A genetic association study was performed to investigate the frequency for nonprogressive, slowly progressive (progression <1° per month for ≥6 months), and rapidly progressive (progression ≥1° per month for ≥6 months) curves. For each genotype (AA, AG, GG) the mean Cobb angle and surgery rate were calculated. The control group consisted of 116 healthy females with negative family history (AA, AG, GG) the mean Cobb angle and surgery rate were calculated. The control group consisted of 116 healthy females with negative family history (AA, AG, GG) the mean Cobb angle and surgery rate were calculated. The control group consisted of 116 healthy females with negative family history (AA, AG, GG) the mean Cobb angle and surgery rate were calculated. The control group consisted of 116 healthy females with negative family history (AA, AG, GG) the mean Cobb angle and surgery rate were calculated. The control group consisted of 116 healthy females with negative family history (AA, AG, GG) the mean Cobb angle and surgery rate were calculated. The control group consisted of 116 healthy females with negative family history (AA, AG, GG) the mean Cobb angle and surgery rate were calculated. The control group consisted of 116 healthy females with negative family history (AA, AG, GG) the mean Cobb angle and surgery rate were calculated. The control group consisted of 116 healthy females with negative family history (AA, AG, GG) the mean Cobb angle and surgery rate were calculated.

Conclusions and discussion: In the current sampling of patients with AIS, a trend toward specific neurotransmitter imbalances was observed. These imbalances may help shed light on the often-observed somatosensory dyscoordination seen in this population.

References

O3

Pathomechanism underlying the onset of scoliosis in a PNX broiler chicken model
Yoichi Aota*, Hayato Terayama, Tomoyuki Saito, Masahiro Itoh
Department of Orthopaedic Surgery, Yokohama City University, Yokohama, Japan
E-mail: yaoita@yokohama-cu.ac.jp
Scoliosis 2013, 8(Suppl 2):O3

Purpose: The pinealectomy (PNX) in a chicken model consistently induces scoliosis with anatomic features that are similar to human adolescent idiopathic scoliosis (AIS). This experimental study attempted to improve the understanding of the mechanisms underlying the onset of scoliosis in a PNX broiler chicken model.

Methods: A histomorphometric study was performed to analyze longitudinal bone growth and cancellous bone remodeling before the development of scoliosis. Static and dynamic parameters in cancellous bone and chondro-osseous junction of the 7th thoracic vertebral body at nine days after hatching were compared between PNX chickens (n=9) and control chickens with no surgery (n=5).

Results: The PNX resulted in a rapid and marked loss of cancellous bone volume (8 ± 1% versus 14 ± 2%, mean ± SD, p<0.005) and profoundly disrupted trabecular structure with increases in dynamic formative parameters, such as mineralizing surface, mineralization apposition rate and adjusted appositional rate. In the chondro-osseous junction, activated osteoclasts phagocitized degenerating chondrocytes, leaving a minimal amount of cartilage matrix and activated osteoblasts, thus losing their scaffolding for bone formation directly covering the hypertrophic zone cells. The osteoid surface and thickness in the chondro-osseous junction were significantly increased in PNX chickens (43 ± 14% versus 12 ± 6% and 4 ± 0.2 μm versus 3 ± 0.4 μm). In the subjacent cartilage regions being protected from further resorption, abundant labeled cartilage remained.

Conclusions and discussion: It is known that fast-growing birds have a unique paradigm of rapid bone elongation with minimal metaphyseal bone production. A bone-forming surface exists at the front of cartilage ossification in the growth plate. Capillae of hypertrophic chondrocytes become included between the trabeculae of metaphyseal bone, and the overall thickness of the growth plate increases considerably in addition to distal expansion. Our results indicate that the unique mechanism for rapid bone elongation in chickens is more pronounced after PNX. PNX also induces high turnover osteoporosis, which may contribute to the development of scoliosis in the chicken.

Reference

O4

Relationship between bone density and bone metabolism in adolescent idiopathic scoliosis (AIS)
Yoichi Aota, Ko Ishida, Nobuyuki Tanabe, Tomoyuki Saito
Department of Orthopaedic Surgery, Yokohama City University, Yokohama, Japan
E-mail: yaoita@yokohama-cu.ac.jp
Scoliosis 2013, 8(Suppl 2):O4

Purpose: Although osteopenia is often associated with AIS, studies on bone metabolism in relation to AIS have not yielded clear results. To characterize bone metabolism in AIS patients, a cross-sectional study assessing bone metabolism and bone density was performed.

Methods: Using dual-energy X-ray absorptiometry and bone metabolism markers (bone formation marker; BAP, bone resorption marker; TRAP5b), the bone mineral density of lumbar and bilateral proximal femurs were studied in 41 AIS patients aged 10 to 20 years old, with a mean of 15.2±9.5 years old. Divided into two groups by levels of bone resorption marker (TRAP5b), BMD, BMI and age of menarche were compared statistically in each group.

Results: Among the AIS patients studied, osteopenia (-1 standard deviations to -2 standard deviations) was found in 34.1% of the patients and osteoporosis (below -2 standard deviations) was found in 24.4% of the patients. In 39 AIS patients (95.2%), BAP values were within normal range. On the other hand, TRAP5b values were significantly high in 65.9% of the patients. In high levels of the TRAP5b group, BMD values of the lumbar spine and right femoral neck were significantly lower than those of the TRAP5b group.

Conclusions and discussion: The bone resorption marker was high in 65.9% of the AIS patients, and high bone resorption in bone metabolism was found to be a possible cause of low bone mineral density in patients with AIS.

References

O5

Is the screening able to lower morbidity in the territory?
Aulisa Angelo Gabriele*, Vincenzo Guzzanti, Francesco Falciglia, Marco Giordano, Marco Penuzzi, Aulisa Lorenzo
Orthopaedic Department, Children’s Hospital Bambino Gesù, Institute of Scientific Research, Rome, Italy
E-mail: angelocabiogabrieleaulisa@fastwebnet.it
Scoliosis 2013, 8(Suppl 2):O5

Background: Although several procedures for treating scoliosis have evolved, the most effective treatment is still based on early detection. For early diagnosis of idiopathic scoliosis, many authors proposed methods of school screening: however, a standardized screening program does not yet exist.

Purpose: The aim of this study was to evaluate a school screening method and the prevalence and distribution of scoliosis in Italian schoolchildren, aged 9-14 years, and to determine if the screening method can reduce morbidity in the territory.

Methods: The screening program was based on three steps:
A clinical examination was performed by the school physician and two specialists. Doubtful cases (presence of hump between the two sides of the torso as measured in the thoracic or thoracolumbar region with use of a humpmeter) were evaluated by an orthopedic specialist that prescribed clinical control every six months or X-ray examination.
Classification of scoliosis and procedures for treatment.
All patients were scheduled for a follow-up program and were evaluated in the subsequent three years. Statistical analyses were performed with GraphPad Prism 6.

Results: A total of 8,995 children were screened for scoliosis. Of the total screened, 487 showed clinical signs of scoliosis and, of these, 181 were referred for antero-posterior radiographs because they had a positive result on the forward-bending test (hump>5mm). No significant statistical difference was observed by the three clinical examiners. Of the 181 patients who were referred, 69 were X rayed, and a clinical diagnosis confirmation was made in 94.2% of the cases. The prevalence of scoliosis (defined as a curve of 10° or more) was 0.76% (65 of 8,995 children), and high bone resorption in bone metabolism was found to be a possible cause of low bone mineral density in patients with AIS.

References
65 children who had a curve, 21 (32.3%) had a double curve, 18 (27.6%) had a thoracolumbar curve, 17 (26.1%) had a lumbar curve and 9 (13.8%) had a thoracic curve. In the following three years, only four patients were found to have curves >20° and none >30°.

Conclusions and discussion: Our results prove that the school screening program was accurate and repeatable. Moreover, screening children for scoliosis using a simple test appears to be an effective means of early detection. Above all the screening process effectively decreased the morbidity in the territory at a negligible cost.

References

O6
Pes cavus and idiopathic scoliosis from school screening
Hanane Belabbassi*, Assia Haddouche, Abdelkader Ouaadah, Houria Kaced Physical Medicine and Rehabilitation Department, University Hospital of Douera, Algiers, Algeria
E-mail: goodhealth60@hotmail.com
Scoliosis 2013, 8(Suppl 2):O6

Background: The correlation between idiopathic scoliosis and cavus foot has previously been reported, and has been ascribed to possible lesions related to muscular imbalance influenced by the central nervous system. This study assessed the rate of Pes cavus in scoliotic children. Two groups of patients were compared: those with idiopathic scoliosis and a control group without idiopathic scoliosis.

Purpose: The aim of this study was to assess the rate of Pes cavus in children with and without scoliosis and to show if there is a significant difference between the two rates.

Methods: A total of 82 children from a school screening program at the Physical Medicine and Rehabilitation Department in University Hospital of Douera, Algiers were examined. Of those, 34 were boys and 48 were girls between the ages of 6 and 17 years. A number of measurements were assessed, including the trunk asymmetry in Standing Forward Bend followed by the Cobb angle in upright spine radiography. We analyzed the footprints under weight bearing on the podoscope (mirror table). The first group included 43 children without scoliosis and the second group included 39 scoliotic children (Cobb angle ≥10 degrees). The presence of cavus foot (footprint type 1 and 2) in these two groups was examined. A statistical analysis was performed using the SPSS package.

Results: Foot examination detected cavus foot in 13 (33.3%) out of the 39 scoliotics, including four (10.26%) typical and nine (23.08%) light cavus foot. There is a statistically significant difference between the Pes cavus rate in children without idiopathic scoliosis and those with idiopathic scoliosis. Comparing 55.8% to 33.3% we found Chi-square = 4.174 with P = 0.041.

Conclusions and discussion: As reported elsewhere, our small sample noted the significant difference between Pes cavus in children with and without idiopathic scoliosis. In our study, the percentage of cavus foot was higher in healthy children than in patients with moderate scoliosis curves.

References

O7
Scoliosis and sagittal balance in Parkinson’s disease: analysis of correlations
Luciano Bissolotti*, Massimiliano Gobbo, Fabio Zaina, Monica Lusini, Sabina Donzelli, Stefano Negrini
Rehabilitation Service, Casa di Cura Domus Salutis, Brescia, Italy
E-mail: Luciano.bissolotti@ancelle.it
Scoliosis 2013, 8(Suppl 2):O7

Background: Information concerning scoliosis in Parkinson’s disease (PD) and its correlations with sagittal balance (SB) is sparse.

Purpose: The aim of this study was to describe the prevalence of scoliosis in PD patients and the existing correlations with SB in relation to the spinoepihelial morphology.

Methods: A total of 46 consecutive PD patients were included: 36 males, 12 females; 70.8±7.6 years; 6.4±4.1 years of disease (YOD); Hoehn Yahr (HY) 2.7±1.2. The clinical assessment included HY score, Pain NRS 0-10 and trunk rotation in bending (ATR). Lumbar lordosis (LL), thoracic kyphosis (TK), scoliosis curves (SC), spinoasacral angle (SSA), spinopelvic angle (SPA), pelvic incidence (PI), sacral slope (SS) and pelvic tilt (PT) were radiographically assessed. Patients have been compared according to the presence of SC >10° (PDSC) or the absence of SC (PD).n

Results: Among the study subjects, 47.9% presented a SC larger than 10°, 84% of the patients in PDSC presented a thoracolumbar curve, 10% a thoracic curve and 6% a lumbar curve. The cohort did not present differences with PD without about (71.8±6.0 vs. 69.8±8.8yrs) and YOD (6.1±4.1 vs. 6.6±4.1 years). No differences have been detected for HY score (2.7±1.2 vs. 2.6±1.6) and NRS (29.6±22.6 vs. 19.4±28.1). ATR was higher in PDSC (5.6±4.9 vs. 1.3±1.9, p<0.01). TK (46.4±16.1 vs. 46.9±12.1°), LL (46.3±26.9 vs. 49.3±13.9°), SSA (104.8±24.7 vs. 118.6±12.9°) and SPA (152.4±20.3 vs. 153.4±12.5°) were not different (p>0.05). PI (57.8±11.1 vs. 53.9±13.1°) and PT (23±6±13.7 vs. 17±6±8.6°) were slightly not statistically different, while SS was not (35.3±12.1 vs. 36.0±8.3°).

Conclusions and discussion: The prevalence of scoliosis in PD was higher than previously described by other authors, with the thoracolumbar spine mostly affected. SB was not different between two groups while, in PDSC, spinopelvic parameters presented the tendency to have a larger PI and PT.

References

O8
Adult scoliosis treatment combining brace and exercises
Dimitris Papadopoulos
Spondylos Laser Spine Lab, Athens, Greece
E-mail: dp@spondylos.eu
Scoliosis 2013, 8(Suppl 2):O8

Background: Wearing a brace or performing exercises are well-known methods of conservative treatment of adult scoliosis. However, the combination of these two methods has not been investigated.

Purpose: Based on the practice of wearing a scoliosis brace immediately after exercising to stabilize the stretch effect at the ligaments and the intervertebral disks [1], the purpose of this study was to reveal the importance of wearing the brace after performing exercises. Another goal of this study was to observe any changes in the major problems associated with adult scoliosis: pain, posture and progression of the curve.

Methods: In April 2009, the study began with 144 adult scoliosis patients: 123 women and 21 men with an average age of 40.8 years (spanning 19–84 years). The average scoliosis Cobb angle was 40.6° (18°-87.5°). All patients had a degree of pain and had been fitted with a Rigo-Cheneau brace, prescribed for at least eight hours per day after completing
Conclusions and discussion: These preliminary findings may suggest that physical therapy utilizing the Schroth Method, with modification for fusion, may be a useful way to treat patients after spinal fusion.

References

O10
The effectiveness of the Schroth method of physical therapy for treating an adult with adolescent idiopathic scoliosis (AIS) in an outpatient clinic in the United States with third-party payer constraints: a case report

Background: Very few studies examine the efficacy of outpatient Schroth therapy for the management of scoliosis, especially in countries such as the U.S. where a third-party payer constrains the therapy duration to an average of 1-3 sessions. Study patient description: double major scoliosis, thoracic Cobb angle 38° and lumbar Cobb angle 24°. Angle of Trunk Rotation (ATR) was 13° in the thoracic and 10° in the lumbar, quality of life score was 2.28 (SRS 22 questionnaire), body image was 1 (Trunk Appearance Perception Scale (TAPS)), pain score was 7 using the Visual Analog Scale (VAS), force vital capacity (FVC) was 2.8 liters, chest expansion was 3.8 cm in the subaxillary, 2.5 cm in the nipple line and 0.5 cm around the waist. Trunk deviation from the central sacral line was 2 cm to the left.

Purpose: The aim of this study was to examine the effects of Schroth therapy on a 26 year old female with AIS.

Methods: The physical therapy regimen included 1-hour Schroth exercise sessions twice per week for four weeks followed by one session each week for 20 additional weeks. In addition, a home exercise program, which consisted of 30-minute sessions five days per week, was recommended. All tests and measurements were recorded before and after treatment.

Results: After a 6-month treatment period, the patient experienced significant and measurable improvement. The Cobb angle was reduced to 27.6° in the thoracic and 19° in the lumbar, the ATR had decreased to 8° in the thoracic and 6° in the lumbar, quality-of-life score and self-image showed improvement with a score of 4.02 on the SRS 22 and 3 on the TAPS. Pain score diminished to 2. Trunk deviation improved by 1 cm, FVC increased to 3.2 liters and chest expansion to 4.5 cm, 3.5 cm and 1.5 cm at the measured locations. In addition, the patient’s strength improved and she felt more comfortable with her appearance and reported satisfaction with the results.

Conclusions and discussion: These preliminary findings suggest that outpatient physical therapy utilizing the Schroth method may be a successful alternative to the traditional methods of treating scoliosis.

References
2. Boyaiev M, Boyaiev A: Scoliosis short-term rehabilitation (SSTR) according to ‘Best Practice’ standards—are the results repeatable? 2012, 7(1).
Background: In 2004, the U.S. Preventive Services Task Force (USPSTF) recommended against the routine screening of asymptomatic adolescents for idiopathic scoliosis (IS). The stated rationale in the Summary of the Recommendation was "the USPSTF concluded that the harms of screening adolescents for idiopathic scoliosis exceed the potential benefits." [1] Since that time, at least five states have removed scoliosis screening from their school health requirements.

