conservative treatment for adolescent idiopathic scoliosis patients with risser 3 and 4.

Patients fulfilling that criteria were included this study 10-17 years of age, diagnosed with AIS, risser 3 or 4 at the diagnosis time, at least had twelve months of follow-up and having conservative treatment. The conservative treatment consisted of full time brace wearing and Schroth exercise treatment. Patients received one session physiotherapist supervised exercise program in a week and other days they asked to perform same program at home.

Total of 14 female patients with AIS who did received a conservative treatment method included in the study. Mean follow up time was 47.5 months (range: 12-171), mean Cobb angle and ATR decreased and differences obtained in Cobb angle was statistically significant (p=0.002) (Table 1). None of the patients underwent surgical treatment. Treatment results were analysed with SPSS.

Table 1: Patients characteristics and treatment results

<table>
<thead>
<tr>
<th></th>
<th>At the beginning of treatment</th>
<th>Last follow up</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td>15.9 ± 2.8 (10-17)</td>
<td>17.6 ± 3.6 (13-19)</td>
</tr>
<tr>
<td><strong>BMI</strong></td>
<td>19.4 ± 3.2 (15-25)</td>
<td>20.7 ± 2.7 (17-25)</td>
</tr>
<tr>
<td><strong>Risser sign</strong></td>
<td>3.6 ± 0.5 (3.0-4.0)</td>
<td>4.2 ± 0.4 (4-5)</td>
</tr>
<tr>
<td><strong>Maximum Cobb angle</strong></td>
<td>36.8 ± 8.2 (22-46)</td>
<td>31.1 ± 9.4 (14-42)</td>
</tr>
<tr>
<td><strong>Maximum ATR</strong></td>
<td>9.9 ± 4.2 (4-20)</td>
<td>8 ± 3.8 (2-15)</td>
</tr>
</tbody>
</table>
P30.89 Correcting a large thoracic adolescent idiopathic scoliosis (AIS) using the 3D Scolibrace approach and scoliosis specific rehabilitation: a case study

Brad Gage1, Miyanji Faroz2, Ravi Ghag3, Jeb Mcaviney4

1The BetterBack Clinic, 2Department of Orthopedics, Faculty of Medicine, University of British Columbia, 3BC Children’s Hospital Orthopedic, 4ScoliCare - Canada

Introduction: Surgery is often recommended when thoracic curves are greater than 45°. However, there is emerging evidence that braces using a 3D approach can actually improve some scoliosis curves. There is also evidence that scoliosis specific rehabilitation can play a helpful adjunctive role. ScoliBrace is a type of scoliosis brace that uses a 3D inversion of the scoliosis and postural alignment, not 3 point pressure, to correct the spine in-brace. The ScoliBrace approach also advocates incorporating scoliosis specific rehabilitation with treatment.

Objectives: To present the treatment results of a 14-year-old girl with AIS and a 52° thoracic scoliosis, treated with a ScoliBrace and a scoliosis rehabilitation program. She was co-managed by a chiropractor and orthopedic surgeons.

Methods: The patient presented with a 52° right thoracic scoliosis, 22° of thoracolumbar rotation measured with a Scoliometer, TRACE score of 11/12 and Risser 3. The ScoliBrace custom spinal orthosis was prescribed and supported by a rehabilitation program of ScoliRoll (a type of fulcrum spinal traction) and Chiropractic Biophysics mirror-image exercises and traction.

Results: At the end of treatment (18 months), the patient was Risser 5, the scoliosis had reduced to 38° - a correction of 14° (out of brace) - and her TRACE reduced from 11/12 to 6/12. She began weaning from the brace and 6 months later she was reassessed and her curve remained at 38° and her TRACE at 6.

Discussion: Traditional 3 point pressure scoliosis braces aim to stabilize rather than improve the scoliosis curvature. These are the type of braces that are most common place in orthopedic clinics world wide. In this case even though the curve was large, a significant correction was achieved. It is also important to note that the patient was initially considered a surgical case but ended treatment below the surgical threshold and surgery was no longer recommended. As ScoliBrace uses a corrective approach that harnesses spinal coupling rather than traditional 3-point pressure, it is thought to allow for a more physiological correction and stability of that correction post treatment.

Conclusion:
This case suggests that this approach may be a more effective non-surgical approach in the treatment of large thoracic AIS curvatures than the traditional approach most commonly used.

Significance:
ScoliBrace combined with rehabilitation is shown in this case to correct a large AIS thoracic curve to below the surgical threshold.
P31.35 Characterizing Upper Body Stiffness in Healthy Young Women Using a Dynamic Spine Brace

Prachi Bakarania, Rosemarie Murray, Chawin Ophaswongse, Kelly Grimes, David Roye, 

_Columbia University Medical Center - USA_

**Introduction:** Approximately, 2-3% of adolescents are diagnosed with adolescent idiopathic scoliosis. Based on current statistics, 1 in 500 children undergo treatment using a spine brace and 1 in 5000 undergo spinal fusion surgery to correct their scoliosis. A scoliosis brace is typically a rigid plastic shell that fits around the trunk and hips and applies counter-pressure on the abnormal curve of the spine. Some of the shortcomings of rigid braces are: (i) their rigidity limit the wearer’s degrees of freedom often making ADLs difficult to perform; (ii) they do not measure the forces and moments applied to the human spine; (iii) they are unable to dynamically alter external forces and moments on the spine over the course of treatment.

**Objective:** A robotic dynamic spine brace was developed at Columbia University with the ability to both ‘measure’ and ‘apply’ desired forces and moments at different cross sections of the spine. The spine brace consists of three rings that fit on the pelvis, just below the xiphoid, and under the axilla. The purpose of this study was to characterize the spine stiffness in healthy young women using this brace.

**Methods:** For this preliminary study, six young women with a healthy spine, ages 22.5 years, height 165 10 cm, weight 55.9 kg, were recruited. Participants were fitted with the spine brace and they wore it for over 45 minutes. The actuators applied six increments of displacement to the rings along the three principal translation and rotation directions as the subjects sat on a stool. The corresponding forces and moments to sustain these displacements were recorded. These data were then analyzed to determine the 6x6 stiffness matrix at that specific posture – the diagonal terms of this matrix are the collinear translational and rotational stiffness, while the off-diagonal terms describe the cross-coupling between translation and rotation.

**Results and Conclusions:** The data indicated that the resulting stiffness matrix is non-symmetric, but there are dominant entries on diagonal and some off-diagonal terms. Data confirmed that sagittal translation stiffness in healthy young women is smaller than coronal plane translational stiffness and these are both smaller than stiffness in the vertical direction. The rotational stiffness about the vertical axis is the smallest among the rotational stiffness along different axes.