Purpose: The purpose of this study is to present the preliminary results of a review of the evidence based outcomes related to the USPSTF's recommendation against scoliosis screening in the U.S.

Methods: We analyzed the Healthcare Cost and Utilization Project (HCUP) database for hospital discharges and costs for ICD 9–737.30 "Idiopathic Scoliosis" for the period 2003–2010, in total and by age group and gender. Our review included a comparative analysis of both the nation as a whole as well as states with legislated screening (SS) and states without legislated screening (NS).

Results: Nationwide hospital discharges for IS were 6,579 in 2003 compared to 13,531 in 2010, an increase of 105.7%. Mean charges for treatment for IS in 2003 were $88,875 compared to $166,344 in 2010, an increase of 87.2%. According to the state data for this same period, total hospital discharges for SS increased 60.4% versus 73.3% for NS (the 18-44 year-old group discharges for SS increased only 5.6% versus 21.1% for NS), and the increase in total mean charges for treatment was 86.6% for SS versus 93.4% for NS.

Conclusions and discussion: Since publication of the USPSTF's recommendation against scoliosis screening, the U.S. has seen an increasing nationwide trend in both the number of hospital discharges of IS patients and the mean charges for their treatment. In addition, the increase in the number of discharges was higher in NS states compared to SS states, and the increase in total charges for treatment was higher in NS states compared to SS states. The USPSTF recommendation has reduced the number of screening programs in the U.S., consistent with the intent of their policy. However, the HCUP data suggest that contrary to the USPSTF's stated rationale, the reduction in scoliosis screening appears to have caused more harm, not less, for IS patients and society as a whole, in terms of an increase in the volume and economic burden of scoliosis surgeries. Further studies with additional databases and statistical analyses are needed to address the limitations of the HCUP database and this preliminary review.

References

O12 Surgical versus non-surgical interventions for adolescent idiopathic scoliosis: a Cochrane review protocol
Josette Bettany-Saltikov, Hans Rudolph Weiss, Nachappan Chokkalingam, Razvan Taranu, Shreya Sinivas, Sally Stapley, Julie Hogg, Victoria Whitaker, Raman Kalra, Petra Groot, Teesside University, Middlesbrough, UK
E-mail: J.B.Saltikov@tees.ac.uk
Scoliosis 2013, 8(Suppl 2):O12

Background: The main aims of all clinical interventions in the treatment of adolescent idiopathic scoliosis (AIS) are to limit curve progression, restore trunk balance and prevent long-term consequences of the deformity. Two separate Cochrane reviews have already reviewed the effects of non-surgical interventions (Negrini, 2010 and Romano, 2012). A further scooping search identified four systematic reviews, however full methodological appraisals within these reviews were very limited (Weiss, 2008), indicating the need for a high-quality Cochrane review focusing on surgical interventions.

Purpose: The goal of this study is to evaluate surgical versus non-surgical interventions in patients with AIS, both in the short- and long-term.

Methods: The primary analysis will combine the results of RCTs and QRCTs. We will also include non-randomised prospective studies with a control group since there is a paucity of RCTs in this area. The review will include all types of instrumented surgery with fusion, aimed at providing curve correction and spine stabilisation. Studies describing non-instrumented spinal correction and fusion will be excluded because it has been shown that they do not provide any better outcome than untreated scoliosis (Lonstein, 2006). All outcomes will be measured in the immediate post-operative, short-term, within two years and long-term results into old age. Primary outcomes will include trunk balance, Cobb angle, angle of trunk rotation; number of patients progressed by more than 5° Cobb as well as topographical and psychological outcomes. Searches of COCHRANE, MEDLINE, EMBASE, CINAHL, PsyCINFO and PEDro will be conducted. Reference lists of ongoing trials, grey and non-English literature will be screened.

Conclusions and discussion: Two review authors will screen search results by reading titles and abstracts. Relevant studies will be obtained in full text and independently assessed for inclusion. Risk of bias for RCTs and QRCTs will be assessed using the 12 criteria recommended by the Cochrane Back Review Group and the Newcastle-Ottawa Scale will be used to assess NR trials.

Results: If a meta-analysis is not possible, results will be described qualitatively and overall quality of evidence for each outcome will be assessed.

References

O13 Three curved thoracic left-scoliosis after tethered spinal cord surgery
Petra Groβl, Christa Lehnter-Schrith
Degree Program Physiotherapy, FH Joanneum Graz, Austria
E-mail: petra.groebel@fh-joanneum.at
Scoliosis 2013, 8(Suppl 2):O13

Background: The case study describes a patient with scoliosis after tethered spinal cord-symptomatic was surgically resolved at the age of 2½ months. At that time, the Cobb angle of the thoracic curve was 32°. At the age of 30 months a three curved thoracic left-scoliosis with a Cobb angle of 80° with serious shape-shift in frontal and sagittal level appeared. At the age of 4½ years the patient was fitted with a Rigo-Cheneau corset, which guided the breath into the right side.

Methods: At the age of 36 months, the Schroth treatment was started. At this time, the primary goal was the correction of the hip that was positioned outwards to the right. This sideward movement, combined with a twist of the pelvis forced the thoracic cage into convexity on the left side and left-backward rotation, producing rib prominence. A hyper-correction according to Schroth was instructed: Side-lying on the right, a thick padding underneath the right hip, flexion with lengthening force to cranial with the right arm. The concave side was wide-positioned, thus diverting the breath in that direction. The right ribs showed two tensed areas. Schroth's turn-angle-breathing was always asked for at the concave places and carried out three-dimensionally in connection with the considered lowering of the diaphragm, eventually repositioning the "weak" ribs into their normal place.

Results: At the beginning of the treatment, there were two visible tensed rib areas, which required tactile stimulus as well as expanse and breathing. After a few months, the right side became stretched and appeared nearly normal. At 2½ years: Body limp and weak, X ray 80° Cobb. At 5½ years: Posture upright, pelvis straight, body appears steady, incorrect posture of the head equable, X ray 45° Cobb.

Conclusions and discussion: Schroth's method seems to be significantly effective even in scoliosis with contributing neurogenic factors.

References
Two year post-menarche rule for bracing: myth or reality?

Stefano Negrini, Sabrina Donzelli, Monia Lusini, Salvatore Minnella, Fabio Zaina
University of Brescia - IRCCS Don Gnocchi, Milan, Italy
E-mail: stefano.negrini@isico.it
Scoliosis 2013, 8(Suppl 2):O14

Background: The SRS criteria for bracing studies proposes the limit of two years post-menarche (2YPM). This is also frequently used for bracing in the clinical everyday world.

Purpose: To verify whether the 2YPM rule for bracing is appropriate in clinics, we aimed to answer the following four questions:

1. Is bone growth (according to Risser) almost completed?
2. Is stature growth ended?
3. Are bracing results significantly reduced?
4. Are patients improved/worsened.

Methods: We consecutively developed four studies from our clinical prospective database, including 5,142 Females with Idiopathic Scoliosis Patients below the age of 20 years.

Results:

1. All FISP with an x-ray at 2YPM
   - 1102 patients
   - Age 13.0±1.8
   - 29.4±10.3° Cobb
   - 263 patients
   - Age 13.1±1.1
   - 35.2±11.1° Cobb
   - European Risser staging
   - Height growth
   - Progression
   - Results of bracing

Conclusions and discussion: These results suggest the need to carefully check the usefulness of the 2YPM rule for clinical studies. While reaching clinical therapeutic decisions in front of single patients, 2YPM is not a reliable parameter, at least not in Italy.

References

O16

Three-dimensional reconstructions of Lenke 5C Curves
Julie Decueneinck*, Jean-Claude Bernard, Eric Berthonnaud
Croix Rouge française - CMCR des Massues, Lyon, France
E-mail: j.decueneinck@cmcr-massues.com
Scoliosis 2013, 8(Suppl 2):O16

Background: With his classification system, Dr Lenke introduced new parameters in radiographic analysis of idiopathic scoliosis, such as lumbar and thoracic sagittal modifiers [1]. Scoliosis is defined as a 3-dimensional (3D) deformity in the frontal, sagittal and horizontal planes. The spine is considered as a heterogeneous beam and is modeled as a deformable wire, with vertebral representatives by heads rotating about the wire. Each vertebra can rotate around the 3D spinal curve, which is formed by several plane regions connected by zones of transition. The 3D spinal curve is uniquely fixed along the plane regions. Biplanar radiographic examination with successive exposures (frontal and sagittal in 30cmx90cm format), coupled with photogrammetric reconstructions, may be used to recreate the 3D spinal curve.

Purpose: The objective of this study was to identify whether all Lenke 5C curves could have the same 3D representation.

Methods: All patients with Lenke 5C curves that consulted and received frontal and sagittal radiographs in turning plate at one institution in 2012 were recruited. Each patient’s characteristics and measurements (i.e., Cobb angles, cervical, thoracic and lumbar sagittal curves, pelvic parameters and election plane characteristics) were recorded.

Results: A total of 61 consecutive Lenke 5C patients (mean age of 12.4 years for 50 girls and 11 boys) were included in the study. Lumbar Cobb angle was between 9º and 50º (mean 18.33º). Pelvic incidence was between 29º and 73º (mean 49.3º) and pelvic tilt between -6º and 28º (mean 6.9º). In most cases, three torsion planes were found, as in asymptomatic subjects; the rotation of these planes was very disparate.

Conclusions and discussion: Lenke 5C curves could be represented in a variety of ways. However, to properly analyse and treat these curves today, the 3D representations of idiopathic scoliosis must enter into our daily practice.

References

O17

Investigation of 3-dimensional radiographic imaging as treated with Hyu Spinal corrective technique
Kim HoSeong*, Nah Dong Koog, Koh Jae-Hyun, Kim Donghyun, Kim JunLae
Department of Physical Medicine and Rehabilitation, Seoul Hyu Clinic, Gyeonggi-do, Korea
E-mail: ob1knob@hanmail.net
Scoliosis 2013, 8(Suppl 2):O17

Background: Adolescent idiopathic scoliosis (AIS) is a common, costly, and progressive spinal deformity that affects 3-dimensional (3D) neuromuscular control of the axial spinal musculature. Conventional studies of spinal corrective techniques have shown improvements in cardiopulmonary function, strength, mobility, pain and body image. Nevertheless, the majority of AIS studies predominately focus on alleviating 1- or 2-dimensional (2D) spinal deformity (frontal or sagittal) risk factors, and have not specifically targeted multi-dimensional risk factors associated with AIS.

Purpose: The goal of this study was to compare the 3D change of spine and pelvic alignment in AIS patients after applying a Hyu Spinal Technique (HST; focusing on 3D-correction along with dynamic lumbo-pelvic and trunk stabilization) and Conventional Exercise (CE).

Methods: Idiopathic scoliosis (N = 62,13 males) between 10 and 19 years of age (14.23 ±2.31 years) were treated either with the HST or CE in outpatient sessions lasting approximately one hour each, 2-3 times a week. A diagnostic 3D X ray imaging technique was used to determine intervention-related changes in the Cobb angle, thoracic kyphosis angle, lumbar lordosis (LL) angle, pelvic incidence (PI) and vertebral rotation (VR, Nash-Moe method). The SRS 22 post-intervention survey was used. Data were analyzed using the non-parametric Mann-Whitney U-test and Wilcoxon signed rank test at p < 0.05.

Results: When compared to CE, the HST showed greater improvements in Cobb angle (p = 0.014), LL angle (p = 0.010), PI (p = 0.010), VR (p = 0.043) and SRS 22 scores (self-image and treatment satisfaction subscale scores and total score, p = 0.026, p = 0.039 and p = 0.041 respectively). There were no significant changes in the other measures between the two groups.

Conclusions and discussion: The results indicate that the HST as 3D spinal corrective technique is effective for correcting spinal malalignment not only in the frontal plane, but in the sagittal and transverse planes. This is the first study using advanced radiographic imaging to investigate the effects of a 3D spinal corrective technique on spinal curvatures and self-image in AIS; thus providing important clinical rationale for the 3D approach in the effective management of AIS.

References

Table 1(abstract O18)

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<tr>
<td>C7+L3 distance (cm)</td>
<td>-3</td>
<td>0</td>
<td>+0.5</td>
<td>-0.5</td>
</tr>
<tr>
<td>ATR (°)</td>
<td>-8</td>
<td>-3</td>
<td>-3</td>
<td>+3</td>
</tr>
</tbody>
</table>
Methods: Case series using the European Risser test.

Results: By chance, a reduction of the Risser test was discovered in one patient. Subsequently, other cases have been searched to see if this was an exceptional situation. In one year, we found three more cases.

Conclusions and discussion: At this stage, the following explanatory hypotheses can be drawn:

Technical radiological differences (exposure, machine)
Variation of pelvis positioning
Postural changes influencing the pelvis
Brace compression on the pelvis

According to our study results, all of the hypotheses include data both in favor and against the reliability of the Risser sign. Since the Risser sign is a 2D evaluation of a 3D phenomenon, pelvis repositioning could perhaps be the most plausible explanation.

This case series is open to the possibility that the Risser sign is even less reliable than originally considered. Unfortunately, this result cannot be checked experimentally due to ethical reasons. Nonetheless, observational designs should be considered in the future.

References

O19
'SpineCor' apical vertebral rotation measuring tool
Alison Murray*, Tim Cook
SpineCorporation Ltd, Montreal, QC, Canada
E-mail: A.Murray@spinecor.com
Scoliosis 2013; 8(Suppl 2):O19

Background: The measurement of Apical Vertebral Rotation (AVR) is vital to the surgical and conservative treatment of idiopathic scoliosis. Several measuring methods are used to assess the AVR on plain radiographs, including the visual Nasn and Moe, Perdriolle's torsion meter and Raimondi's table, all of which have positive and negative aspects [1-3].

Purpose: We developed an AVR image scale of 0-55° rotation, predetermined, to assess its ease of use as a visual method when comparing the mean inter- and intra-reliability against Perdriolle's and Raimondi's scales.

Method: A human lumbar vertebra (L4) set on a rotating device, and a series of X rays were taken, at 1 degree increments, from 0-55° clockwise rotation. These images were flipped to produce 0-55° counterclockwise rotation. The apical rotations of 39 curves was measured by three different observers (each having more than three years of experience specializing in the field of scoliosis) using the SpineCor AVR scale, Perdriolle's torsion meter and Raimondi's table. The measurements were taken twice, with a minimum of one week between each measurement.

Results: The inter-rater mean difference for the SpineCor AVR scale versus both Perdriolle's and Raimondi's was the same (within 0.01°) but this mean difference was greater than the mean difference between Raimondi's and Perdriolle's by 0.48° and 0.49° respectively (SpineCor AVR scale versus Raimondi = mean difference of 4.18° SD +/- 2.04°, SpineCor AVR scale v Perdriolle's = mean difference 4.19° SD +/- 2.05°, Raimondi v Perdriolle's = 3.70° SD +/- 1.92°); the intra-rater mean difference was 1.07° greater with the SpineCor AVR scales than with Perdriolle's and 0.43° greater than Raimondi's table (intra-rater mean difference for the three testers with SpineCor images= 2.29° SD +/- 0.44°, with Raimondi's = 1.84° SD +/- 0.39° and with Perdriolle's = 1.12° SD +/- 0.44°).

Conclusions and discussion: The SpineCor AVR scales demonstrated high intra-reliability mean differences with a mean difference of 2.29° SD +/- 0.44° and inter-reliability of 4.16° +/- 2.04° SD and 4.19° +/- 2.05° SD, which does appear to demonstrate favourable intra- and inter-reliability in comparison to both Perdriolle's and Raimondi's scales[1,2].

References
Background: Radiographic lateral spine view remains the gold-standard evaluation for sagittal curvatures of the spine. Specific positioning of the forward upper extremities during radiographic exposure is recommended to ensure no vertebrae is obscured. However, the postural impact of arm positions has never been verified for the normal adolescent population. As a result, no data are available about the influence of arms positioning on the sagittal positioning of the trunk.

Purpose: The aim of this study is to measure the effect of arm positioning on surface topography measures.

Methods: In a cross-sectional study, 694 subjects (K=412; F=275) aged 10-18 years of age were examined and were scanned with a 3-dimensional (3D) telediagnostic system for postural screening. For this study, we used 3D surface topography (“3D Orthoscreen”) enhanced by structured light and accurate calibration in XYZ Cartesian space, which enables the system to measure vertical trunk inclination angle against the plumb line. The statistical analysis was performed using SAS v.9.3.

Results: No systematic difference was found between measurements in two different positions. British Standardization Institute Index (BSII) (2SD) was 11.4°. Results for 94.2% of the subjects fulfilled the criteria for BSII. Reliability index (ICC) was 0.60; p<0.0001; higher for girls (0.65) than for boys (0.5). We discovered systematic differences between lordosis angle values in standing positions with hands hanging freely and “fingers on the clavicles”. The average value of standing position with flexed elbows was higher. Observed differences were significant regardless of gender. The correlation between results in two positions was 0.86 in girls and 0.81 in boys. No systematic differences were found for trunk vertical inclination in sagittal plane in relation to two different positions. BSII was (2SD) 4.8. Results for 94.2% of the subjects fulfilled the criteria for BSII. The reliability intraclass correlation coefficients index represented a significant correlation between results 0.74; p<0.0001, slightly higher for girls (0.78) than for boys (0.72).

Conclusions and discussion: We conclude that the habitual position, regardless of elbow extension or flexion, has no influence on sagittal thoracic curvature, and on vertical trunk inclination against plumb line. However, the position with fingers on the clavicles significantly influences lumbar lordosis. The 3D surface topography may help when considering the real habitual standing angles.

References

O22 Correlation between stereoradiography and 3D topographic measurements
XueCheng Liu, John Thometz, Carlos Marquez-Barrientos, Channing Tassone
Dept. of Orthopaedic Surgery, Medical College of WI, Milwaukee, WI, USA
E-mail: xcliu@mcw.edu
Scoliosis 2013, 8(Suppl 2):O22

Background: The EOS is a low-dose digital stereoradiography system that can produce highly reproducible spine measurements. The Milwaukee Topographic System (MTS) has reliably detected the 3-dimensional (3D) back surface contour changes. The correlation between Cobb angles and the MTS analog to Cobb angles in both the sagittal and coronal planes have been studied, but data are limited for comparisons of axial vertebral rotation measures derived from the MTS and X ray system.

Purpose: The goal of this study was to evaluate the correlations between EOS-derived axial rotation and MTS-registered axial surface rotation at each vertebral level.

Methods: A case control study design was performed, and four subjects with adolescent idiopathic scoliosis (ages 10 to 17) had measurements taken using both the MTS and EOS system. The MTS used a handheld laser scanner to gather the subjects’ back geometry while standing. Markers were placed on the subjects' spinal processes so they could be identified in the scans and a custom software package was used to calculate 3D back measures. The EOS system took bi-planar images of the subjects’ torsos while standing and then calculated spine measurements by semi-automatically making a 3D reconstruction of the spine. The vertebral axial rotations from the MTS and EOS system were compared for the thoracic and lumbar vertebrae. The Pearson correlation coefficient was calculated for all the vertebrae.

Results: Only one vertebral level measurement, the third lumbar vertebra (r=0.95, p<0.049), had a significant correlation, although the eighth (r=0.94, p<0.06) and ninth (r=0.92, p<0.08) thoracic vertebrae had high correlations that were close to significance.

Conclusions and discussion: In this limited study, the MTS predicts for the transverse rotations of the spinal segments, especially in the thoracolumbar and proximal lumbar region. Our current experience may indicate that the larger the vertebral body, the better the 3D reconstructive process using EOS.

O23 Clinical application of 3D topographic device for monitoring scoliosis progression
John Thometz, XueCheng Liu, Channing Tassone, Roger Lyon
Dept. of Orthopaedic Surgery, Children’s Hospital of WI, Medical College of WI, Milwaukee, WI USA
E-mail: JThometz@chw.org
Scoliosis 2013, 8(Suppl 2):O23

Background: Cumulative exposure to radiation from diagnostic radiographs increases patient risk of cancer development. Minimizing exposure to radiation is desired for the patient’s health, so there is a need to develop alternative non-invasive tools to measure spine deformity.

Purpose: The aims of this study were to (1) determine the reproducibility of the newly developed 3-dimensional (3D) Milwaukee Topographic System (MTS) through inter- and intra-rater measurements and (2) calculate the correlation between the 3D angle obtained by the device and the Cobb angle measured with radiographs.

Methods: The study group consisted of twenty children with idiopathic scoliosis (IS), aged 6-18 years, with a range of Cobb angles. The MTS is composed of two wide-angle optical cameras, two electro-magnetic sensors, a light, a software package, a positioning frame, and a desktop computer. The device required four 5-second scan sweeps (three vertical and one horizontal) for each subject. Four measurements were performed by two investigators, alternately. Reliability for the device was measured with intra-class correlation coefficient (ICC) controlling subject effect in a stratified model. Pearson correlations were calculated as well as mean values and confidence intervals for each metric.

Results: A Pearson data analysis showed excellent intra-class correlation (ICC > 0.6) between investigators for 10 metrics, and moderate ICC from 0.4 to 0.6 for four metrics (p<0.05). A Pearson analysis of intra-investigator ICC demonstrated moderate to excellent ICC in all 17 measured parameters (p<0.05). A Pearson correlation coefficient between the 3D angles obtained from the MTS and radiographs was remarkably higher for the Cobb angle in the sagittal plane (r=0.91, p<0.001).

Conclusions and discussion: The new MTS provides reproducible measures for the assessment of patients with scoliotic deformity.

O24 Merging 3D optical measurement system (structured light-based surface topography) and digital radiograms - the technique and preliminary results
Glinkowski Wojciech*, Paśko Stawomir, Waleśki Katarzyna, Sitnik Robert, Görecki Andrzej
Chair and Department of Orthopaedics and Traumatology of Locomotor System, Center of Excellence “TeleOrto”, Baby Jesus Clinical Hospital, Medical University of Warsaw, Poland
E-mail: wglinkowski@gmail.com
Scoliosis 2013, 8(Suppl 2):O24

Background: Diagnosing scoliosis requires the ability to visualize curvature of the spine in a 3-dimensional (3D) environment. 2-dimensional X ray remains the primary imaging modality [1]. However, recent progress
The purpose of this study was to present the potential usefulness of merging data from the 1-directional radiogram with a 3D model obtained with an optical measurement system.

Methods: The images of 11 adolescents (average age 15.05 years) with adolescent idiopathic scoliosis (AIS) were selected for this study. Average Cobb angle 31.7° surface kyphosis angle 10.45° and surface lordosis angle 36.06°. An IRB was approved for this study. The merging algorithms were developed as an operational plug-in for OsiriX Imaging Software used in the facility for viewing medical images from the hospital PACS system. The 3D data from a 4-directional (360°) optical measurement system (structured light-based surface topography) and digital radiograms were merged into one, consistent 3D model. The plug-in allowed loading and adjusting the data collected by these two systems. Finally, the composed 3D image was viewed, processed and saved in DICOM file format.

Results: Merged images showed the data obtained from a 4-directional 3D optical system and X ray for the same patient made the same day. The results of this comparison are presented in graphical form. Additionally, patients appreciated that the merged 3D/X ray images provided a better understanding of the deformity and the ability to see their body surface from a new untreated perspective.

Conclusions and discussion: Merging of data obtained with the 4-directional optical measurement system with data taken from another medical system, such as X ray photography, gives physicians a powerful diagnostics tool that combines the advantages of both examination methods [3]. Moreover, as acquisition time for 4-directional optical measurement is short (a few seconds) and there is no X ray radiation, the examination can be repeated as many times as needed.

Acknowledgement: This project NR13-0109-10/2010 is founded by National Center for Research and Development.

References

O25
Assessment of torso deformities using 3D markerless asymmetry analysis and its clinical applications
Amin Komeilī, Lindsey Westover, Eric Parent, Marc Moreau, Marwan El-Rich, Samar Adeeb
University of Alberta, Alberta, Canada
E-mail: akomeili@ualberta.ca
Scoliosis 2013, 8(Suppl 2):O25

Background: The location of the scoliosis curve apex is important in brace prescription and can only be obtained from radiographs [1]. Surface Topography (ST) has poor correlation with curve shape but current ST analyses often rely on markers placed by operators, which can affect measurement accuracy.

Purpose: This study aimed to meet the following objectives: (1) develop an approach to analyzing markerless torso ST data, (2) propose a ST classification system for torso asymmetry in adolescent idiopathic scoliosis (AIS) patients, and (3) predict the location of the curve apex based on ST.

Methods: The full torso ST of 90 AIS patients with different curve types were retrieved from our previous study [2]. The mean Cobb angle was 32.5° (range: 8°-69°). The best plane of symmetry that divides the torso into left and right parts was calculated. Deviations between the left and right parts were measured and displayed as deviation colour maps (DCMs). To propose a surface clarification, the DCMs of 46 patients were appraised by three scoliosis professionals. The DCMs were then classified into three main groups and six subgroups by four novice observers. The intra and inter-observer reliability of the classification was assessed using Kappa coefficients. The vertical position of the maximum deviation point above the PSIsS was multiplied by a correction factor to estimate the vertical location of the curve apex.

Results: The mean kappa coefficient for intra-observer reliability was 0.85 (0.68-0.92) indicating good to excellent classification reliability [3]. The inter-observer kappa coefficient was 0.62 and the percentage of agreement was 80%, indicating moderate reliability[3]. For 88 torsos with thoracic curves (subgroups 2, 4 or 5), the location of the point of maximum deviation predicted the location of the curve apex with a ±2.2cm accuracy (range 0.02-5.5cm, R²=0.72). For 39 lumbar curves with Cobb angle >20°, prediction accuracy was ±1.6cm (0.02-4.2cm, R²=0.42).

Conclusions and discussion: A non-invasive markerless ST quantification of the asymmetry of the torso was developed allowing reliable classification of patients with scoliosis. The new approach can predict the location of the curve apex with errors corresponding to the dimensions of one vertebra.

References

O26
The effect of a unilateral upper extremity load (backpack) on the resulting spinal posture
Patrick Knott*, Sarah Davis, Ashley Harrison, Carly Larson Rosalind Franklin University of Medicine and Science, Chicago, USA
E-mail: Patrick.Knott@RosalindFranklin.edu
Scoliosis 2013, 8(Suppl 2):O26

Background: A frequent question from parents of adolescents is whether there are risk factors that could make a scoliosis curve increase, specifically whether carrying a heavy backpack on one shoulder could be detrimental to an existed curve. There has been very little research published to answer whether a unilateral upper extremity load would have an effect on spine position, let alone scoliosis progression (Chow, 2006).

Purpose: The purpose of this study was to measure changes in spinal curvature with increasing unilateral carrying load in order to analyze the possible risk for patients with adolescent scoliosis.

Method: Six young, non-scoliotic adults were measured with carrying loads of 15% and 20% of the subjects’ body weight compared to the neutral condition and analyzed for significant change. The forometric 3-dimensional/4-dimensional topography scanner was used to measure (1) weight distribution (2) kyphotic angle of the thoracic spine (3) lordotic angle of the lumbar spine (4) scoliosis angle of either the thoracic or lumbar spine, (5) coronal vertical axis (6) sagittal axis, and (7) shoulder tilt.

Results: Coronal imbalance had a small shift of about 4 mm off center towards the side holding the backpack. Sagittal imbalance shifted forward by about 15mm, regardless of the side holding the backpack. The pelvic obliquity changed by about 2° away from the side holding the backpack. Kyphosis and lordosis stayed fairly stable. Shoulder slope changed by about 8°, with the backpack side lower, resulting in a 2mm shoulder height difference. Weight shifted towards the side holding the backpack by about 20%, but did not shift towards the front or back.

Conclusions and discussion: We found that coronal imbalance, sagittal imbalance, shoulder tilt and weight distribution changed significantly from the neutral position with 15% and 20% weight applied to either side of the body. Although it is not known what effect this would have on progression of scoliosis, these changes could potentially contribute in a negative way to spinal imbalance.

References
2. Chow DH, Ng KH, Holmes AD, Cheng JC, Tao FY, Wong MS. Effects of backpack loading on the pulmonary capacities of normal schoolgirls

O27

Evidence-based clinical tool for quantitative analysis of posture in children and adolescents with idiopathic scoliosis

Carole Fortin1,2,*, Debbie Feldman Ehrmann1,2, Fabia Cheriet1,2, Hubert Labelle1
1Centre de recherche, CHU Sainte-Justine, Montreal, Quebec, Canada; 2École de réadaptation, Faculté de médecine, Université de Montréal, Montreal, Quebec, Canada
E-mail: Carole.fortin@umontreal.ca
Scoliosis 2013, 8(Suppl 2):O27

Background: Correction of posture is an important goal of physiotherapy interventions in persons with idiopathic scoliosis (IS) to prevent scoliosis progression and to reduce morphologic deformities and their impact on quality of life. Currently, there are no clinical tools that globally quantify changes in posture attributable to scoliosis progression or treatment effectiveness.

Purpose: The goal of this study was to develop and validate a new clinical quantitative posture assessment tool among persons with IS.

Methods: We constructed a software-based program (2-dimensional (2D) tool) to calculate 23 posture indices (PI) representing frontal and sagittal alignment of body segments selected from a literature review [1]. The standing posture of 70 participants aged 10 to 20 years old with IS (S Cobb angle: 15° to 60°) was assessed on two occasions by two physiotherapists. Markers placed on several bony landmarks as well as natural reference points (e.g., eyes and ear lobes) were used to measure the PI from photographs with the 2D tool and to calculate 3-dimensional (3D) PI obtained from trunk reconstructions with a surface topography system. Frontal and sagittal Cobb angles and trunk list were also calculated on radiographs. The generalizability theory (and standard error of measurement – SEM) and Pearson correlation coefficients (r) were used to determine reliability and concurrent validity, respectively.

Results: In the random design, 21 out of 23 of the PI had a good level of reliability (r ≥ 0.81). The SEM values ranged from 0.9º to 4.3º and 2.1 mm to 8.5 mm. Correlation between 2D and 3D PI was good to excellent for shoulder, pelvis, trunk list and thoracic scoliosis angles (0.81 > r < 0.97; p < 0.01) but fair to moderate for sagittal and thoraco-lumbar/lumbar scoliosis spinal indices (0.30 > r < 0.56; p < 0.05). Correlation between 2D and radiograph spinal indices was fair to good (-0.33 to-0.80 with Cobb angles and 0.76 for trunk list; p < 0.05).

Conclusions and discussion: This 2D-imaging tool provides reliable [2] and valid [3] measurements of posture. This new evidenced-based tool may improve physiotherapy practice by facilitating posture analysis. Future longitudinal studies will determine its ability to monitor treatment effectiveness and change in posture over time in persons with IS.

References

O28

The formetric TRACER index: a valid measure of aesthetic deformity in adolescent idiopathic scoliosis

Francesco Negrini, Fabio Zaina, Stefano Negrini
Università Vita-Salute San Raffaele, Milan, Italy
E-mail: stefano.negrini@isico.it
Scoliosis 2013, 8(Suppl 2):O28

Background: The gold standard of scoliosis evaluation—Cobb angle measurement—is a valuable tool for assessing spinal deformity and making therapeutic decisions [1,2] but is not fully able to describe the trunk deformity (aesthetics), which is a main concern of patients. Posture, deformity of other bones and soft tissues could be other determinants of the aesthetic impairment due to scoliosis. We do not currently have a commonly accepted measurement of aesthetic impairment due to scoliosis.

Purpose: The goal of this study was to find a parametric measure to describe aesthetic impairment due to scoliosis. Design: Cross-sectional study. Population: 119 adolescent idiopathic scoliosis (AIS) patients (10.0% males, age 13.9±2.3; 23.4±10.9°Cobb). The sample was randomly divided into two subgroups.