**Significance:**

Our hypothesis is that women with scoliosis will show different patterns of stiffness compared to their healthy peers. These differences in stiffness may correlate with bracing outcomes and prognosis of bracing. To investigate this hypothesis, we are currently recruiting age and size matched young women with a diagnosis of scoliosis to undergo the same protocol as their healthy peers. Our preliminary data with four women shows a trend that supports this hypothesis.
P33.104 Outcomes of the treatment applying individually designed and manufactured brace based on 3D structured light points clouds

Wojciech Glinkowski¹, Katarzyna Walesiak¹, Agnieszka Zukowska¹, Karolina Krawczak¹, Jakub Michonski², Krzysztof Mularczyk², Jerzy Narloch¹, Robert Sitnik²

¹ Department of Orthopaedics and Traumatology of Locomotor System, Baby Jesus Clinical Hospital, // ² Department of Medical Informatics and Telemedicine, Center of Excellence of Telediagnostics and Treatment of Injuries and Disorders of the Locomotor Syst, ² Virtual Reality Techniques Division, University of Technology * Poland

Introduction: Several reports have indicated the bracing to be an effective conservative treatment of adolescent idiopathic scoliosis (AIS).

Objectives: The aim of the study was to evaluate outcomes after applying individually designed and manufactured brace based on 3D structured light points cloud in the clinical practice. The four-dimensional structured light system was used to obtain a custom fit patients torso model for brace design and manufacturing.

Material and method: The 3D structured light laboratory has been established at the Orthopaedic Clinic. The four-dimensional system has been developed based on previous experiences. The IRB approval has been obtained for clinical studies. Forty-nine scoliotic patients were enrolled in the study. The mean age of patients was 13,25 years [from 9 to 18; STD 2,25 ]. The mean main thoracic Cobb angle was 30 degrees (from 11 – 55). 3D model was obtained from patients. Patients were scanned using the structured light four directional/3-dimensional system. The 3D model was obtained using 3D

four-dimensional structured light scanning. Scans were transformed to a global coordination system. The STL model was reconstructed and sent to the orthotics manufacturer. Step-by-step technique obtained the three-dimensional mold as a positive for Cheneau type brace. The type Cheneau braces were manufactured by carving the model in a 1:1 scale. The orthotist applied the final brace. Patients were followed-up with the 3D structured light system, clinical exam and surveyed with Polish versions of SRS 22, BSSQ-Deformity, Brace Questionnaire and Oswestry Disability Index to assess the outcomes.

Results: Friedman ANOVA and Kendall Coeff. of Concordance showed that ODI total score during four following exams did not change significantly (ANOVA Chi Sqr. (N = 21, df = 3) = 3,92; p = 0,27 Coeff. of Concordance = 0,06 Aver. rank r = 0,015). The mean ODI score at the beginning of the study was 8,3 (STD 7,3), 7,6 (STD 6,82) on the second exam; 11,4 (STD 14,4) on the third exam and 9,3 (STD 14,4) on the last exam. BSSQ Deformity Score did not changed significantly (N = 18, df = 3) = 2,29 p = 0,51 Coeff. of Concordance = 0,04 Aver. rank r = -0,01. The mean BSSQ-Deformity SCORE at the beginning of the study was 9,67 (STD 7,02); 9,78 (STD 7,66) on the second exam; 11,67 (STD 5,03) on the third exam and 10,83 (STD 4,26) on the last exam. The results of the SRS 22 total score were significantly different (Friedman ANOVA and Kendall Coeff. of Concordance ANOVA Chi Sqr. (N = 49, df = 3) = 111,55 p<0,0001) Coeff. of Concordance = 0,76 Aver. rank r = 0,75). The mean SRS 22 total score at the beginning of the study was 3,47 (STD 0,63); 3,45 (STD 0,86) on the second exam; 1,62 (STD 0,76) on the third exam and 1,46 (STD 0,85) at the end of follow-up. Cobb angle, POTSİ, DAPI, kyphosis, lordosis, ATR, SHS (p>0,05) assessed with the Wilcoxon Matched Pairs
Test showed no significant statistical differences after brace treatment.

Conclusions and Significance: Presented method presents the practical ability to use an individually designed brace manufactured with the use of a 3D structured light four directional system. The presented system was useful for the spinal curvatures and deformity monitoring allowing 3-dimensional visualization of the spinal curves and the external shape of the trunk beside to supplement radiographic studies and lower the frequency of the X-ray use. No significant differences in the measurements of the 3D image of the patient’s torsos confirm the ability of the 3D system to noninvasive parametric follow-up.

P34.86 Self-experienced Trunk Appearance and Quality of Life in Individuals with and without Idiopathic Scoliosis

Panayiotis Savvides ¹, Elias Diarbarkerli ¹,², Anna Grauers ³,³, Aina Danielsson ⁴ Paul Gerdhem ¹,²

¹ Department of Orthopaedics, Karolinska University Hospital Huddinge, Stockholm, Sweden, ² Department of Clinical Sciences, Intervention and Technology (CLINTEC), Karolinska Institutet, Stockholm, Sweden, ³Department of Orthopaedics, Sundsvall and Härrnosand County Hospital, Sundsvall, Sweden, ⁴ Department of Orthopaedics, Sahlgrenska University Hospital, Gothenburg, Sweden

Introduction: A large scoliotic deformity increases the risk of back pain and diminished lung function. However, the deformity itself has also a psychological impact on the patient.

Objectives: To describe the self-experienced trunk appearance and its relation to quality of life in individuals with and without idiopathic scoliosis.

Methods: The pictorial part of the Spinal Appearance Questionnaire (pSAQ) and the Scoliosis Research Society (SRS) -22r questionnaire were administered to 1412 individuals with idiopathic scoliosis (381 untreated, 530 brace treated, 501 surgically treated) and 272 individuals without scoliosis. Comparisons were made between individuals with and without scoliosis and between untreated, brace treated and surgically treated individuals with scoliosis with analyses of covariance (ANCOVA), Chi-square tests or logistic regression.

Results: Mean (SD) age of the individuals with scoliosis was 36.3 (14.6) years and 39.7 (18.7) without scoliosis. Adjusted means (95% confidence interval) for pSAQ was 12.4 (12.2-12.6) for individuals with scoliosis and 7.3 (7.0-7.8) for individuals without. Corresponding results for SRS22r were 4.1 (4.0-4.1) and 4.5 (4.4-4.6). Adjusted means for pSAQ was 11.6 (11.2-12.0) for untreated, 12.9 (12.6-13.2) for brace treated and 12.3 (12.0-12.7) for surgically treated. Results for the SRS22r subscore was 4.1 (4.1-4.2), 4.1 (4.0-4.1) and 4.0 (3.9-4.0). Untreated and braced individuals stated shoulder level to be the most bothering (11% and 10% respectively) and rib prominence was reported in the surgically treated (11%). The correlation between the pSAQ and SRS22r self -image domain was -0.56 in untreated, -0.57 in brace treated and -0.58 in surgically treated (all p<0.001).

Conclusion: Scoliosis impacts the self-experienced body appearance negatively as pSAQ discriminates between individuals with and without scoliosis and between those with and without scoliosis treatment.