Methods: Repeated formetric evaluations and simultaneous pictures of the back were performed. An online questionnaire with the photos was completed by 41 laypeople with no scoliosis experience (53.6% males, age 30.3±13.3), who judged the photos on a 0-3 Likert scale (0 normal, 3 highly asymmetric). Statistics: On the first subgroup, we performed a stepwise forward regression technique considering as dependent variable the median of the results of the questionnaire, and as independent variable formetric, clinical and radiological parameters. On the second group, we checked the correlation between the index found (TRACER) and the median of the results of the questionnaire (Spearman’s Rho). Finally, we checked the test-retest repeatability (Spearman’s Rho), concurrent (Spearman’s Rho) and diagnostic (T-test) validity of the index we found.

Results: The following formula was found: TRACER=(0.726+(Cobb-Max∗0.018)+(SurfaceRotation∗0.037))/3∗100. This TRACER index (0-100) was well-correlated (Rho=0.414, p<0.01) with the median of the questionnaire results in the second group; it was also highly repeatable (Rho=0.922), strongly correlated to Cobb degrees (Rho=0.838), mildly correlated to TRACE index [3] (Rho=0.376) and distinguished pathological and healthy subjects (p<0.01).

Conclusions and discussion: The TRACER index could be used to measure aesthetic deformity in AIS patients; however, further studies are needed to investigate its role in the conservative and surgical treatment of scoliosis.

References

O29

Sagittal balance in the conservative treatment of pathological kyphosis: a retrospective observational study

Salvatore Minnella, Sabrina Donzelli, Monica Lusini, Fabio Zaina, Michele Romano, Alessandra Negrini, Stefano Negrini
ISICO Italian Scientific Spine Institute, Milan, Italy
E-mail: salvatore.minnella@isico.it
Scoliosis 2013, 8(Suppl 2):O29

Background: Sagittal alignment of the spine is not well understood. Some authors have demonstrated that the spinal shape is closely correlated with the pelvic shape and orientation. Uncertainty exists if pathological kyphosis should be treated, regardless of sagittal balance.

Purpose: The goal of this study was to assess how conservative treatment of pathological kyphosis during growth correlates with spinal and pelvic sagittal balance parameters.

Methods: Study Design: Retrospective observational study. Population: A total of 23 patients (15 males; 8 females), aged 11 to 17 years were included. Each patient had at least two clinical evaluations and spinal X rays (lateral projection) at the time of therapy start (T0) and stop (T1). Methods: 20 patients presented thoracic hyperkyphosis and three presented thoracolumbar kyphosis. All of the patients were treated
conseratively; specifically, 17 were treated with brace plus specific exercises and 6 were treated with only specific exercises. For all of the patients we measured the sagittal parameters of thoracic kyphosis (TK), lumbar lordosis (LL), pelvic incidence (PI), pelvic tilt (PT), sacral slope (SS) and spinosacular angle (SSA). Statistical analysis: paired Wilcoxon test and correlation (Pearson).

**Results:** Mean and standard deviation for each parameter were measured in T0: TK, LL, PI, 43.83 ± 7.95, PT, 4.83 ± 0.96, SS, 39.97 ± 6.77, SSA; and in T1: TK, LL, PI, 41.87 ± 9.62, PT, 5.48 ± 7.04, SS, 36.39 ± 7.80, SSA. Highly significant improvements were found for the main spinal parameters from T0 to T1: TK reduced from 54.22 ± 13.58 to 44.48 ± 12.80 (p = 0.0006), LL from 57.43 ± 11.16 to 51.13 ± 10.28 (p = 0.0077) and SSA from 132.87 ± 9.80 to 127.09 ± 9.24 (p = 0.0036); no significant differences were found for the other parameters. Looking at sagittal parameter correlations, very few were found at the start of treatment: SS correlated with LL (R = 0.651; p = 0.007), SSA (R = 0.6; p = 0.0025) and PI (R = 0.596; p = 0.0027) which also correlated with PT (R = 0.515; p = 0.0119). Contrarily, at the end of treatment, most parameters were correlated: LL with PI (R = 0.514; p = 0.0122), SS (R = 0.499; p = 0.0152), and SSA (R = 0.743; p < 0.0001), PI with PT (R = 0.600; p = 0.0024), SS (R = 0.691; p < 0.0001) and SSA (R = 0.628; p = 0.0013) and SS with SSA (R = 0.650; p < 0.0008).

**Conclusions and discussion:** According to our results, conservative treatment is an effective therapy for pathological kyphosis. Since it can change correlations between sagittal balance parameters, making them similar to those described in previous studies in healthy subjects, we can hypothesize its primary role in restoring sagittal balance itself.

**References**

**O30**
Coronal decompensation of the trunk by means of a set of show lifts
Coronal decompensation of the trunk by means of a set of show lifts

Michele Romano, Deborah Luzzi, Alessandra Negrini, Stefano Negrini
ISICO, Milan, Italy
E-mail: Michele.romano@isico.it
Scoliosis 2013, 8(Suppl 2):O30

**Background:** A shoe lift (SL) is often used in the treatment of scoliosis curves in two main cases: (1) an identified discrepancy of the legs’ lengths in order to gain a better balance of the pelvis or (2) a recognized improvement of some specific outcome, like the hump magnitude, when the SL is adopted.

**Purpose:** The purpose of this study is to measure the trunk pattern in response to the use of a SL (for this study, a series of SLs). In case of a pre-existing coronal decompensation, we observed the trunk reaction when the SL is respectively under the short leg.

**Methods:** We evaluated 27 consecutive patients (26 females and 1 male) who visited our Institute for spine diseases (scoliosis or hyperkyphosis). With the patient in a standing position, we performed a set of tests with a 3-dimensional rastereography (DIERS Formetric 4D) with different SL (5mm, 10mm and 15mm) placed alternatively under each foot. We assessed the variations of two important elements: the change of pelvic inclination and the change of the line that joins C7 and the middle of the sacral spine (C7-MSS). For simplicity, we divided the entire group of patients into two subgroups. One subgroup of patients (13) showed (in standing and normal position) a physiological inclination of the line between C7 and the middle of the sacrum (C7-MSS). For the other subgroup of patients (15) we showed a physiological inclination of the line towards the right. The situation was the same if the patients had a physiological inclination of this line towards the right. The results show a completely different pattern. Tables 1 and 2 below show the mean inclinations of this line, using the three SL:

**Conclusions and discussion:** The use of a SL (5mm, 10mm and 15mm) positioned under each foot did not change the pattern of the inclination (theoretically, a reduction or an increase of the inclination of C7-MSS) measured in standing and normal positions. The spine seems to have an individual anti-gravity pattern that cannot be modified by the use of a SL.
Conclusions and discussion: The accuracy of the rasterstereograph is superior on a wooden plate and comparable during dynamic measurements to the VICON system, with the advantage that it calculates a three-dimensional surface map and also allows the analysis of the underlying spine. The measurements made under dynamic conditions can be factored into the spinal model to allow an analysis of the scoliotic spine during motion.

References

O32 Dynamic SST for monitoring position and changes in kyphosis/lordosis angles
Helmut Diers*, Christian Diers, Evelyn Firle, Sven Moosha, Amira Basic, Marco Kleist, Kjell Heitmann
DIERS International GmbH, Schlangenbad, Germany
E-mail: diers@diers.de
Scoliosis 2013, 8(Suppl 2):O32

Background: Spine & Surface Topography (SST) has been used to perform spine diagnostics for more than 20 years. Until recently, static scans were primarily used, as dynamic scans were not properly scientifically and clinically evaluated. Also, the hardware required to perform the dynamic scan was expensive and too slow for a proper clinical use. Due to the emergence of new technology, it is now possible to record and analyze surfaces with a frequency of up to 50 Hertz. The formetric 4D (DIERS International GmbH, Schlangenbad, Germany) static and dynamic SST system records and reconstructs the spinal position of a normally standing patient, with an additional measurement, performs the same tasks while the patient is standing walking in at a sequence of 50 fps [1]. The reconstruction of the spine is done according to following the methods of Hierholzer / Dreurup [2].

Purpose: To use static and dynamic surface topography in monitoring changes in kyphosis and lordosis angles during the normal walking stride of a patient (treadmill, 5-10 sec, 50 fps) in comparison to a patient in a normal standing position.

Methods: Using the formetric 4D, 100 static and dynamic measurements of both pathologic and healthy patients were taken. For this study, the output parameters for the angles ICT-ITL (kyphosis) and ITL-ILS (lordosis) were analyzed. For dynamic measurements the median values for kyphosis and lordosis were used and compared with the values from static measurements using linear regressions.

Results: The results of linear regressions between the static and dynamic measurements of kyphosis and lordosis angles show a high significance. This validates the usability of dynamic SST compared to static SST. A second result shows that in most of the observed patients the median of kyphosis and lordosis angles from dynamic SST is smaller than in a static SST. Conclusions and discussion: Dynamic SST can be used for further studies of kyphosis and lordosis angles. Dynamic SST gives additional information for lordosis and kyphosis angles that cannot be seen in static SST nor in other static measurement technologies.

References

O33 Determination of reference values for dynamic spinal parameters using video rasterstereography
Robert Percy Marshall, Philip Catala-Lehnen
University Hospital Hamburg-Eppendorf, Department of Sports-Medicine, Hamburg, Germany
E-mail: r.marshall@uke.de
Scoliosis 2013, 8(Suppl 2):O33

Background: Rasterstereography has been used clinically for static back measurements for more than three decades. In contrast to X-radiation, which was the sole diagnostic tool for imaging spinal deformities for many years, rasterstereography is a radiation-free method of projecting light beams onto the subject’s back. Allowing the precise identification of the 3-dimensional topography of the back’s surface. As a result, an exact match of the underlying spine can be created [1] by using Turner-Smith’s spine model. The original rasterstereography however, provides static parameters: it does not consider patients’ motion and its effects on the spine. Current development has improved rasterstereography devices, enabling dynamic measurements [2] to be taken.

Purpose: The purpose of this study is to establish reference values for clinically established parameters in static spinal analysis [3] of healthy subjects measured under standardised dynamic conditions. Understanding spinal dynamic motion in healthy subjects will help to find pathological parameters and plan more individual therapy regimes.

Methods: A total of 100 healthy subjects (50 males and 50 females), aged 20-40 years, were measured using the newly developed dynamic rasterstereography at constant speed. Special questionnaires were created to standardise the cohort: back pain within the past six months, spinal surgery or chronic diseases were exclusion criteria. Additionally, subjects were clinically examined with respect to their spinal movement (Schober’s Test, Ott Test, etc.) to exclude further statistical outliers.

Results: For the first time, this study gives gender-specific reference values for healthy subjects aged 20-40 years measured with dynamic rasterstereography. Additionally, the authors will compare the raised data with pathological examinations either self-measured or given by corresponding hospitals and research-fellows. This will further prove the system’s validity as well as suggest how the reference values can be used in future therapy regimes, such as to plan and protocol conservative treatment.

Conclusions and discussion: This study shows that dynamic rasterstereography enables more insight into spinal motion and, thus, helps doctors and therapy personnel to protocol therapy outcomes as well as their initial goals.

References

O34 Abnormal skeletal growth patterns in adolescent idiopathic scoliosis
Houria Kaced*, Hanene Belabbassi, Assia Haddouche
Physical Medicine and Rehabilitation Department of University Hospital of Douera, Algiers, Algeria
E-mail: houria_kaced@live.com
Scoliosis 2013, 8(Suppl 2):O34

Background: Adolescent Idiopathic Scoliosis (AIS) occurs during a child’s pubertal growth spurt. Although there is no clear consensus on the difference in body height between girls and boys with AIS and healthy controls, it is generally thought that the development and curve progression in children with AIS is closely associated with their growth rate. We proceeded to perform a prospective study on the anthropometric parameters of children with AIS.
Purpose: Our aim is to compare the anthropometric parameters of children with AIS with those of a control group, using cross-sectional data set in comparison with the children’s ages.

Methods: A total of 431 children (238 girls and 173 boys, aged 9 to 16 years) were included in the study. Of the girls, 110 had AIS and 148 were healthy controls; of the boys, 49 had AIS and 124 were healthy controls. Clinical data and detailed anthropometric parameters were recorded. In the cross-sectional analysis, the groups of subjects were compared within different age groups ranging from 9 to 16 years old.

Results: In the cross-sectional analysis, the girls with AIS were generally taller and heavier, than the healthy controls. Specifically, the girls with AIS were found to be significantly taller and heavier at the age of 12 years old, whereas the boys with AIS were significantly taller at the age of 14 years old than the healthy controls.

Conclusions and discussion: The growth patterns in terms of height of children with AIS were significantly different from the healthy controls at the age of 12 for girls and at the age of 14 for boys.

References:

O35

The usefulness of bioelectrical body composition analysis (BIA) in the proper assessment of nutritional status in children and adolescents with idiopathic scoliosis (IS)

Jacek Durmala1, Edyta Matusik1, Jacek Durmala1, Pawel Matusik2, Karol Wadołowski3
1Department of Rehabilitation, Medical University of Silesia, Katowice, Poland; 2Department of Pediatrics, Pediatric Endocrinology and Diabetes, Medical University of Silesia, Katowice, Poland
E-mail: jdurmala@gmail.com
Scoliosis 2013, 8(Suppl 2):O35

Background: Based on our recent data, nutritional status disturbances (both under- and overweight) can be associated with the severity of scoliotic curve.

Purpose: The study objective was to compare two methods for the assessment of nutritional status (BMI vs. BIA-body composition analysis by bioelectrical impedance analyzer) in IS patients.

Methods: For a total of 317 IS patients (240 girls and 77 boys), mean age 14.1±1.2; 79, the scoliotic curve was assessed by Cobb angle and angle vertebra rotation (AVR). Height, weight, and hip circumferences were measured and BMI, BMI Z-score, waist/height ratio (WHRT) and waist/hip ratio (WHR) were calculated for the entire group. Body composition parameters, such as fat mass (FM), fat-free mass (FFM), predicted muscle mass (PMM) and total body water (TBW), were evaluated using a bioelectrical impedance analyzer. Nutritional status was classified by centile charts for BMI as underweight, normal weight, overweight or obese, and for FAT% as underfat, lean, overweight or obesity. This was a prospective, randomized study.

Results: Nutritional status assessed by BMI has been associated with 21.1% of misclassification compared to BIA. There were important differences between the percentage of underweight vs. underfat patients (13.9% vs. 9.5%), overweight vs. overfat (5.4% vs. 7.9%) and obesity vs. adiposity (2.8% vs. 5.0%). There was no significant correlation between BMI and scoliosis severity in the subgroups classified by standard measurement. However, the BMI Z-score correlated significantly with Cobb and AVR in every BMI-classified subgroup. There were also significant correlations between body composition parameters (BIA) and vertebral deformity in only the normal BMI group. After the correction to the FAT%, 252 (78.9%) children were properly classified; of this group of IS patients, statistical analysis showed strong (p<0.001), significant correlation between either Cobb’s angle or AVR vs. every (standard and bioelectrical) anthropometrical parameter.

Conclusions and discussion: Nutritional status classification by BMI assessment overestimates the underweight and leads to the under-estimation of both overweight and obese patients with IS. Bioelectrical impedance analysis is a useful tool for the proper nutritional status assessment in the pediatric population with IS. Properly assessed nutritional status is significantly associated with the severity of scoliotic curve assessed by Cobb’s angle and AVR.

References

O36

Ultrasound image measurements of erector spinea muscle thickness at four spinal levels in adolescents with idiopathic scoliosis: reliability and concave-convex comparison

Alan Richter1, Eric C Parent, Gregory Kawchuk, Marc Moreau, Douglas Hedden, Edmond Lou
University of Alberta, Alberta, Canada
E-mail: arichter@ualberta.ca
Scoliosis 2013, 8(Suppl 2):O36

Background: Muscular characteristics in scoliosis are insufficiently documented. Ultrasound imaging measurements of extensor muscle thickness are commonly used in low back pain (LBP) [1] but not in scoliosis. Taking measurements of extensor muscle thickness may aid in exercise prescription for patients with adolescent idiopathic scoliosis (AIS) [2].

Purpose: The purpose of this study is to (1) determine the intra-rater reliability of erector spinea ultrasound thickness measurements at different spinal levels, and (2) determine the concave-convex differences in erector spinea thickness in patients with AIS.

Methods: Nine patients with AIS (8 females) with a single thoracic curve, aged 13.5±1.8 years old, with mean Cobb angles of 39.4±9.1°, under observation or undergoing brace treatment were included. In a prone position, three ultrasound images of erector thickness were obtained on each side at L3, the upper end vertebra, lower-end vertebra and the apex of the curve in random order. A 5cm curvilinear probe was used to capture images of the erectors parasagittally over the facets. Thickness was measured using ImageJ as the distance from the facet to the first fascia line by an examiner blinded to image location and measurements. Reliability was estimated using Intraclass Correlation Coefficients (ICCs,1 and 2,2) and standard error of measurement (SEM). Differences between sides were determined using paired t-tests at each level.

Results: The intrarater ICCs (2,1) for a single measurement varied between 0.75 and 0.99. The ICCs(2,2) corresponding to the average of the most similar two out of three measurements varied between 0.86 and 0.99, depending on levels. The corresponding SEM for these average measurements varied between 0.03 and 0.17cm (mean 0.09), depending on sides and levels with no systematic pattern. The only statistically significant difference between sides was observed at the upper-end vertebra (concave<convex 0.23±0.22cm). Mean extensor thickness was 1.75±0.30cm and 1.98±0.34cm at the left and right upper-end vertebra level, respectively. Mean thickness was 2.33±0.11, 2.18±0.14, and 2.57±0.12cm at the apex, lower-end vertebra and L3, respectively.

Conclusions and discussion: Adequate intra-rater reliability for research was obtained by averaging the most similar two of three erector spinea thickness measurements.3 Reliability was similar at all spinal levels and consistent with results in LBP [1]. By measuring at rest, only one small convex-convex thickness difference was detected.
References

O37 Habitual, perceived ideal and neutral sitting postures within an asymptomatic young adult population: muscle activity and sagittal spinal curvature
Steven Mabb, Josette Bettany-Saltikov, David Hodgson
Teesside University, Middlesbrough, UK
E-mail: steven_mabb@hotmail.com
Scoliosis 2013, 8(Suppl 2):O37

Background: Sitting posture is a common aggravating factor for pain both at the cervical and lumbar spine regions, with extended periods of sitting associated with increased discomfort at the neck and upper and lower back. Sitting postures independently adopted by asymptomatic individuals in comparison to theorized ‘optimal’ sitting postures have not been fully evaluated (O’Sullivan et al., 2010). If a clinically significant imbalance exists between these postures, intervention may be required to optimize the postural habits of the general public.
Purpose: The purpose of this study was to quantitatively compare three upright, unsupported sitting postures: the habitual sitting posture (HSP), subjectively perceived ideal posture (SPIP) and neutral sitting posture (NSP).
Methods: A convenience sample of 24 asymptomatic young adults participated in this study. Spinal posture was analyzed from C2-L5 using the Microscribe 3DX digitiser. Five muscles were measured by surface electromyography. Differences between postures for spinal curvature were analyzed using ANOVA. Friedman’s ANOVA was used to analyze muscle activity.
Results: HSP was more kyphosed than the NSP at the upper lumbar spine region (MD 4.63 with a 95% CI = 1.97 to 7.29). The SPIP was less kyphosed at the lower thoracic spine region (MD of -2.31 with 95% CI = -3.31 to -0.41) compared to the NSP. Muscle activity was greater at the cervical erector spinae for the HSP, compared to both the SPIP (p = 0.001) and NSP (p = 0.001). Muscle activity was greater during the SPIP and NSP, compared to the HSP for the thoracic erector spinae (p < 0.044) and external oblique (p = 0.006); no differences in muscle activity between the SPIP and NSP were identified.
Conclusions and discussion: The NSP was identified as a relatively midrange sitting posture compared to HSP and SPIP. Education that aims to optimize asymptomatic individuals’ sitting habits may therefore benefit from highlighting the importance of midrange sitting postures. It should be noted that both the NSP and SPIP, when maintained, will likely lead to increased levels of fatigue due to increased global muscle activity, compared to the HSP. To reduce the onset of fatigue during prolonged periods of unsupported sitting, incorporation of active movements may be beneficial (Pynt, Higgs and Mackey, 2002). However, further study is required to support this.
References

O38 Determination of the amount of leg length inequality that induces scoliotic spinal posture changes in healthy subjects using video rasterstereography
Marcel Betsch, Michael Wild
Oregon Health & Science University, Portland, OR USA
E-mail: betsch@ohsu.edu
Scoliosis 2013, 8(Suppl 2):O38

Background: Leg length inequalities (LLIs) can result in a functional scoliosis, increased energy consumption, abnormal gait or osteoarthritis of the hip [1]. In a previous study we simulated different LLIs of up to 15 mm and evaluated their effects on the pelvic position and spinal posture [2]. We found a correlation between LLIs and resulting changes of the pelvic position. Despite suggestions in the literature, we were not able to detect significant changes of the spinal posture.
Purpose: The purpose of this study was to determine the amount of LLI that would alter the spinal posture and induce scoliotic changes of the spine.
Methods: All subjects (n=110) were placed on an adjustable height platform, which was precisely controlled by the measuring device to simulate different LLIs of up to 20 mm. For LLIs greater than 20 mm, additional precision-cut wooden blocks were used under one foot. After an adaptation period, the resulting changes of the pelvis and spine were measured with a rasterstereographic device. Unifactorial ANOVA was calculated to check for changes in the mean values. The level of significance was set at p < 0.05.
Results: We found a significant correlation between platform height changes and changes of the pelvic position. The frontal spinal parameters surface rotation and lateral deviation changed significantly when simulating differences greater than 20 mm. In addition, the results showed that the spine always deviated toward the short leg side No changes of the sagittal spinal curvature were measured; however, a trend toward decreasing kyphotic angles was noted.
Conclusions and discussion: Our study has shown that LLIs greater than 20 mm will lead to scoliotic changes in the spinal posture of healthy test subjects. However, these changes were only found in frontal (surface rotation and lateral flexion) spinal parameters, and not in sagittal parameters. For the kyphotic angle, only a tendency toward decreasing angles was noted. In addition, we found a significant correlation between different leg lengths and changes of the pelvic position. Further, females and males seem to react in the same ways to LLIs.
References

O39 Examination of the breast asymmetry associated with adolescent idiopathic scoliosis using surface topography methods
Alexandra Trovato 1, Amin Komeili 2, Lindsey Westover 2, Eric Parent 3, Marc Moreau 5, Samer Adeeib 2, Esteban Sepulveda 5
1Department of Civil and Environmental Engineering, University of Alberta, Edmonton, Alberta, USA; 2Department of Mechanical Engineering, University of Alberta, Edmonton, Alberta, USA; 3Department of Physical Therapy, University of Alberta, Edmonton, Alberta, USA; 4Department of Surgery, University of Alberta, Edmonton, Alberta, USA; 5Facultad de Minas, Universidad Nacional de Colombia, Colombia
E-mail: atrovato@ualberta.ca
Scoliosis 2013, 8(Suppl 2):O39

Background: Breast asymmetry in females is significantly more common in adolescent idiopathic scoliosis (AIS) than in non-scoliotic females [1]. Researchers and clinicians currently use the “Cobb angle” from radiographs as the standard assessment method for scoliosis. Since exposure to radiation has been shown to increase the risk of cancer [2], radiography is not the safest method of assessment. Unlike surface topography (ST), radiographic assessments do not measure cosmetic deformities associated with AIS, which is very important to patients and has a psychological impact on the quality of life [3].
Purpose: The objectives of this study were to observe the association between AIS and breast asymmetry using a 3-dimensional, markerless ST analysis technique, and to present a novel approach to analyze breast asymmetry that is associated with AIS.


Methods: Torso ST scans of 25 females with AIS (Cobb angle: 36.5°±14.0°, curve types: Lenke 1, 3, 5 and 6) were analyzed. The mean patient age was 15.4 ± 1.3 years (range: 13.5–17.5). At the time of the scan, two patients were pre-menarchal and the remaining had experienced menarche 1.9±1.1 years prior to the scan. The best plane of symmetry was found by mirroring the scan about the sagittal plane. The mirrored torso was fitted to the observed torso such that the average deviation between the torsos was minimized. The relative deviation between the mirrored and observed torso was measured and displayed as a deviation colour map (DCM). The DCMs were visually appraised, resulting in five types of breast asymmetry.

Results: Breast asymmetry was identified in all patients through a qualitative assessment. All had deviations exceeding 3mm between sides. The patients were classified into five distinct groups based on their pattern of breast asymmetry.

Conclusions and discussion: All of the patients presented breast asymmetry that could be categorized into five groups. Future work includes the correlation of breast asymmetry classification to the type and severity of the scoliosis curve. This ST analysis technique provides a non-invasive and objective method to assess breast asymmetry in patients with AIS. Further work is required to test the reliability of this classification.

References

O40
Which is the most prominent spinous process in the cervico-thoracic spinal junction? A radiological study in a Mediterranean population sample

Theodoros Grivas, Gerasimos Tsimidos, Christos Verras, Konstantinos Botsios, Marianna Chatzisaroglou

Department of Trauma and Orthopaedics, “Tzaneeo” General Hospital, Piraeus, Greece
E-mail: tgr69@otenet.gr

Scoliosis 2013, 8(Suppl 2):O40

Background: The spinous process (SP) of the seventh cervical vertebra (C7) is characterized as the most prominent, which makes it an anatomical landmark for the recognition of other SPs. However, is the C7 SP always longer and more prominent, or is there a deviation from this morphology?

Purpose: The purpose of this study was to answer the question above.

Methods: A total of 195 subjects were included in this study: 93 men and 102 women. Body weight, height, and body mass index (BMI) were recorded. The patients were classified into five distinct groups based on their pattern of breast asymmetry. The anatomical differences of C7 and T1 SP morphology. In males, the average length of C7 SP was 44,11 mm (range 23,70 mm to 61,90 mm); in females, the average length of C7 SP was 37,82 mm (range 26,10 mm to 54,20 mm). In males, the T1 SP length was 40,44 mm (ranging 24,40 mm to 53,10 mm). In females, the average length of C7 SP was 37,82 mm (range 26,10 mm to 54,20 mm). In males, the T1 SP length was 40,44 mm (ranging 24,40 mm to 53,10 mm). In females, the T1 SP length was 40,44 mm (ranging 24,40 mm to 53,10 mm).

Conclusions and discussion: The anatomical differences of C7 and T1 SP lengths are now described qualitatively and quantitatively in a Mediterranean population sample. It is found that there is a sexual dimorphism, with C7 SP in the males and T1 in females often being longer. The morphological patterns found in this study vary from those published earlier about scoliotic subjects, a finding that may implicate SP morphology in idiopathic scoliosis aetiology. Based on these results, the necessity of finding the correct anatomical landmark on the surface of the torso (SPs of C7 or T1) is confirmed for the purpose of clinical examination and for surface topography apparatus to correctly function in a scoliosis clinic. In addition, finding the correct anatomical landmark on the torso is essential to a number of other medical specialties using surface anatomical landmarks (e.g., general orthopedics, anaesthesiology and forensic medicine).

References

O41
Diagnosis and treatment of leg-length discrepancy in scoliosis
Franz Landauer
Univ. Clinic of Orthopedics (PMU), Salzburg, Austria
E-mail: flandauer@salk.at

Scoliosis 2013, 8(Suppl 2):O41

Background: Balancing the sacrum is a prerequisite to the treatment of scoliosis.

Purpose: The purpose of this study was to diagnose the cause of leg-length discrepancy and review their surgical treatment options.

Methods: The x-rays (upright ap-view) of 250 patients diagnosed with “idiopathic scoliosis” were examined to determine a leg length difference of >1.0 cm. First issue: How many patients show scoliosis as a compensation mechanism of leg-length discrepancy? How many needed epiphysiodesis in differences >1.5 cm. Second issue: What causes of leg-length discrepancy are found and what are the therapeutic consequences? Patients with neurological findings were excluded.

Results: First issue: In 5 of the 250 examined patients, scoliosis was only a compensation mechanism of the leg-length discrepancy. Leg-length compensation (insole) was sufficient for spinal correction. In three cases with a leg-length difference >1.5 cm, a temporary epiphysiodesis was indexed. Second issue: Two patients with pathological findings in the lower extremity showed hypoplasia of the fibula (type IA Achtermann and Kalamachi) and one patient showed a hypoplastic femur (type IX by Pappas). One patient had a femoral fracture in early childhood, one patient suffered from an injury of the femoral growth plate and one patient showed a fibrous dysplasia. In two cases, involving the hip, a chronic slipped capital femoral epiphysis was found requiring surgical intervention. Additional hormonal causes, such as Hashimoto thyroiditis and delayed puberty, were conspicuous. In one patient, a femoral head deformity after a femoral head fracture was found. Four patients with first diagnosed neurological findings are excluded. In 15 of 246 patients, leg-length-discrepancy >1 cm was diagnosed.

Conclusions and discussion: Of the 246 patients, the identified 15 cases are a challenge to treating “scoliosis” because the cause, or one of the causes, of scoliosis was found to be independent of the spine and had to be dealt with as such. With correct treatment of these cases, a partial correction of the “scoliosis” happens automatically. This study provides an initial overview of leg-length discrepancy and recommends: “Take the lower extremities into account when diagnosing and treating scoliosis”.

Reference

O42
Psychological aspects of bracing in scoliosis in relation to age and duration of brace-wear
Nina Byskosh
Arlington Heights, IL USA
E-mail: nbyskosh@ao.com

Scoliosis 2013, 8(Suppl 2):O42
Background: Numerous questionnaires, including SRS-22, SRS-23, SRS-24 and BSSQ, were created to evaluate the psychological aspects of the patients with scoliosis. The study of the psychological impacts of bracing has proven beneficial in the comprehensive treatment plan for the young patient.

Purpose: The purpose of this study was to use the NBNO questionnaire to evaluate the problem of back pain in children and adolescents - pilot study in a medium-sized town Włocławek (Glinkowska), Izabela Czyżak, Bożena Glinkowska, Agnieszka Żukowska, Chair and Department of Orthopaedics and Traumatology of Locomotor System, Center of Excellence "TeleOrto", Baby Jesus Clinical Hospital, Medical University of Warsaw, Poland

E-mail: w.glinkowska@gmail.com
Scoliosis 2013, 8(Suppl 2):O43

Background: The frequent use of websites by today's education programs provides greater opportunities for surveys where schoolchildren and adolescents on health-related issues, including back pain. The prevalence of nonspecific back pain increases during adolescence [1-3]. There are several reasons for this increase in back pain in adolescents.

Purpose: The aim of the study was to use a web-based surveying system to investigate the possible connection between back pain in adolescents and the use of bags or backpacks.

Methods: The study was conducted in a town of almost 50,000 residents in north-central Poland. A cross-sectional study consisted of a web-based survey with modified questionnaire that was distributed to five schools along with an official recommendation by local authorities.

Results: A total of 380 questionnaires were submitted with no logical errors and highly probable answers from 220 girls (average age 13.4 years old) and 160 boys (average age 13.7 years old). The back and neck pain was mentioned by 49% of adolescents (51% of girls and 46% of boys). Thoracic and lumbar pain was mentioned by 39 girls (10%) and 100 boys (26%).

The reported pain occurred intermittently (72.5%), mostly during the day (63%). Some respondents mentioned that pain occurs when they carry their bags on their shoulders (7%) or when they carry their backpacks (19%). More likely carry bags (youth style), and boys prefer backbacks or ruck sacks. Girls usually carry bags on the same shoulder. Of the total respondents, 65% were pain-free while being physically active 2-4 hours per week outside of the school physical education program (p<0.01).

Conclusions and discussion: Our study confirms the usefulness of the web-based survey for children and adolescents. In addition, we discovered a relatively high prevalence of back pain in adolescents, with girls experiencing pain significantly more frequently than boys. Compared with adolescents who had no back pain, adolescents with back pain carried significantly heavier backpacks that represented a significantly greater percentage of their body weights.