Significance: Scoliosis exerts a negative psychological impact on individuals and different clinical treatment outcomes should be considered in daily practice.
P35.2 Effects of Body Image Perception and Self-Esteem on Quality of Life and Treatment Compliance in Girls with Adolescent Idiopathic Scoliosis

Irem Karanki, Hurriyet Yilmaz, Gunes Yavuzer

Department of Physiotherapy and Rehabilitation, School of Health Sciences, Halic University, Istanbul - Turkey

Introduction: It has been shown that poor body image perception and low self-esteem due to scoliosis cause serious psychosocial problems and lower quality of life in adolescents with scoliosis. There are few studies investigating self-esteem and compliance to brace use in this population.

Objectives: In this study we aimed to evaluate the effects of body image perception and self-esteem on quality of life and treatment compliance in girls with adolescent idiopathic scoliosis.

Methods: We included 40 adolescent girls with scoliosis (mean age 13.7±1.3 years) into this study that were followed at Formed Private Scoliosis Center for at least 3 years. Sociodemographic and clinical characteristics were documented. Participants were using brace for at least 3 months. We used Walter Reed Visual Assessment Scale (WRVAS) to evaluate patient’s body image perception, Coopersmith Self-Esteem Inventory (CSEI) to establish their self-esteem level, SRS-22 Patient Questionnaire to assess quality of life. To evaluate patient’s compliance to treatment procedure, we created and used a 7 item self-assessment questionnaire “Compliance of Scoliosis Treatment Assessment Scale” (CSTAS). All assessments were performed once under the supervision of the same researcher.

Results: Mean±standard deviation of Cobb angle was 32.1±9.8°. Analysis showed that body image perception was correlated with Cobb angle of scoliotic curve (r=0.53, p=0.001) and self-esteem (r=-0.35, p=0.028). Quality of life was correlated with body image perception (r=-0.61, p=0.001) and self-esteem (r=0.60, p=0.001). Treatment compliance was correlated with body image perception (r=-0.46, p=0.003), self-esteem (r=0.42, p=0.007) and quality of life (r=0.51, p=0.001).

Conclusions and Significance: This study revealed that higher Cobb angle results in poor body image perception. High body image perception positively effects self-esteem and quality of life. Higher body image perception, self-esteem and quality of life increases treatment compliance in adolescents with scoliosis. Scoliosis in adolescents is a multidimensional health problem including both physical and psychosocial components that should be managed by a multidisciplinary team. Successful conservative treatment with high compliance depends on child-centered interdisciplinary approach. Questionnaires measuring compliance not only to brace use but to all treatment procedure as well as daily living activities are needed.

P36.99 Evaluating quality of life changes using an adjustable orthosis in an adult spinal cord injury patient with scoliosis: A case study

Michelle Dwyer ¹, Patrick Flanagan ²

¹ Michelle Dwyer Physical Therapy, ² ONPInnovations

Background: Clinical manifestations of adult scoliosis can have a significant impact on a patient’s quality of life. Clinicians and patients face additional challenges when addressing scolio-
sosis secondary to spinal cord injuries. The Aspen Peak Scoliosis brace is an adjustable, unloading brace designed to relieve pain and improve quality of life in adult scoliosis patients.

**Aim:** The aim of this study is to assess the changes in quality of life in an adult scoliosis patient with an incomplete spinal cord injury (SCI) using the Aspen Peak Scoliosis brace.

**Methods:** A 64 y/o female patient with an incomplete SCI was referred to physical therapy for evaluation for the Aspen Peak Scoliosis brace. This patient was already independent and compliant in scoliosis specific exercises using Schroth and SEAS principles prior to brace fitting. The patient had concerns regarding her decreasing ability to perform recreational and activities of daily living without pain. The patient was fitted with the Aspen Peak Scoliosis brace and provided with specific wearing instructions. The patient was seen in the clinic for follow up appointments at 2, 9, 12 wks, and one year. The Visual Analogue Pain Scale (VAS) was given at each appointment and the SRS-22 was given at the initial and final appointments.

**Results:** Results of the 12 month follow up indicated a decrease in Pain from 8/10 on the VAS to 3/10. The SRS-22 revealed significant improvements in the following areas: pain, mental health, self image, and satisfaction of the intervention.

**Conclusion:** In the case presented, the Aspen Peak Scoliosis Brace improved quality of life measures most significantly in the area of pain reduction and mental health. The Aspen Peak Scoliosis brace could be a viable option in addressing scoliosis in adult patients with incomplete spinal cord injuries.

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**P62 The Short-term Effect of Specific Exercise Intervention on Vertebral Rotation in Patients with Idiopathic Scoliosis**

Yi-Ting Deng¹* Yung-Chun Hung¹ Ta-SenWei² Yen-Chun Chen² Kuan-Lin Chen²

1 Department of Physical Therapy, Chunghwa Christian Hospital, Chunghwa, Taiwan – 2 Department of Physical Medicine and Rehabilitation, Chunghwa Christian Hospital, Chunghwa, Taiwan

**Introduction:** Idiopathic Scoliosis is a common spine deformity in adolescent. According to SOSORT 2011 guideline, the primary goal of scoliosis treatment is to stop the progression of the spinal curve and the secondary goal is to reduce angle of the spinal curve and improve posture. There are many scoliosis treatment options to achieve these goals. Pilates exercise is one of noninvasive methods and is beneficial to control posture. Scoliosis is a three-dimensional spinal deformity with vertebral deviations in the coronal, sagittal and horizontal planes. In this study, we focus on the problem of the spine rotation in horizontal plane causing the rib humps which are described by Katharina Schroth. We choose appropriate Pilates exercises for scoliosis subjects are based on the principles of Schroth method exercises.

**Objectives:** The effect of specific exercise on vertebral deviation in the horizontal plane in subjects with idiopathic scoliosis

**Methods:** All of the subjects were from Chunghwa Christian Hospital, Chunghwa, Taiwan during July, 2015 to December, 2016. The inclusion criteria were as follow: having a diagnosis with idiopathic scoliosis, Cobb’s angle was above 10 degrees. The exclusion criteria were as follow: spinal op-
eration, other neuromuscular problems, mental problems, psychological problems. They received the specific pilates exercise for 45 minutes per session, one session per week. The exercise was design by experienced physical therapist who certificated by Balance body® of international pilates mat1 & mat2, included spine elongation, spine de-flexion, de-rotation, postural correction and home programs. The trunk rotation angle was measured before and after every session using Baseline® scoliometer in Adam’s test.

Results and Discussion: 45 patients (age: 18.6±9.6 years-old, 12 males and 33 females, Cobb’s angle: 20.4±12.9 degrees) were enrolled in this study, and 2 patients were excluded because mental retardation and inadequate compliance. Each subjects received 3.8±2.8 sessions of corrective exercise. The total trunk rotation angle reduction was 2.7±1.6 degrees. The single session angle reduction was 1.3±1.2 degrees.

Conclusions and Significance: The patients with idiopathic scoliosis had decreased trunk rotation angle after receiving 45-minute per week specific Pilates exercise under supervision of physical therapist. The specific Pilates exercise had a short-term benefit for scoliosis patients.