References

O44

The effects of a 6-month Schroth intervention for Adolescent Idiopathic Scoliosis (AIS): preliminary analysis of an ongoing randomized controlled trial
Sanja Schreiber1, Eric C Parent, Douglas M Hedden, Marc Moreau, Douglas Hill, Elise M Watkins
University of Alberta, Faculty of Rehabilitation Medicine, Alberta, Canada
E-mail: sboonjaka@ualberta.ca
Scoliosis 2013, 8(Suppl 2):O44

Background: Literature lacks strong evidence on the effect of exercises on scoliosis [1]. Schroth scoliosis-specific exercises have shown promising results in studies of suboptimal quality.

Purpose: The purpose of this study was to evaluate the effect of Schroth exercises on back endurance in patients with AIS using the Scoliosis Research Society-22r (SRS-22r) and Self-Efficacy (SEQ) questionnaires.

Methods: A total of 31 patients with AIS, aged 10-18, with curves from 10°-45°, wearing a brace or not, participated. Sixteen were randomized to Schroth with standard care, and 15 to standard care alone (monitoring or ruck sacks). The Schroth intervention consisted of five individual visits to learn the exercises, followed by weekly supervised group sessions of one hour each, with daily home exercises prescribed using an algorithm [2] (45 minutes per day). Compliance was monitored with a logbook, and outcomes were recorded at baseline and six months. Effect sizes were estimated using Cohen’s d, which corresponds to the mean difference between the groups in the change observed from baseline to six months (Schroth – standard care), divided by the pooled standard deviation at baseline (Cohen’s d =0.8=large, 0.5-0.8=moderate, 0-0.2=small) [3].

Results: Two controls and one Schroth group participant dropped out. Mean age was 14.4±2.1 yrs for Schroth and 13.7±1.7 yrs for controls; mean Cobb angles were 32.6±7.9° and 28.8±10.0°, respectively. Schroth participants with complete follow-up attended 87±8% of the prescribed weekly exercise sessions and completed 86±5% of the prescribed home exercises. Intention-to-treat analysis lowered compliance to 83±19% and 81±17% for weekly sessions and home program, respectively. Effect sizes at six months for the SRS-22r were smaller than expected, but favored the Schroth group with Cohen’s d: pain=0.09, self-image=0.09, function=0.00 and total=0.21. The effect sizes for self-efficacy (0.18) and for the Biering-Sorensen test (0.28) also favored Schroth. The perceived mean global rating of change in the Schroth group was 3.8±2.2, corresponding to moderate improvement, and -0.3±1.7 in the standard care group, corresponding to a small amount of deterioration.

Conclusions and discussion: The dropout rate was low (9.7%), which was reflective of the patients’ commitment to the therapy. Outcomes favored
the Schroth group. In this preliminary analysis, Schroth exercises showed a small but positive influence on self-efficacy, self-image, pain and back muscle endurance.

References

O45
The effect of a 6-month Schroth exercise program: a pilot study using subjects as their own controls
University of Alberta, Alberta, Canada
E-mail: eparent@ualberta.ca
Scoliosis 2013, 8(Suppl 2):O45

Background: Studies about Schroth exercises show that they may be effective in slowing curve progression and improving outcomes in individuals with adolescent idiopathic scoliosis (AIS) [1], however, these studies were of suboptimal quality. Systematic reviews highlight the need for randomized and prospective controlled studies on scoliosis-specific exercises [2].

Purpose: The goal of this study was to determine the effect of Schroth exercises on curve progression using questionnaire scores of patients with AIS who were randomly assigned to spend six months as controls.

Methods: We included patients with AIS, 10-18 years, with curves of 10-45°, wearing a brace or not, and randomized initially into the standard-care group (observation or bracing) of an ongoing RCT. After receiving standard care for 6 months, controls received the 6-month Schroth intervention. Patients completed five introductory individual visits followed by 1-hour weekly supervised group sessions combined with daily home exercises prescribed using an algorithm (45 minutes). Outcomes were recorded at baseline, 6 and 12 months. Effect sizes were estimated using Cohen’s d (d=0.2=small, 0.5-0.8=moderate, >0.8=large), which corresponds to the difference between groups divided by the pooled standard deviation of the individual differences [2].

Results: Of 13 subjects, 2 dropped out while controls and 2 while in Schroth therapy. Of the nine subjects who completed all follow-ups, the mean age and Cobb angle at baseline were 14±0.8±3 years and 31±10.5° (17-43°), respectively. The recruitment rate was 14% among eligible participants, with time constraints limiting participation. All effect sizes favored Schroth except the Spinal Appearance Questionnaire (SAQ) waist score (0.14). Effect size of the SRS-22 questionnaire were as follows: self-image=0.92, pain=0.60, function=0.18 and total=0.56. Pain, self-image and total scores improvements were statistically significant (repeated measures ANOVA). SAQ effect size scores were as follows: general=0.23, chest=0.96, kyphosis=1.43, shoulders=0.40, trunk shift=0.44, prominence=0.77 and curve=0.89. Effect sizes for curve measures were as follows: major Cobb angle=0.00 and combined Cobb angles=0.13. Global ratings of change were significantly higher after Schroth therapy (4.7±2.3, 15-point scale).

Conclusions and discussion: All but one effect size favored Schroth and nearly half of the effect sizes were moderate or large. Of 70 patients, a change of 0.3-effect size would be considered to be a significant finding. Although only minor effects were observed on curve angles, Schroth exercises can positively affect appearance perception and quality of life, which are deemed priorities with scoliosis conservative treatments [3].

References

O46
Long-term results with Game-Based Physiotherapy (GBPT) according to Schroth in children with Juvenile Idiopathic Scoliosis (JIS)
Petra Groeb*, Vinay Saraph
Degree Program Physiotherapy, FH JOANNEUM Graz, Austria, LKH Unv.-Klinikum Graz, Austria
E-mail: petra.groebel@fh-joanneum.at
Scoliosis 2013, 8(Suppl 2):O46

Background: Apart from correcting inconvenient everyday postures, therapeutic exercises are the key to positive development of children with JIS.

Purpose: The goal is to foster healing by offering motivating exercises combined with regular training aids. The available computer program provides valuable information on the exercise regime and can be used to monitor and evaluate treatment processes. Precise performance of exercises and exercise times are used more efficiently. Hypothesis: Patients who train with GBPT have, on average, a significantly better therapy outcome than those who are treated conventionally without a measuring instrument.

Methods: An intervention and control group consisted of 13 children with JIS between the ages of 9 and 13 years (Cobb curve of 23° +/- 4°, bracing with Cheneau braces). Both groups exercised for six months according to the “Schroth” concept; two standardized exercises were chosen for the study group and guided by the computer program GBPT, so that minor movements of feet could be detected in a narrow range, but not for the control group.

Results: Comparing children of the intervention group with those of the control group revealed a difference in the Cobb angle after the observed period of six months exercising. The comparison of the two test groups showed a significant difference in the lumbar spine results of 3.5° (p=0.049). The evaluation showed a clear tendency of the test group in angle improvement, whereas the control group showed a deterioration of the Cobb angle during the test phase.

Conclusions and discussion: The results of the long-term study led to the conclusion that the exercise, “Muscle Cylinder in Side Position” of the Schroth concept, supported by the game track, seemed to have a positive influence on the Cobb curve of the spine in the treatment of children with JIS.

References

O47
Preliminary result of 4 years of conservative management Juvenile Idiopathic Scoliosis, case report
Andrea Lebel
Ottawa & District Physiotherapy Clinic, Ottawa, Canada
E-mail: andrealebel@me.com
Scoliosis 2013, 8(Suppl 2):O47

Background: Based on Scoliosis Research Society guidelines, individuals with JIS over 50 degrees Cobb are usually treated surgically. The JIS surgery option in Ottawa, Canada, is the growing-rod surgery, extended every 6 months until end of growth. Multiple surgery complication rate is high (57%) in this age group. On the other hand, there is a lack of evidence for the effectiveness of conservative management of JIS.

Methods: In 2008, a 5-year-old girl was diagnosed with JIS; 53 degrees thoracic and 24 degrees lumbar curve, with a risk of progression calculated at 90-100%. The patient started Schroth physiotherapy in 2009 in combination with full-time bracing in an outpatient setting, was initially seen once a week, then monitored regularly every 3-6 months. The patient’s mother was instructed on the home exercise program that was designed specifically for the patient’s curve pattern, following the principals of the Schroth method.
The girl was followed for four years. During this time, objective data was collected: x-ray, ATR, Chest extension, Vital Capacity (V/C) and clinical pictures.

Results: Since 2011, the patient was showing improvements in Cobb angle and ATR: out-of-brace x-ray measured 20 degrees in 2011 and in 16 degrees in 2012. ATR in 2009 was 18 degrees and reduced to 5 degrees in 2013. Chest expansion improved from 1 cm in 2009 to 7cm in 2012. Her V/C and lung development in 2012 were found to be normal for her age and height (2000 ml). The patient’s height measurement increased 27 cm, from 110cm in 2009 to 137cm in 2013, and she had a normal activity level. The benefits of this treatment method included minimal x-ray exposure, no hospitalization or frequent medical appointments for pre- and post-surgery check-ups (patient avoided 8-9 growing rod surgeries so far).

Conclusions and discussion: Even though the Schroth method is questionable for a patient as young as 5 years old, in this case report, the patient was able to carry out Schroth exercises at home with supervision by her mother and showed consistent and significant improvements over the years of the treatment. In general, this JIS patient is responding well to Schroth physiotherapy and full-time bracing. Conservative management for JIS, including bracing and physiotherapy in an outpatient setting, could be effective and should be offered to the patient and family as an option when treating JIS.

References

048

Brace treatment in juvenile idiopathic scoliosis: a prospective study with outcomes in agreement with SRS committee on bracing and nonoperative management standardization criteria
Aulisa Angelo Gabriele*, Vincenzo Guzzanti, Francesco Falciglia, Emanuele Marzetti, Marco Peruzzi, Lorenzo Aulisa
Orthopaedic Department, Children’s Hospital Bambino Gesù, Institute of Scientific Research, Rome, Italy
E-mail: angelo.gabriele@fastwebnet.it
Scoliosis 2013, 8(Suppl 2):O48

Background: Based on age of onset, severity and evolutivity, the purpose and use of conservative methods to treat juvenile idiopathic scoliosis (JIS) is a source of great debate. The different clinical experiences highlight difficulties in applying a conservative treatment to patients with JIS, characterized by inevitable evolutivity, who are effectively facing a long growing period.

Purpose: The purpose of the present prospective study was to determine the effectiveness of conservative treatment in patients diagnosed with JIS.

Methods: A total of 1,238 individuals who were treated for JIS between 1995 and 2012 fulfilled the inclusion criteria (age between 4-10 years, full-time prescription), with 163 patients treated with progressive action short brace, Lyon brace and Milwaukee. Of these, 113 patients had a definite outcome, 27 abandoned treatment and 23 are still in treatment. The minimum duration of follow-up was 24 months. Antero-posterior radiographs were used to estimate the curve magnitude (CM) and the torsion of the apical vertebra (TA) at five points in time: beginning of treatment (t1), one year after the beginning of treatment (t2), intermediate time between t1 and t4 (t3), end of weaning (t4)and 2-year minimum follow-up from t4 (t5). Three outcomes were distinguished in agreement with Scoliosis Research Society criteria: curve correction, curve stabilization and curve progression. Moreover, results were evaluated according to compliance, dividing patients into five subgroups. Statistical analyses were performed with GraphPad Prism 6.

Results: The results of our study showed that, of the 113 patients with a definite outcome, the CM mean value was 30.55 ± 5.16 SD at t1 and 21.9 ± 7.65 SD at t5. TA was 13.58 ± 6.14 SD at t1 and 8.95 ± 5.82 SD at t5. The variations between measures of Cobb and Perdriolle degrees between CM t1-t5 and TA t5-t1 were statistically significantly different. Curve correction was accomplished in 88 patients (77.8%), whereas a curve stabilization was obtained in 18 patients (15.9%). Seven patients (6.19%) had a curve progression; of these, four (3.5%) were recommended for surgery. Of the 26 patients who abandoned treatment, at the time of abandonment (12.4 years of age) they had achieved curve correction in 19 cases (73.0%), curve stabilization in five cases (19.2%) and curve progression in three cases (11.5%). Of these patients, who were reviewed at the end of their growing periods, four have undergone surgery. In addition, there was a statistically significant correlation between compliance and result from t1-t5 with an interaction of 3.43 P <0.0001.

Conclusions and discussion: Our study confirmed that conservative treatment with bracing is highly effective in treating JIS, with most patients achieving a complete curve correction and only 4.9% of patients requiring surgery. In addition, the study confirmed that full-time bracing and patient compliance is essential to obtaining positive results.

References

049

A novel spinal brace in management of scoliosis due to cerebral palsy. Radiological and subjective clinical results after at least one year of treatment
Ichiro Kajiura*, Yu Moriguchi, Yoshihiro Matsui, Tokimitsu Morimoto, Yohie Matsui, Motoki Iwasaki, Tsunehiko Suzuki
Osaka Developmental Rehabilitation Center Minami Osaka Hospital for Handicapped Children, Osaka, Japan
E-mail: u_in_music@wj8.so-net.ne.jp
Scoliosis 2013, 8(Suppl 2):O49

Background: Severe scoliosis in patients with cerebral palsy (CP) causes difficulty in sitting balance and creates increased nursing demands. Surgical stabilization has proven to be a valuable method to stop the progression of scoliosis [1]. However, the complication rate after such surgery is substantial [2]. Additionally, many patients with quadriplegia and large curvatures of the spine have impaired general health, epilepsy and reduced respiratory capacity, making them poor candidates for major surgery like spine fusion. Therefore, other treatment alternatives should be available. We have recently developed a spinal brace named Dynamic Spinal Brace (DSB), which is a custom-molded, polycarbonate orthosis characterized by lightness and flexibility. Unlike the other underarm orthoses, DSB does not fix the pelvic girdle rigidly and, thus, potentially contributes to good compliance with bracing.

Purpose: The purpose of this study was to examine the efficacy of DSB for the management of scoliosis in CP patients.

Methods: A total of 151 patients with CP and scoliosis have been treated by DSB (age: 14.3 ± 8.2 years). The mean follow-up period was 33.9 ± 11.9 months. Periodic x-ray tests in the sitting position were performed in order to evaluate in-brace correction and curve progression. Questionnaires of the caretakers were performed to evaluate activities of daily living (ADL) of the patients.

Results: Cobb angle with and without DSB were 42.1 ± 30.2 and 60.0 ± (33.7) degrees, respectively. Initial in-brace curve correction was 17.8 ± 11.6 degrees. The curve progression per year was 3.8 ± 7.0 degrees. Initial in-brace correction was negatively correlated with Cobb angle at t5-t1 and TA t5-t1 were statistically significantly different. Curve correction was accomplished in 88 patients (77.8%), whereas a curve stabilization was obtained in 18 patients (15.9%). Seven patients (6.19%) had a curve progression; of these, four (3.5%) were recommended for surgery. Of the 26 patients who abandoned treatment, at the time of abandonment (12.4 years of age) they had achieved curve correction in 19 cases (73.0%), curve stabilization in five cases (19.2%) and curve progression in three cases (11.5%). Of these patients, who were reviewed at the end of their growing periods, four have undergone surgery. In addition, there was a statistically significant correlation between compliance and result from t1-t5 with an interaction of 3.43 P <0.0001.

Conclusions and discussion: Our study confirmed that conservative treatment with bracing is highly effective in treating JIS, with most patients achieving a complete curve correction and only 4.9% of patients requiring surgery. In addition, the study confirmed that full-time bracing and patient compliance is essential to obtaining positive results.

References
longer follow-up, DSB could be an option for the management of scoliosis in CP patients.

References

O50
Prospective study of 393 adolescent thoracic hyperkyphosis patients treated by the Lyon method
Jean Claude de Mauroy *, Didier Fort
Clinique du Parc, Lyon, France
E-mail: demauroy@aol.com
Scoliosis 2013, 8(Suppl 2):O50

Background: Unlike scoliosis, there is no alteration in respiratory function with hyperkyphosis [1]. The resulting problems are mainly related to aesthetics and pain. The various conservative orthopedic treatments were related to the 7th SOSORT consensus session [2]. Is bracing useful to improve aesthetics and prevent back pain?