P19 Long term chiropractic management of progressive adolescent idiopathic scoliosis – a case report

A. Joshua Woggon

CLEAR Scoliosis Institute (USA)

Introduction: Idiopathic scoliosis is the most common spinal deformity in adolescents,1 affecting approximately 2 to 4 percent of children 10 to 16 years of age.2 Scoliosis has a tendency to worsen during periods of rapid growth;3 bracing and scoliosis surgery are typically recommended to prevent this. Bracing is generally regarded as effective in preventing the progression of scoliosis to surgical levels, provided the patient is highly compliant.4 Surgery is believed to be effective in curbing progression and reducing the signs and symptoms of spinal deformity in adolescent idiopathic scoliosis, although it is currently not known if surgical intervention for AIS is superior to natural history.5 Although there is insufficient evidence to draw conclusions, manual therapy alone is not believed to significantly alter the natural history of scoliosis.6 Generalized full-spine adjustments, heel lifts, and postural counseling do not appear to be effective in reducing the severity of mild scoliosis.7 Case reports have been published describing the results of manual therapy in conjunction with other forms of soft tissue and neuromuscular rehabilitation strategies.8-13 This article presents the results of a long-term chiropractic treatment plan, developed specifically for scoliosis patients, in a female with adolescent idiopathic scoliosis.

Case Presentation: The patient was initially diagnosed with idiopathic scoliosis in 2003 at 11 YOA; the Cobb angle
was measured at 25 degrees. The patient received generalized chiropractic care, which was not effective in preventing progression. In 2009, the patient traveled out-of-state to receive care at a private chiropractic clinic that had developed a scoliosis-specific chiropractic treatment protocol; radiographs were taken and the Cobb angles were measured to be 79 in the thoracic spine and 67 in the lumbar.

Treatment consisting of active mobility and spinal traction exercises, massage therapy, passive spinal distraction, spinal manipulation therapy (SMT), whole-body vibration (WBV) therapy, and sensorimotor re-integration strategies was applied twice daily over a period of two weeks, for a total of 20 treatment sessions. A radiograph was taken at the end of two weeks, which demonstrated a 54 degree thoracic Cobb angle and a 46 degree lumbar Cobb angle. The patient was instructed to perform an outpatient exercise program, and return for re-evaluation and additional treatment.

The patient returned for care one year later in 2010; the Cobb angles measured 75 thoracic, 66 lumbar. After 20 treatment sessions, they measured 55 and 51 degrees respectively. Subsequent one-week, 10-visit treatment programs were conducted every six months, with outpatient exercises to be in the interim. In January of 2011; the Cobb angles measured 73 and 62 degrees. After treatment, the Cobb angles measured 57 and 39. In July of 2011, the Cobb angles measured 63 and 57; after treatment, they measured 52 and 39. In January of 2012, the Cobb angles measured 59 and 56; after treatment, they measured 49 and 41. In June of 2012, the Cobb angles measured 53 and 46; after treatment, they measured 41 and 38. In January of 2013, the Cobb angles measured 54 and 49; after treatment, they measured 42 and 41. In June of 2013, the Cobb angles measured 48 and 49 degrees; after treatment, they measured 42 and 35. In January of 2014, the Cobb angles measured 48 and 47; after treatment, they measured 42 and 43.

From the initial presentation in 2009, to the most recent x-ray taken in 2014, the thoracic Cobb angle changed from 79 to 42, and the lumbar Cobb angle changed from 67 to 43. Although Cobb angle is not a linear measurement (e.g., an 80 degree Cobb angle is more than twice as severe as a 40 degree Cobb angle), this represents a 46.8% reduction in the thoracic Cobb angle and a 35.8% reduction in the lumbar Cobb angle.

Discussion: According to the NBCE, 2.7 million visits are made to chiropractors annually for scoliosis or scoliosis-related complaints, many of whom are undoubtedly adolescents whose parents have self-selected chiropractic care. Similar to the premise that scoliosis-specific exercises are more effective in treating scoliosis than generalized physiotherapeutical approaches, we hypothesize that a chiropractic treatment protocol developed specifically for the treatment of scoliosis could be more effective than generalized chiropractic treatment. In this case, the patient utilized chiropractic services for six years which were not effective in halting progression before self-selecting a scoliosis-specific chiropractic protocol that was effective in reducing the severity of the curvature over the long-term. When the patient presented for care in 2009, the periods of most rapid spinal growth were in the past, although the potential for spinal growth remained. Between July of 2009 and January of 2013, the patient’s height increased by two centimeters in a linear fashion, then remained stable. This could account for the larger losses of correction observed over the intervals between the first six treatment sessions, compared to the relatively modest losses documented between the last three. Another possible explanation is that the patient’s height
increased as a result of the treatment, and no actual growth occurred. The spine, as a biomechanical structure, is influenced by the forces acting upon it, such as gravity, and Cobb angle can change as a result of these forces; Beauchamp et al documented diurnal variations in scoliosis as high as 20 degrees within a 24-hour period. Lateral curvature of the spine can be influenced by the activity of the muscles and the nervous system, as well as the position of the spine in the coronal and sagittal plane. Factors linked to the risk of progression in scoliosis include imbalanced EMG activity of the paraspinal muscles;19 coronal and sagittal imbalances;20,21 and, abnormalities in EEG activity related to adaptation-compensation mechanisms in the CNS.22 We hypothesize that the risk of progression in scoliosis could be reduced by strategies aimed at rehabilitating these measurable functional deficits.

Conclusion: This case study follows a patient who received chiropractic treatment for her scoliosis over a period of eleven years. A scoliosis-specific protocol appeared to achieve better long-term results in reducing the severity of her scoliosis.

P 58 Influence of asymmetrical muscle length on the position of the pelvis and spine with idiopathic scoliosis

Petra Auner-Groebl¹, Christine Widmer²,
¹ FH-JOANNEUM university of applied sciences, Graz, ² Department of orthopedics and traumatology, medical university of Graz (Austria)

Background: The single case study describes a 25-year-old female patient with juvenile idiopathic scoliosis with lumbar 32°-degree Cobb. The assessment result according to Schroth showed a scoliosis 3BH including torsion of the pelvis. When screening the length of the leg and pelvis muscles, asymmetries were found, which could have an impact on the severity of the left rotation of the lumbar spine. If the hypothesis can be proven, that a muscle shortening on one side promotes deformation in the spine, this would indicate that regaining symmetrical muscle length would be a basic physiotherapeutic tool when treating idiopathic scoliosis.

Intervention: During the screening the muscle function of selected muscle groups of legs, pelvis and trunk (ischiofemoral, rectus femoris, adductors, iliopsoas, quadratus lumborum, and erector spineae muscle) as well as muscle strength and muscle length were additionally tested by applying physiotherapeutic screening tools. For every screening the patient was positioned optimally according to Schroth. For data acquisition a measure tape and goniometer was applied. The rotation of the lumbar spine was measured during muscle screening in neutral position and in a maximal stretched position of the respective muscle with a Scoliometer. In the movement laboratory strength status was measured with dynamometry. Sonography was used
to compare musclediameter in relaxation and when contracting voluntarily with maximum force.

**Results:** The patient showed a shortening of the rectus femoris muscle, of the quadratus lumborum and the erector spinae muscle at the concavity of the lumbar scoliosis and also a decreased strength of the ischiocrural muscle, of the adductors and the iliopsoas. In stretched end position all muscles increased the rotation in the lumbar spine, even though the patient was positioned ideally according to Schroth. On the convex side the ischiocrural muscle, the adductors, and the iliopsoas muscle were shortened and the rectus femoris, the m. iliopsoas, the quadratus lumborum and the erector spinae muscle showed decreased strength. The rotation in the lumbar spine was increased when in maximum muscle stretch position, too. Diagnostic data deriving from x-rays were included in the test data.

**Conclusion:** Asymmetric muscle length of the leg, pelvis and trunk muscles seem to have an huge influence on the position of the pelvis and the curvature of the spine in terms of continuing movement.

The results from the assessments are used for planning therapy and steering the physiotherapeutic setting. Furthermore, a study is going to be conducted to screen and provide physiotherapeutic intervention for all patients with idiopathic scoliosis (AIS). SETS trial inclusion criteria were: 10 to 18 years of age, Cobb angles of 10 to 45o, and with or without a brace. Exclusion criteria were having undergone any torso, or lower limb surgery.

Participants were imaged using a 3D US imager with position and orientation tracking during a single session in natu-
ral standing (using a frame stabilizing shoulders and pelvis), and prone position (passive and active Schroth corrections and psoas activation). A US scan was performed along the spinous processes from C7 to L5. A Schroth therapist guided exercises. Images were analysed using custom software. A novice rater trained with test images before digitizing the center of the laminae to extract the curve angle for each curve. Differences between positions were compared using paired T-test. Percent correction was estimated for each curve.

**Results:** Mean age was 15±1 (range 12-21) year old at time of testing. All but one participant also received brace treatment. Schroth curve types included: 4CP (n=8), 4C (n=1) and 3CP (n=1). Eight thoracic, and 9 lumbar curves measured over 10° in standing. Nevertheless, a thoracic and lumbar curve was measured for all 10 participants. Thoracic curve angles in standing (16±9°) were significantly (p=0.047) reduced with the prone exercise (7±14°) by a median of 31% (range 10%; -257%). Lumbar curve angles in standing (21±12°) were significantly (p<0.001) reduced with the prone exercise (2±12°) by a median of 77% (range 44%; 290%). All but 2 participants achieved over 50% lumbar curve correction with the prone exercise.

**Conclusion:** This study provided preliminary evidence of the validity of Schroth PSSE prone exercise positioning and active correction instructions by demonstrating that all patients achieved at least 50% correction for at least one curve.

**Significance:** Studying immediate correction achievable using exercise instructions will help refine how we teach exercises to patients and therapists to achieve optimal correction. Future research will determine if the ability to autocorrect at different stages of the exercise therapy predicts long-term outcomes.

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**P79 A novel 3D imaging, mobile and surface topography APP for measuring 3D back and body shape: an intra and inter-rater reliability study**

Gokulakannan Kandasamy, Josette Bettany-Saltikov, Iain Spears
Teesside University (UK)

**Introduction:** Spinal pain is an extremely common musculoskeletal symptom caused by multiple factors. Postural/spinal deformity is one of the cause that contributes to spinal pain for example: scoliosis, hyper kyphosis as well as marked back asymmetries. These lead to abnormal stress and loading on spinal musculoskeletal structures. To date numerous non-radiographic surface measurement methods for the detection of back shape and posture have been developed e.g. Quantec and ISIS 2. However most of this equipment either laboratory based, very expensive, heavy to move, and can only measure the back. There is demand for a low cost, portable, mobile back shape measurement system. This will allow an extended assessment of full back shape measurement in all planes within the clinical environment.

**Objective(s):** The objective of this study is to present a novel and highly portable method for assessing whole body posture. A further objective is to present the reliability and repeatability of the system to determine its applicability for assessing back and full body shape in normal subjects and patients with spinal deformities.

**Method(s):**

Participants: Healthy adults (n=16) participated in this study.
Instrumentation: In this study we have used the commercially available IPad based 3D mobile scanning tool ‘Structure SensorTM’ to capture the shape of the back as well as the whole participants’ body. This sensor consists of two different cameras (Color video (red-blue-green) and the depth camera). This sensor along with the normal IPad camera provides real-time anatomical landmarks and reconstructs the whole back and body shape using the triangulation method.

Procedure: For each subject, three trials of standing back and body posture were individually measured by two raters on two separate occasions. The data was then processed in the open source software and back shapes was manually measured by both the raters.

Results and Discussion: Pearson’s Correlation test estimated the reliability and standard error of measurement for the overall, test–retest and inter-rater designs. Bland and Altman’s method was used to document agreement between sessions and raters. Good intra and inter reliability was found.

Conclusions and Significance: Given that it is inexpensive, extremely portable and very simple to setup, this tool has got a high potential to be used within clinical practice for monitoring spinal deformity. This will reduce dependence on serial radiography and reduce radiation exposure to patients with postural disorders and spinal deformities.

Background: Scoliosis researchers and clinical communities use the “Cobb angle” obtained from anterior-posterior X-rays as the standard assessment tool for scoliosis. In order to reduce radiation exposure [1], surface topography has been suggested to assess the deformities associated with scoliosis [2, 3]. This study aimed to estimate the reliability of 3D processes spinal curve measurements obtained with surface topography and conventional manual or radiography assessments. Studied indices are routinely used to evaluate scoliosis deformities.

Objective(s): The main purpose of this research was to evaluate correlation between external spinal curve parameters and traditional clinical examination measurements.

Methods: Measurements are carried out with the OrtenBody[ONE] system (Orten, Lyon, France). It consists in a mobile column with optical data acquisition system with turntable to acquire the whole surface of the patient. Acquisition time comes to 25 s. The 3D relief is processed on dedicated OrtenClinic software to obtain clinical measurements. Spatial spine curve is carried out from automatic detection with the anatomical landmarks indicated by the operator. Surface topography measurements were obtained using OrtenClinic software. They are compared to sagittal arrows measured with the C7 plumb line and expressed in millimeters. Thoracic kyphosis and lumbar lordosis angles were measured as well using standard techniques [4]. For this ongoing study, twenty-eight consenting clinic patients (24 females, 4 males) with confirmed adolescent idiopathic scoliosis who had not undergone spinal fusion surgery were scanned and X-rayed. Patients had a mean age of 14.8 year (SD: 2.2 year, range: 8–18 year).
Results: For each patient data, there were three parameters compared: Sagittal arrows (at C7, kyphosis and lordosis level) in millimeters, sagittal thoracic angle and sagittal lumbar angle in degrees. Pearson correlation coefficients $r$ were calculated for each of the five parameters to compare the two measurement systems. Correlation coefficients were assessed with Student’s t-test. For sagittal arrows, the correlations found when comparing OrtenClinic measurements to manual measurements were strong ($r=0.869$) and statistically significant ($t=8.998$ at the confidence level of 95%, $\alpha=0.05$). Comparison between lordosis angle computed from X-ray images and angle of processes spinal curve show a low correlation ($r=0.02$) and is not significant. However, kyphosis angle gives a medium correlation ($r=0.482$) and is statistically significant ($t=6.3617$ at the level of significance $t=2.048$, $\alpha=0.05$).