Purpose: A retrospective study was presented at the SOSORT Montreal [3]. The good results observed were complemented by a prospective study performed on our entire database of orthopedic medicine between 1998 and 2007.

Methods: The Lyon method includes:
- A reduction with plaster cast for a minimum of 1 month to increase the length of the anterior longitudinal ligament (creep).
- An immobilization in a corrected position by a plexidur 5 points brace worn at minimum during the night.
- A specific physiotherapy.

Results: Conservative treatment was indicated in 393 patients.
- 27% of patients do not accept the proposed treatment or interrupt it spontaneously.
- 23% of patients have a physiological angulation less than 44° at the end of treatment.
- 43% of patients were reviewed two years after removal of the brace.

The initial kyphosis angle was 60.5°.

The final angulation 2 years after removal of the brace was 41°. Among the 262 patients who performed the full treatment:
- All patients who had pain before treatment were relieved of that pain after treatment began.
- 79% were fully corrected with final angulation <45°.
- 7% were stabilized with a final angulation between 45° and 55°.
- 11% retained an angle of >55° and can be considered as treatment failures.

In total, 222 patients were reviewed more than 10 years after removal of the brace. The angle remains stable in 21 cases.

Conclusions and discussion: The Lyon method is difficult for the patient and one-third of patients did not accept it.

Unlike scoliosis, which is stabilized by orthopedic treatment, it is possible to restore a physiological kyphosis in the sagittal plane.

References

O51
Outcomes of brace treatment for Adolescent Idiopathic Scoliosis - factors affecting the results of the treatment
Tóru Maruyama*, Yusuke Nakao, Yusuke Kobayashi, Makoto Miura
Saitama Medical Center, Saitama Medical University, Saitama, Japan
E-mail: tmrayama17@yahoo.co.jp
Scoliosis 2013, 8(Suppl 2):O51

Background: Controversies still exist regarding the effectiveness of brace treatment for adolescent idiopathic scoliosis (AIS).

Purpose: The goal of this study was to analyze the outcomes of brace treatment for AIS and to clarify the factors affecting the results of the treatment.

Methods: According to the Scoliosis Research Society (SRS) AIS brace studies standardization criteria, the following conditions were used to determine which patients to include in this study: aged 10 years or older, Risser 0-II, primary curve magnitude 25°-40° and no prior treatment when the brace was subscribed. At skeletal maturity, the percentage of patients whose curve progressed more than 6°, whose curve exceeded 45° or who underwent surgery was investigated. These results were compared with natural history or other brace studies. Factors affecting the results were analyzed.

Results: A total of 29 patients, 24 females and 5 males, met the SRS inclusion criteria. Average age at the beginning of the treatment was 12.0 years (range 10 to 15 years), Risser sign was 0 in 10, I in 6 and II in 13 patients. Curve pattern was thoracic (T) in 11, thoracolumbar or lumbar (TL) in 11 and double (D) in 7 patients. Average Cobb angle before treatment was 31.3°. Initial correction rate by the brace was 51.7% on average (35.2% for T, 75.5% for TL and 43.4% for D curve). Most patients wore their brace part-time, at home or at night. All the patients were followed until they reached skeletal maturity, with an average follow-up period of 29 months. The average Cobb angle at follow-up was 32.2°. Of 29 patients, six (21%) progressed more than 6° and three (10%) exceeded 45°. Only one patient (3%) underwent surgical treatment during the study period. These results were more favorable than the reported natural history or most of the other brace studies. Factors predicting the better results of brace treatment were Risser sign of I or II at the beginning of the treatment and better initial correction rate with the brace.

Conclusions and discussion: Of the curves with AIS, 79% were stabilized by the treatment. These results illustrate that brace treatment was effective for the treatment of AIS.

Reference
scoliosis, were treated with both a Kalibus-style TLSO and a standard anterior open TLSO with no window openings. Initial in-brace x-rays were evaluated by one orthopedic surgeon.

**Results:** The standard anterior open TLSO provided corrections of 7 degrees and 8 degrees in the congenital scoliosis patients and 3 degrees and 0 degrees in the infantile scoliosis patient. The Kalibus-style TLSO provided corrections of 0 degrees and 7 degrees in the congenital scoliosis patients and 0 degrees in the infantile scoliosis patient.

**Conclusions and discussion:** In this case series of three patients, the standard anterior open TLSO with no window openings produced greater in-brace correction than the Kalibus-style TLSO with a floating, adjustable pad with an opening opposite the pad. Additionally, we found that parents preferred the standard anterior open design as it was easier to manage than the Kalibus style.

**Reference**


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**OS5**

**A long-lever spinal orthosis for idiopathic scoliosis: corrective potential in 10 patients**

Brian Dovorany*, Mark Morningstar
Spine & Posture Center, Green Bay, WI USA
E-mail: drdovorany@treatingscoliosis.com

**Scoliosis** 2013, 8(Suppl 2):OS5

**Background:** The long-lever orthosis was designed to treat large translational displacements associated with idiopathic scoliosis. Adding a long-lever system allows the practitioner to affect the spine with a relatively low amount of force, while changing the rotational displacement of scoliosis based upon its effect on the thoracic cage.

**Purpose:** The goal of this study was to determine whether a novel long-lever orthosis has the ability to positively impact idiopathic scoliosis.

**Methods:** A sample of 10 patients, ranging in age from 11 to 16 years, with adolescent idiopathic scoliosis presented to a private chiropractic clinic for evaluation and management. All 10 patients had double major scoliosis curve patterns and were fitted for a long-lever orthosis system. Once in place, scoliosis radiographs were obtained while wearing the orthoses. Outcome measurements included Cobb angle and rotational displacement.

**Results:** The average baseline Cobb angles were 51° thoracic (range 39-76°) and 31° lumbar (range 23-41°). While wearing the long-lever orthosis system, the thoracic and lumbar Cobb angles decreased to an average of 28° and 27°, respectively. In five of the patients tested, additional improvement in thoracic rotation was observed, by an average of 52% (range 12-97%). No patient tested had an increase in curves or rotation while wearing the long-lever orthosis system.

**Conclusions and discussion:** While wearing a specialized long-lever orthosis system, patients saw their Cobb angles and thoracic rotation decrease. This orthosis may help complement exercise-based scoliosis rehabilitation programs for patients with large translational displacements of the thoracic spine.

**References**


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**OS4**

**Assessment of early rib hump deformity correction in adolescent idiopathic scoliosis treated with a dynamic derotation brace using the double rib contour sign**

Theodorus Grivas*, Georgios Triantafyllopoulos, Christina Mazioti
Scoliosis Clinic of the Department of Trauma and Orthopaedics, "Tzanéo" General Hospital, Piraeus, Greece
E-mail: tgr69@otenet.gr

*Scoliosis* 2013, 8(Suppl 2):OS4

**Background:** Scoliotic children and their parents are very much concerned about trunk deformity (TD). One of the TD components is the rib hump (RH), which is mainly the expression of rib deformity. Bracing treatment aims not only to hold or correct the central axis (i.e. the spine), but also the TD in the thorax (i.e., the RH).

**Purpose:** The goal of this study was to assess the initial correction of the RH in patients with AIS who were treated with the Dynamic Derotation Brace (DDB).

**Methods:** In total, 20 children with right thoracic (n=14) and double curves (n=6) (right thoracic left lumbar) were assessed. The SRS/SORST inclusion criteria for brace treatment were used. The Cobb angle was measured on postero-anterior and the rib index (RI) was calculated from the double rib contour sign (DRCS) according to Grivas et al. 2002 on lateral standing spinal radiographs. The reference vertebra from which the RI was assessed was documented. Statistical analysis was done using the Statistical Package Social Science (SPSS) using the t-test.

**Results:** The mean thoracic Cobb angle was 27.5 degrees. The posterior margin of the reference vertebra was the T8 in four scoliotics, T9 in two, T10 in four, T11 in six, L1 in two and L2 in two, respectively. The mean pre-brace treatment RI was 1.864 and the early post-brace 1.205, respectively.

**Conclusions and discussion:** The RI resulting from the DRCS for the first time was used to assess RH deformity in scoliotic children during brace treatment. The RI was used due to its simplicity and the ability to be calculated on the lateral scoliosis film with no need for special imaging or additional exposure to radiation. The DDB significantly improved the RH deformity during the initial treatment period in the thoracic curves and in the thoracic component of the double scoliotic curves. The impressive improvement of the RI can be attributed to the metallic blades featuring DDB. The RI based on DRCS could easily be used to assess any brace effectiveness on the RH deformity correction.

**Reference**


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**OS5**

**Not only being compliant, but also being constant in brace wearing improves short-term results: a prospective Thermobrace study**

Sabrina Donzelli*, Monica Luini, Salvatore Minnella, Fabio Zaina, Stefano Negrini
ISICO Italian Scientific Spine Institute, Milan, Italy
E-mail: sabrina.donzelli@isico.it

*Scoliosis* 2013, 8(Suppl 2):OS5

**Background:** Compliance, together with quality of bracing, have shown to achieve good results in scoliotic patients. However, nothing is known about constant brace wearing (CBW), which means maintaining the same number of hours almost every day. CBW is recommended at each brace prescription, but is it true that being constant will bring the best results?

**Purpose:** The goal of this study was to find out if CBW is rewarded with better bracing results in the short term.

**Methods:** Prospective controlled cohort study nested into a clinical database started in 2003. On December 31, 2012, out of 11,800 patients in the database, we selected 168 who met the following inclusion criteria: Adolescent Idiopathic Scoliosis, Sforzesco brace prescription 18 to 23 hours/day, at least four months of observation, Thermobrace (TB) adoption and out-of-brace x-ray before treatment. CBW (104 patients) was compared to fickle-brace wearing (FBW: 64); due to the abnormal distribution of TB values, one hour in the inter-quartile range distinguished the two groups. A 6-degree Cobb cut-off was defined to classify results as improved, worsened or stabilized. Patients were also classified for compliance: High (HC: >95% of prescription), Medium (MC: 70-94%) and Low (<70%). For statistical analysis, chi-square test has been used; the relative risk (RR) of not improvement (i.e., progression or stabilization only) with 95% Confidence Interval (IC95) has been calculated as well.

**Results:** Males were more frequent in FBW (78.1% vs 12.5% in CBW – P=0.0001). CBW-HC showed a high percentage of improved and stabilized curves (44.2% and 28.8% ) when compared to FBW (10.9% and 10.9%). CBW are frequently HC, 81.7% versus 21.8% in FBW (P=0.0001). In both
groups, HC were more frequent in the group of prescription over 22h per day, while the severity of scoliosis did not affect compliance or CBW. Without distinctions for compliance, RR in the short-term for FBW was 1.35 (IC95: 0.95-1.93 - P = 0.08). FBW-MC/CL, compared to CBW-HC showed a RR of 1.50 (IC95: 1.0-2.3 - P=0.04).

Conclusions and discussion: Wearing a brace rigorously (HC) and constantly (CBW) provides good results, and this remains true in MC. Compliance to prescription is fundamental to a higher probability of achieving good results, but FBW can represent a risk for progression. Future studies should document these data at the end of treatment.

References

O56
SpineCor vs rigid brace for Adolescent Idiopathic Scoliosis: end of growth results from a retrospective controlled study
Fabio Zaina, Fabio Digiacomo, Sabrina Donzelli, Michele Romano, Alessandra Negrini, Monia Luzini, Salvatore Minnella, Stefano Negrini
ISICO Italian Scientific Spine Institute, Milan, Italy
E-mail: fabio.zaina@isico.it
Scoliosis 2013, 8(Suppl 2):O56

Background: SpineCor and rigid braces both have both results testifying to their effectiveness in Adolescent Idiopathic Scoliosis (AIS) treatment: an RCT recently compared the two, showing the superiority of rigid braces. In a previous study, we found similar short-term results in curves between 20° and 30° Cobb.

Purpose: The objective of this study was to compare the short-term results of the Spinecor vs SPoRT brace for AIS in this selected population.

Methods: Study design: retrospective controlled study. Population: Rigid Brace Groups (RBGs) 20 patients (16 female), age 13±1, Cobb 24±5°, ATR 8±3°, TRACE score 7, Risser 0-3. SpineCor Group (SG): 41 patients (33 females) age 13±1, Cobb angle 24±5°, ATR 8±3°, TRACE score 6, Risser 0-3. Both groups were treated with a full-time brace (18 to 23 hours per day) and 30° Cobb.

Results: Considering patients with more than 5° of Cobb angle change, 40% improved, 45% remained stable and 15% worsened in the RBG vs. 22%, 34% and 44% (p<0.05), respectively. No differences were found for ATR. For TRACE, there were no differences among groups: in RBG, 50% improved and 50% were stable, vs. 63%, 31% and 5% worsened (p<0.05).

Conclusions and discussion: Both treatments showed to be effective in improving the aesthetics in AIS. For the other parameters, the SPoRT brace seemed to be more effective than the SpineCor to avoid curve progression, since the number of worsened patients was much higher for the SG. The main limits of the study were the retrospective design and the small population, so further studies are required.

References

O57
A retrospective controlled study comparing Spinecor vs exercises for Adolescent Idiopathic Scoliosis
Fabio Zaina, Fabio Digiacomo, Sabrina Donzelli, Michele Romano, Alessandra Negrini, Sabrina Donzelli, Monia Luzini, Salvatore Minnella, Stefano Negrini
ISICO Italian Scientific Spine Institute, Milan, Italy
E-mail: fabio.zaina@isico.it
Scoliosis 2013, 8(Suppl 2):O57

Background: SpineCor and exercises both have results testifying to their effectiveness in Adolescent Idiopathic Scoliosis (AIS) treatment. Several years ago, we introduced SpineCor as a treatment for patients at the highest risk of brace which we previously treated with exercises. In a previous study, we compared the short-time results of SpineCor and specific exercise for AIS.

Purpose: The objective of this study was to compare the end treatment results of the SpineCor vs. Scientific Exercises Approach to Scoliosis (SEAS) for AIS.

Methods: Study design: retrospective controlled study. Population: Exercise Group (EG): 28 consecutive scoliosis patients (26 females), age 13±2, TRACE 4±5, Cobb angle 18±5°, ATR 7±3°, Risser 0-3. SpineCor Group (SG): 41 patients (33 females), age 13±1, TRACE score 6, Cobb angle 24±5°: ATR 8±3°, Risser 0-3. EG patients performed specific exercises twice per week according to the SEAS protocol. SG patients wore the SpineCor brace 20 hours per day. Patients were evaluated both clinically and radiographically before and after the treatment. Main outcome measured TRACE (changes ≥3), Cobb angle (changes > ±5) and ATR.

Results: At baseline, the Cobb angle in the SG was significantly larger than the EG group. Considering the number of patients with significant changes for Cobb angle, we found 7% improved, 36% stable and 57% worsened vs. 22%, 32% and 46% respectively (p<0.05). For ATR, the results were similar. There were similar results for TRACE: 46% improved and 54% stable for EG versus 65%, 31% and 4% worsened in the SG (P<0.05).

Conclusions and discussion: There was a slight difference among groups at the beginning of the study, so the interpretation of the results must be cautious. Both treatments could achieve some improvements of the aesthetics. In terms of risk of progression, results were slightly better for SpineCor, but the difference is not statistically significant. This could be due to the difference in the initial Cobb angle: the SpineCor group included more severe curves compared to the exercise group. The main limits of the study were the retrospective design and the small population. Moreover, the initial difference in the severity of the curve made the comparison not totally reliable.

References

O58
Exercise efficiency of adolescents with idiopathic scoliosis in and without Cheneau brace
Jacek Dumala*, Joanna Pajak
Department of Rehabilitation, Medical University of Silesia, Poland
E-mail: jdumala@gmail.com
Scoliosis 2013, 8(Suppl 2):O58

Background: Untreated idiopathic scoliosis (IS) may lead to large deformations of the trunk, limiting capacity and biomechanics functions of the chest and exercise capacity, which is closely related to changes in the
functioning of the cardio-pulmonary system. The conservative treatment of IS is applied in a brace treatment and various methods of physiotherapy. However, the usage of the brace may additionally decrease the cardio-pulmonary efficiency, regardless of what the beneficial effects of persistent brace therapy might be.