Discussion & Conclusion: The spine curve of OrtenClinic is comparable to clinic and radiography examination in terms of its test-retest reproducibility. Although this system does not predict sagittal angles exactly, the predictions correlate strongly with the spinous processes arrows determined from clinic examination. It can be reliably used in the surveillance of patients with AIS. In order to achieve these objectives, an intensive clinical validation using a large database of scoliotic patients is currently undertaken at the Massues Rehabilitation Center.


surgery were scanned and X-rayed. Patients had a mean age of 14.8 year (SD: 2.2 year, range: 8–18 year).

**Results:** In order to evaluate the reliability of the studied asymmetry indices, we have compared the both external indices to internal radiological measurements. Pearson correlation coefficients r were calculated for each of the five parameters to compare the two measurement systems. Correlation coefficients were assessed with Student’s t-test. Correlation coefficient between cross section axis angle and Cobb angle curvature shows moderate uphill relationship (r=0.563) and is statistically significant (t=3.850 at the level of significance t>1.697, alpha=0.05). Symmetry map gives better results and have strong relationship (r=0.72) and is statistically significant (t=3.850 at the level significance t>1.697, alpha=0.05).

**Discussion & Conclusion:** Torso surface topographic imaging showed that scoliotic deformity was associated with relatively small, predominantly rotational, changes to torso surface shape. In this reliability study, OrtenClinic asymmetry map analysis of full-torso scan imaging provides superior accuracy than cross-section rotation angle method. There is hope that using routine asymmetry indices of 3D imaging in scoliosis will help clinicians “see” this torso deformity in ways that will increase their understanding of the condition and ultimately lead to improvements in treatment. Future work will focus on study of more patients including subgroups of patients as we attempt to make a clinically useful estimation of scoliotic deformity from torso surface shape.


**P57 Schroth Physiotherapeutic Scoliosis-Specific Exercises for Adolescent Idiopathic Scoliosis: How Many Patients Require Treatment To Prevent One Deterioration?**

Sanja Schreiber¹, Eric Parent², Doug Hill¹, Douglas Hedden², Marc Moreau¹, Sarah Southon¹

¹ Alberta Health Services, ² University of Alberta (Canada)

**Introduction:** Three recent randomized controlled trials (RCTs) support using physiotherapeutic scoliosis-specific exercises (PSSE) for adolescents with idiopathic scoliosis (AIS). All RCTs reported statistically significant results favouring PSSE but none reported on clinical significance. The number needed to treat (NNT) helps determine if RCT results are clinically meaningful. The NNT is the number of patients that need to be treated to prevent one bad outcome in a given period. A low NNT suggests that a therapy has positive outcomes in most patients offered the therapy.

**Objective:** To determine how many patients require Schroth PSSE added to standard care (observation or brace treatment) to prevent one progression (NNT) of the Largest Curve (LC) or Sum of Curves (SOC) beyond 5° over a 6-month interval.

**Methods:** This was a secondary analysis of a RCT. Fifty consecutive participants from a scoliosis clinic were randomized to the Schroth PSSE + standard of care group (n=25) or the standard of care group (n=25).

We included males and females with AIS, age 10-18 years, all curve types, with curve magnitudes 10°- 45°, with or without brace, and all maturity levels. We excluded patients awaiting surgery, having had surgery, having completed brace treatment and with other scoliosis diagnoses. The local ethics
review board approved the study (Pro00011552) registered with ClinicalTrials.gov (NCT01610908).

The Schroth intervention consisted of weekly 1-hour supervised Schroth PSSE sessions and a daily home program delivered over six months in addition to the standard of care. A prescription algorithm was used to determine which exercises patients were to perform. Controls received only standard of care.

Cobb angles were measured using a semi-automatic system with 2.2° error from PA standing radiographs at baseline and 6 months.

The NTT was calculated as: NNT=1/ARR, where the absolute risk reduction (ARR) is calculated as the difference between the control event rate (CER) and the experimental event rate (EER). The CER and EER are the proportion of patients in the control and experimental group who deteriorated by >5°, respectively. We estimated 95% confidence intervals (CI) using the Wilson score method. Patients with missing values (PSSE group; N=2 and controls; N=4) were assumed to have had curve progression (worst case scenario).

Results: For LC, NNT=3 (95% CI 1.7 – 11.2), and for SOC, NNT=4 (95% CI 2.0 – 64.0). The corresponding ARR was 38% for LC and 26% for the SOC. Patients with complete follow-up attended 85% of prescribed visits and completed 82.5% of the home program. Assuming zero compliance after dropout, 76% of visits were attended and 73% of the prescribed home exercises were completed.

Conclusions and Significance: The short term PSSE intervention added to standard care provided a large benefit as compared to standard care alone. Results suggest that three (LC) and four (SOC) patients require treatment for the additional benefit of a 6-month long Schroth intervention to be observed beyond the standard of care in at least one patient.
the respondents were from USA Northeast and North Central. 85% of the respondents participate in research, 83% in academic teaching, and 93% in professional education about scoliosis. Over 63% practice in private outpatient clinic, and over 26% in hospital based outpatient clinic. Lead referral source is direct access via Schroth PT directories/internet, 2nd source is surgeon referral, 3rd leading source is via other patient or support group. Referrals are thought to be limited by: 1. Patient/family not aware of Schroth 2. No Schroth practitioner in geographical area 3. Limitations in insurance coverages. Practitioners are utilizing Schroth for primarily AIS, Adults with pain and degenerative scoliosis. The leading frequency of treatment is 1-2x per week with or without tapering. The leading duration is 45-60 minutes per session. Most common total care is <20hrs for adults with pain and 21-40hrs for AIS. 98% review x-rays prior beginning care and COBB angle and Risser score are two leading calculation.

Conclusion: This cross sectional survey has demonstrated that despite Schroth’s origins, the patterns of practice in North America are beginning to resemble those of general physical therapy in interventions, outcome measures, and reimbursement. The demographics of the practitioners are rather homogenous, with the leading geographical areas representing the 2 earliest presence of Schroth in the US.

Significance: The current trends in the USA for the Schroth method are significantly modified from its origins. This is an important variable to consider as the efficacy research expands in the USA/North America. Furthermore, the dosage, motor learning and response research needs to be expanded to ensure limited over and under treatment

P101 The effect of intensive, short-term Schroth physiotherapy program in an adult male patient with Scheuermann’s Disease: Case study

Andrea Lebel¹, Judit Orban¹, Victoria A Lebel

1 Ottawa & District Physiotherapy Clinic, Scoliosis Physiotherapy & Posture Centre (Canada)

Background: Scheuermann’s Disease (SD), a wedged vertebral deformity resulting in hyperkyphosis, occurs in ~5% of the general population. Current evidence suggests a role for non-operative therapies in the management of SD in juvenile and adolescent populations. Thoracic hyperkyphosis secondary to SD is a frequent problem in adulthood and can greatly impact a patient’s quality of life. Short-term, intensive rehabilitation programs are not offered to adult patients. The purpose of this case study is to observe the effect of an intensive, short-term Schroth physiotherapy exercise program in an adult patient with SD.

Case Description: A 52-year-old male with SD was diagnosed with left convex lumbar scoliosis as a teen. Later in 2000, when he experienced pain, radiographs confirmed the diagnosis of SD and Scoliosis. On November 11th, 2016 during the initial physiotherapy assessment, thoracic hyperkyphosis (T1-L2) was 65°, lumbar hyperlordosis (L2-L5) was 48° and cervical lordosis was 55°. Vital capacity (VC) was 4700 mL and chest expansion was 6 cm. The lumbar angle of trunk rotation (ATR) was 7°. Vertical height was 176.7 cm. The patient’s genetic leg length discrepancy of 1.5 cm was corrected with foot orthotics. Hamstring muscle flexibility was 45° bilaterally. Initial SRS-22 score was 3.6 and upper thoracic pain was 4/10.

Methods: A Saunder’s digital inclinometer was used for sagittal kyphosis and lordosis curve measurements. Radiographs were from the year 2000. Additional objective data included chest expansion, VC, and vertical height. The patient received 2-hour private Schroth physiotherapy treatment sessions 2 times a week for 6 consecutive weeks from November 11, 2016
to December 30, 2016. The patient also completed a 30-minute individualized home exercise program (HEP) 3-5 times a week during this same time period. The SRS-22 questionnaire was used to assess function, pain, self-image, and mental health. Subjective thoracic pain was assessed using the pain numeric rating scale.

**Results:** After 6 weeks of Schroth physiotherapy, thoracic hyperkyphosis decreased to 52° and lumbar hyperlordosis decreased to 37°. Cervical lordosis decreased to 36°. VC remained stable and chest expansion increased by 1 cm. Lumbar ATR decreased to 1.5°. Vertical height increased to 178.0 cm. Hamstring muscle flexibility improved to 65° bilaterally. Follow up SRS-22 score was 4.4 and upper thoracic pain resolved (0/10).

**Conclusion:** As shown in this case study, short term, intensive Schroth physiotherapy is an effective treatment option for adult patients with SD, not only in decreasing curve angles and increasing VC, vertical height, and hamstring muscle flexibility, but also in improving SRS-22 scores, pain scores, and overall quality of life, and should be routinely offered to adult patients with SD.

**References:**
P100 Adolescent Idiopathic Scoliosis and Hyperkyphosis treated with Physiotherapy Scoliosis Specific Exercises based on the Schroth Method: Case study

Andrea Lebel¹, Victoria A Lebel

1 Ottawa & District Physiotherapy Clinic, Scoliosis Physiotherapy & Posture Centre (Canada)

Background: Until recently, patients with mild scoliosis curves (10-25 degrees) and hyperkyphosis (>50 degrees) were not referred for Physiotherapy Scoliosis Specific Exercises (PSSE) in Canada.

Prior to 2016, patients with 10-25 degree Cobb angle scoliosis curves and >50 degree Cobb angle kyphosis curves were placed on the “wait and watch” method, where they were monitored for curve progression. The purpose of this case study is to show that patients with mild scoliosis curves and hyperkyphosis, if treated with early PSSE using the Schroth method, can avoid curve progression and even reverse their spinal deformities.

Case Description: In August 2010, a 13.5-year-old female patient (Risser 2.5) was diagnosed with a 20-degree Cobb angle left convex thoracic curve and a 25-degree Cobb angle right convex thoracolumbar curve scoliosis, measured on PA and lateral radiographs (4C scoliosis curve pattern).

Additionally, her sagittal radiograph revealed a 57-degree Cobb angle T4-T12 hyperkyphosis. Thoracic and lumbar angles of trunk rotation (ATR) were 8 degrees and 10 degrees, respectively. The patient was placed on the “wait and watch” list by the orthopedic surgeon. In September, 1 month after initial diagnosis, the patient was assessed for PSSE.

Methods: All radiographs were taken at hospitals in Ontario, Canada between 2010-2011. Baseline ATR measurements, using a Bunnell scoliometer, were obtained before starting PSSE, 11 months after daily PSSE, and then 8 months after discontinuing regular PSSE. The patient received a total of 10 private physiotherapist-supervised 1-hour PSSE sessions between September 2010 and February 2011. The patient continued with a daily 30-45 minute individualized scoliosis and hyperkyphosis home exercise program (HEP) between February and August 2011, and then periodically afterwards.

Results: Radiographs taken in December 2010, 3 months after beginning PSSE, showed a 5-6 degree reduction in Cobb angles of both scoliosis curves. Follow up radiographs in August 2011, 11 months after beginning PSSE, showed a 6-degree T11-L4 thoracolumbar curvature and no appreciable dextroconvex thoracic scoliosis – a cured scoliosis! Radiographs also showed a 22-degree reduction in kyphosis to 35 degrees (within the normal natural kyphosis range) – a cured hyperkyphosis! ATR was decreased to 7 degrees. The patient followed up in April 2012, 8 months after discontinuing regular PSSE, and ATR was stable at 7 degrees.

Conclusion: At the time of this case study, scoliosis and hyperkyphosis patients were not routinely referred for PSSE in Canada and were instead placed on the “wait and watch” method and monitored for curve progression. As shown in this case study, mild scoliosis curves and hyperkyphosis can be reversed and stabilized with daily PSSE using the Schroth method.

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**P64 Radiological and clinical improvement in scoliotic patients with single thoracolumbar curves, treated with Schroth BSPTS exercises**

Nikos Karavidas  
Scoliosis Best Practice Rehab Services (Greece)

**Introduction:** The main aims of Adolescent Idiopathic Scoliosis (AIS) treatment are to prevent progression and improve aesthetics. Single thoracolumbar curve patterns usually have noticeable pelvic shift, causing coronal imbalance and increasing the potential of progression. There is growing evidence in the literature that Physiotherapeutic Scoliosis Specific Exercises (PSSE) can be the exclusive treatment in mild scoliosis.

**Objectives:** The purpose of the study is to evaluate the effectiveness of Schroth BSPTS exercises in the treatment of single thoracolumbar scoliosis in young adolescents.

**Methods:** Prospective case-series. 4 female patients with left thoracolumbar scoliosis were included in the study (mean age 14.2 years, Risser sign 3, Cobb angle 25.5°). An out-patient program of scoliosis specific exercises was performed by the patients, with regular supervised sessions by a certified physiotherapist. No patient wore a brace, although 2 of them had medical recommendation to start bracing. Mean follow up time was 16 months. Radiological outcome was evaluated by measuring Cobb angles, and clinical outcome by Angle of Trunk Rotation (ATR) with a scoliometer, TRACE scale and SRS-22 questionnaire, with self-image category questions, before and after Schroth BSPTS exercises.

Results: All the outcome parameters were statistically improved in every patient. Cobb angle decreased from 25.5° to 16.2° (p=0.02), ATR from 9° to 6.2° (p=0.05), TRACE from 3.5 to 1.3 (p=0.02) and SRS-22 self-image scores from 23.3 to 19 (p=0.03).

**Conclusions and Significance: Schroth BSPTS exercises can effectively treat single thoracolumbar scoliosis in patients with mild curves. A statistically significant improvement was achieved in Cobb angle, ATR, TRACE and SRS-22 scores. Some of the patients that are chosen to be braced at a late growth stage, can have a satisfied clinical and radiological treatment result doing only PSSE with Schroth BSPTS method.

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**P87 Treating a Kypho-Scoliosis in a young adult using the KyphoScoliBrace and scoliosis specific rehabilitation: a case study**

Chris Gubbels¹, Jeb McAviney²  
¹ SquareOne Health (USA) - ² ScoliCare (Australia)

**Introduction:** Kypho-Scoliosis is a difficult spinal deformity to treat non-surgically. No studies exist exploring the role of bracing in adults who have this condition from childhood. In young adults, surgery is often recommended if their kyphosis is greater than 70 degrees, and bracing and rehabilitation are not often advocated for adult patients with this condition.

**Objectives:** To present the treatment results of a 26-year-old male with adolescent kypho-scoliosis as an adult. He presented with a kyphosis measuring 79° and a thoracolumbar scoliosis measuring 27°. He was treated with a hybrid Scolibrace called the KyphoScoliBrace and a scoliosis rehabilitation program.

**Methods:** At the time of presentation the patient reported complaints of back pain and dissatisfaction in his cosmetic ap-
pearance. In particular he reported difficulty standing or sitting for extended periods of time. He had previously worn a TLSO brace as a teenager with no positive effect, and he had had spinal epidural injections in his early 20's for pain, again with no effect. His NRS for back pain was 7/10 at worst, 4/10 on average. He had an ODI of 18 and an overall SRS score of 3.0, with his lowest score being 2.6 for self image.

The KyphoScoliBrace custom spinal orthosis was prescribed 16-18 hours per day and supported by a rehabilitation program of ScoliRoll (a type of fulcrum spinal traction) and Chiropractic Biophysics mirror-image exercises and a shoe lift.

**Results:** At the end of 3 months there was a significant in-brace improvement of the thoracolumbar curve measuring 16° in the brace compared to 27°. An in-brace x-ray of the kyphosis was not taken at this time.

At 6 months out of the brace his kyphosis had improved by 16° from 79° to 63° and his thoracolumbar scoliosis improved by 7° from 27° to 20°. His ODI improved from 18% to 4%, SRS 3.0 to 3.8 with self image improving from 2.6 to 4.2 and satisfaction with treatment from 3.0 to 4.5. His NRS improved from 7/10 worst and 4/10 average to 2/10 worst and 0/10 average. There was also an appreciable subjective change in his overall posture and cosmetic appearance.

**Discussion:** A literature search did not return any published cases where bracing and specific rehabilitation had been successfully used to improve the spinal alignment, posture, pain and function of an adult patient suffering with Kypho-Scoliosis. Although these are interim results they are more positive than the patient’s reported results from previous bracing and epidural injections and the patient has reported excellent satisfaction with the treatment. It is unknown how much if any of the gains achieved with the current treatment would remain if treatment was stopped. However in the clinical setting the recommendation is for ongoing part time bracing and rehabilitation exercises to maintain the improvements.

**Conclusion:** In this case of an adult patient suffering from Kypho-Scoliosis, it was possible to improve his spinal alignment, posture, pain and function. The results of this case suggest that the KyphoScoliBrace in combination with scoliosis rehabilitation, could be an effective treatment for kyphoscoliosis even in skeletally mature young adults.

**Significance:** No previous research has previously been published on the use of bracing and exercise for kyphoscoliosis in young adults.

**P47 Dynamic beam innovation in rehabilitation of spine disorders such as a support for classic physiotherapy**

Giacchino Ferracane¹, Pierfranco lentini²

¹ Studio associato di fisioterapisti Centro Lionese, ² Centro Movimento Benessere (Italy)

**Background:** Since 1971 the beam has been used in the rehabilitation field, such as the Balance-Beam Exercises for Milwaukee Brace-wearers. By the time we modified this aspect and we started to develop a new approach for the rehabilitation of spine disorders with an unstable beam (with a special bending radius) where patients lay in decubitus supine position, to avoid stress compression resulting from the standing position and to annul the postural compensations. This position allows the stimulations of spinal proprioceptive skin receptors by the use of pressure sensors placed on the Dynamic Beam (Dy.Be.). The patient’s position on Dy.Be. facilitates the vertebral skin
proprioceptive receptors stimulation and allows through different sensors placed on the beam (dorsal, lumbar and pelvis) to monitor the pressure applied on the right and on the left, during and at the end of the session. For each sensor are extracted the pressure values at different instants of time, and this allows to plot a graphs where is possible to make some considerations regarding the initial pressure at the first session and at the end of the whole session.

**Objectives:** Disturbances, balance turbulences, determine the displacement of the centre body mass control relative to the base of support and stimulate outer-proprioceptive receptors of the spinal district (Rachis) which transmit the information to the tonic postural system

A. On the position of each vertebra;
B. On the change of each muscle, ligament tension, in relation to the balance;
C. On kinaesthetic sensitivity
D. On balance

The tonic postural system processes these informations and programs immediate motor-sensory responses through the spinal vestibule system, determining:

- The improvement of mobilization and sensitization of the rachis
- The strengthening of deep and shallow spinal muscles
- Rebalancing muscular-ligaments tensions
- The improvement of multi-sensory balance system
- The improvement of deep proprioceptive reflexes and therefore the posture and gait

**Methods:** Patients, before using the Dy.Be. make a cognitive awareness of rachis, (laying on the floor) concentrating their attention on the pain ‘areas, the contact parts with the floor and the areas that are painful. After that, on the Dy.Be., is going to be selected the specific program and exercise (stretching, strengthen, coordination...)

The specific program for each disorder (such as scoliosis, kyphosis and mechanical lower back pain), was performed three times a week for a 50 minutes’ session on Dy.Be. for a whole year.

The study was tested on 90 patients suffering from those diseases.

**Results:** Skin information optimization. Improvements of immediate stimulation of muscles strength, balance, proprioception and posture.

**Conclusions:** This allows to state that the use of Dy.Be. increases the ability of maintenance of the subject’s balance in the supine position and increases the effectiveness of synaptic circuits responsible for spinal reflex. The concept of balance is made possible thanks to continuous micro-postural adjustments, that are achievable through the spinal synapses in locked loop. A good proprioceptive and postural system is able to maintain the posture of the subject by slightest oscillations of the body. In addition, we expect a distribution of rachis loads going homogeneous session after session, during the performance of motor-tasks.

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