**Purpose:** The goal of this study was to observe whether a Cheneau brace (CB) affects the exercise capacity (ExC) among the patients with IS based on the analysis of the two forms of exercise: Cycle Ergometer Test (CET) and the 6-Minute Walk Test (6MWT). Additional goals were to determine the relationship between factors such as curvature size (Cobb), the deformation extent and the degree of a direct effect of the CB on ExC.

**Methods:** Fifty-Six patients (10-18 years) with diagnosed IS, who passed through the CET and the 6MWT. Tests were performed twice: once in a brace and once without it. Design: A randomized, controlled trial.

**Results:** The study showed a disability of the exercise test parameters on the CET during the test with a CB compared to the test without a CB. The search for a correlation between the degree and location of the scoliosis, the thoracic kyphosis degree, children's age and the CET parameters exercise test failed in most cases. The significantly shorter average distance of 6MWT was founded in the children's group wearing a brace compared to the group without the brace.

**Conclusions and discussion:** A CB significantly limits the ExC. The impairment of this capacity has been demonstrated in both tests for CET and 6MWT. Both exercise tests had limited utility in assessing the negative effect of the degree and location of scoliosis on some parameters in these trials. More useful in this aspect was a 6MWT, in which was found a significant inverse correlation between the thoracic kyphosis degree and the difference in march distance with and without a brace.

**References**

**O60**
A prospective study in adolescent idiopathic scoliosis affected by thoracolumbar and lumbar curves in treatment with a progressive action short brace (PASB): assessment of results according to the SRS committee on bracing and nonoperative management standardization criteria

Angelo Gabriele Aulisia*, Vincenzo Guzzanti, Marco Giordano, Giuseppe Mastantuoni, Marco Peruzzi, Lorenzo Aulisia
Orthopaedic Department, Children's Hospital Bambino Gesù, Institute of Scientific Research, Rome, Italy
E-mail: angelogabriele.aulisia@fastwebnet.it
Scoliosis 2013, 8(Suppl 2):O60

**Background:** The effectiveness of conservative treatment of scoliosis is controversial. In recent retrospective studies, we have demonstrated the effectiveness of PASB in correcting and holding thoracolumbar and lumbar curves. Furthermore, several papers have recently been published on adolescent idiopathic scoliosis in agreement with SRS criteria; however, none of them was prospective.

**Purpose:** The purpose of this study was to confirm the effectiveness of PASB in the correction of thoracolumbar and lumbar curves, in agreement with the SRS Committee on Bracing and Nonoperative Management Standardization Criteria in a prospective study.

**Methods:** We have carried out a prospective study of 197 adolescents (mean age 11.8 ± 0.5 years) treated from 1993 to 2012 with thoracolumbar and lumbar curve and a pre-treatment Risser scores ranging from 0 to 2. To evaluate the effectiveness of treatment and standardize the results, SRS criteria were used. All patients were prescribed a full-time PASB. The minimum duration of follow-up was 24 months. Anteroposterior radiographs were used to estimate the curve magnitude (CM) and the torsion of the apical vertebra (TA) at five time points: beginning of treatment (t1), one year after the beginning of treatment (t2), intermediate time between t1 and t4 (t3), end of weaning (t4), and 2-year minimum follow-up from t4 (t5). Three outcomes were distinguished: curve correction, curve stabilization and curve progression. Statistical analyses were performed with GraphPad Prism 6.

**Results:** Of the total patients in the study, 136 (69%) had at least two years of follow-up, 37 (19%) were still in treatment and 24 (12%) abandoned the treatment. Of the 24 patients who abandoned the treatment, there was curve correction in 20 cases, curve stabilization in three cases and curve progression in one case at the time of abandonment. Of these, nine were revised to follow-up and one patient was recommended for surgery. In patients with a definite outcome CM mean value was 29.06 ± 4.73 SD at t1 and 13.58±8.7 SD at t5. TA was 11.56±5.53 at t1 and 7.4±4.93 at t5.
The variations between measures of Cobb and Perdriolle degrees between CM t5-t1 and TA t5-t1 were statistically significantly different. Curve correction was accomplished in 120 patients (88%), whereas curve stabilization was obtained in 13 patients (10%). Three patients (2%) had a curve progression and nobody was recommended for surgery.

Conclusions and discussion: Our study confirmed that the PASB is highly effective in treating thoracolumbar and lumbar curves, with most patients reaching a curve correction, and is especially effective in reducing surgical rates. Moreover, the PASB has an excellent compliance, with a dropout rate of only 12%.

References

O61 Overweight is not predictive of reduced effectiveness of orthosis treatment in Adolescent Idiopathic Scoliosis: results from a retrospective cohort study.
Fabio Zaina,† Sabrina Donzelli, Monia Gusini, Salvatore Minnella, Luca Vismara, Paolo Capodaglio, Stefano Negrini.
ISICO Italian Scientific Spine Institute, Milan, Italy.
E-mail: fabio.zaina@isico.it
Scoliosis 2013; 8(Suppl 2):O61

Background: A previous study reported that being overweight is predictive of decreased effectiveness of bracing for patients diagnosed with Adolescent Idiopathic Scoliosis (AIS), with the risk of worsening three times higher in overweight patients than in normal-weight scoliosis patients.

Purpose: The goal of this study was to verify if body mass index (BMI) and, specifically, obesity, are predictive for the effectiveness of bracing in a cohort of AIS patients.

Methods: Design: retrospective cohort study. Population: 351 AIS patients (306 females), age 10-15 years at first assessment (average 12.9±1.4), worst curve 35.6±11.4° Cobb, ATR 11±4.3°, median Risser 2, BMI 19.7±3. All subjects included were prescribed a brace treatment at first visit (initially 18-23 hours per day) accompanied by Scoliosis Physiotherapeutic Exercise according to the Scientific Exercises Approach to Scoliosis (SEAS) protocol. After the treatment, all patients were evaluated again and changes were analysed. Outcome: n° of patients improved/worsened (defined as patients with a change of more than 5° Cobb) or stable, average change of Cobb angle. Statistical analysis: a stepwise linear regression was used to look for the effect of BMI as a predictor of result. A chi-square test and a logistic were used for the category of overweight patients (BMI³85° percentile). During the statistical analysis, we controlled for possible confounders.

Results: The chi-square test showed similar results in overweight and normal weight 44% vs. 52% improved, 52% vs. 41% stable and 3% vs. 7% worsened, respectively. We found BMI to be poorly correlated with final results. Adjusting for confounders did not change this poor correlation, and the predictive model explained about 10% of the result.

Conclusions and discussion: We found similar results in overweight and normal weight subjects treated with a brace for AIS. This is in contrast with a previous study that suggested the overweight condition to be a contraindication for brace treatment due to poor results. It is possible that these differences in results depend on the management of the treatment, which in our study followed the indication of the SOSORT guidelines.

Further studies are needed to confirm our results in different settings and populations.

References

POSTER PRESENTATIONS

P1
Manipulation under anesthesia for adult scoliosis pain: case series with 1-year follow-up.
Mark Morningstar
Natural Wellness & Pain Relief Center, Richmond, MI, USA.
E-mail: drmorningstar@nwprc.com
Scoliosis 2013; 8(Suppl 2):P1

Background: Manipulation under anesthesia has been used in the U.S. since the 1920s, when it was primarily developed for the treatment of chronic or recurrent back and leg pain associated with intervertebral disc herniation or sciatica.

Purpose: The goal of this study was to report the radiographic and self-rated outcomes of adult scoliosis patients treated with manipulation under anesthesia (MUA). These patients had failed or plateaued with other non-surgical therapies.

Methods: A review of patient files who received MUA between January 2007 and March 2010 at the same outpatient surgery center. Of these, 17 patients had a history of adult scoliosis and had previously tried other conservative therapies for pain for at least six weeks. Patients ranged in age from 37 to 61 years. After reviewing the charts of these 17 patients, 14 of them had completed a 1-year follow-up. Outcome assessments included a Quadruple Visual Analog Scale (QVAS), Functional Rating Index (FRI) and Cobb angle.

Results: All 14 patients reported statistically significant outcomes on both the QVAS and the FRI immediately following the serial procedure, which were maintained at one year. The Cobb angle was reduced by an average of 11° in the lumbar group, 6° in the thoracic group and 4°5° in the double major group.

References

P2
Joint hypermobility in girls with idiopathic scoliosis: relation with age, curve pattern and curve size
Dariusz Czaprowski, , Tomasz Kotwicki, Paulina Pawłowska, Łukasz Stolfski, Mateusz Kozimoga, Piotr Janusz
Department of Physiotherapy, Jozef Rusiecki University College, Częstochowa, Poland; Rehasport Clinic, Poznań, Poland.
E-mail: dariusz.czaprowski@interia.pl
Scoliosis 2013; 8(Suppl 2):P2

Background: A complete musculoskeletal examination should include the specific tests to detect hypermobile individuals, especially when physiotherapy affecting joint mobility is planned. Joint hypermobility (JH)
is defined as an excessive range of motion of joints, taking into consideration the subject’s gender, age, and ethnic background [1].

**Purpose:** The goal of this study was to assess the prevalence of JH in girls with idiopathic scoliosis (IS), taking into account the age, curve pattern and curve size.

**Methods:** The study group included 147 Caucasian girls with IS, aged 9-18 years (mean 13.1 ±.3), selected at random from the group of 300 girls free of IS (angle of trunk rotation <5°). The presence of JH was assessed at the 9-point Beighton scale [1], using the cut-off ≥5 points.

**Results:** JH was diagnosed in 24.5% of IS girls, whilst in the control group, it was diagnosed in 15.1% (p=0.04). The prevalence of JH was significantly lower in IS girls aged 16-18 years in comparison to younger individuals (9-15). There was no difference regarding JH occurrence among girls with mild, moderate and severe scoliosis (p=0.8). No significant differences in JH prevalence was observed among girls with single thoracic, single lumbar and double curve scoliosis (p=0.68). The number of vertebrae within curvature did not influence the prevalence of JH (p=0.13).

**Conclusions and discussion:** JH appeared more often in IS girls than in healthy controls. Its prevalence decreased with age. No relation between JH prevalence and curve pattern, curve size or number of vertebrae within curvature was found.

**Reference**

**P3**

**Reliability of pelvic parameters measurement**

Julie Deceuninck*, Jean-Claude Bernard, Eric Berthonnaud

**Cross Rouge française – CMCR des Massues, Lyon, France**

E-mail: j.deceuninck@cmcr-massues.com

Scoliosis 2013, 8(Suppl 2):P3

**Background:** Pelvic parameters are an essential measurement in sagittal radiographic analysis. However, it is difficult to control the patient position during radiograph and it is possible that a strict profile cannot be obtained.

**Method:** Fourteen standing biplanar radiographic files of asymptomatic and scoliotic patients have been recorded and treated in the frame of pelvis/spine studies. Radiographic examinations involved frontal and sagittal exposures grasped successively. A standard radiographic set up is used, involving a rotating platform, interposed between radiographic source and plate. Patients must stand motionless on the platform, with bearing poles helping patients to keep a stable posture. Two numerical radiographs (size 30 cm x 90 cm) are shot but with feet in a board position with heels spaced 19cm apart [3].

**Results:** a. Bare skin acquisition. b. Cutaneous benchmark: the first sagittal exposures grasped successively. A standard radiographic set up is then applied to the two radiographs, which takes into account small deviations: 1°, 2°, 3°, 4°, 5°. c. With platform: Difference after three days -8.6° to 18.25°. Average: 1.4° deviation: 20.45°. d. Without platform: -0.3° deviation: 19.2°. Variations were observed in both directions with an overestimated gap when using the platform. d. Without platform: Difference after three days -9.75° to 10.7°. Average: -1.4° deviation: 20.45°. e. With platform: Difference after three days -8.6° to 18.25°. Average: 1.4° deviation: 26.85°. More variation is observed when the platform is used.

**Conclusions and discussion:** The trend would be to choose the natural position of the feet in order to obtain an exam as reproducible as possible.

**References**

**P4**

**Interest of standardization of feet position during 3-dimensional trunk capture**

Gregory Notin*, Sophie Pouret, Cyril Lecante, Julie Decuéninck, Nicolas Frasse, Jean Claude Bernard

Lecante, Lyon, France

E-mail: gregnotin@gmail.com

Scoliosis 2013, 8(Suppl 2):P4

**Background:** Follow-up visits with scoliotic patients require too many radiologic exams. The ORTEN optical sensor [1,2] captures the external shape of the trunk in 3-dimensions that can be used for intermediary exams and limit the usage of x-rays.

**Purpose:** The objective of this study was to demonstrate the value-added benefit of the standardization of the feet posture during the digitization of the patient’s trunk.

**Methods:** a. Bare skin acquisition. b. Cutaneous benchmark: the first sagittal exposures grasped successively. A standard radiographic set up is then applied to the two radiographs, which takes into account small deviations: 1°, 2°, 3°, 4°, 5°. c. With platform: Difference after three days -8.6° to 18.25°. Average: 1.4° deviation: 20.45°. d. Without platform: Difference after three days -9.75° to 10.7°. Average: -1.4° deviation: 20.45°. e. With platform: Difference after three days -8.6° to 18.25°. Average: 1.4° deviation: 26.85°. More variation is observed when the platform is used.

**Conclusions and discussion:** The trend would be to choose the natural position of the feet in order to obtain an exam as reproducible as possible.

**References**


**P5**

**Cobb angle changes after standardized chiropractic intervention in 12 females with adolescent idiopathic scoliosis with double major curve types: a retrospective review of patient records**

Alan Wooggon*, Daniel Martinez

CLEAR Scoliosis Institute, St Cloud, MN, USA

E-mail: jwoggon@clear-institute.org

Scoliosis 2013, 8(Suppl 2):P5

**Background:** Scoliosis is a 3-dimensional spinal deformity measured in two dimensions. [1] and is the leading orthopedic problem seen in school-aged children, affecting approximately 2-4% of children 10 to 16 years of age. First introduced in 1948, the Cobb angle is the current standard for measuring the severity of scoliosis. As stated by Gstoettner et al. in 2007, “It is an objective measure and is generally used to make decisions about the progression of a curve, as well as the need and success of treatment.”
Measurements of the Cobb angle are useful for determining the level of lumbar kyphosis, but the measurement cannot be compared across studies because of differences in the methods used for measuring the angles. The Cobb angle method is considered the standard method for measuring lumbar kyphosis, but it has some limitations, including the difficulty of obtaining accurate measurements and the difficulty of comparing measurements across different studies. Therefore, researchers have developed alternative methods for measuring lumbar kyphosis, such as the Scoliometer and the Spinal Brace Angle. These methods have been shown to be more accurate and reliable than the Cobb angle method, but they are not as widely used as the Cobb angle method. Overall, the Cobb angle method remains the most widely used method for measuring lumbar kyphosis, but researchers are actively working to develop new and improved methods for measuring this important parameter.
spine and chest, often associated with abnormal sagittal profile, such as flatback. I want to discuss the brace form or correct manner of modelling the brace, which is surely very important; however, the full concept, such as RSC, is also very important in providing good results. Since 2001, the RSC Management System is a patented system for producing customized standardized custom-molded scoliosis orthoses for patients with scoliosis. This brace system is based off handmade molds from MR dating back from the early 1990s to the present. Treatment using a RSC brace involves a medical team collaboration among MR in Spain, Ortholutions in Germany, and the exclusive RSC brace treatment center. The RSC brace is a scoliosis corset produced by computer technology according to the Ortholutions patented method. It is supplied exclusively to specialist firms trained for this. The concept is not only logical but also holistic, according to further development of the original Chineaus Brace by international scoliosis experts and Ortholutions. The model data bank grows continuously with the latest scientific knowledge. Each RSC brace is produced according to the unique Ortholutions patented method. One of the many special features is the individual diagnosis and brace design for each individual patient. The main goal is to provide valuable treatment with a high rate of correction. All patients are seen and classified by two MDs, two COPs and one physiotherapist. Every patient has their own database, where all data is stored and can be viewed and evaluated by the team or health insurance provider.

References
1. RSC Brace by Ortholutions.
2. Terzic Alem: COP. Betriebswirt HvV.O
3. Dino Gallo, Grant Wood, Robert Dalmayer: Quality Control of Idiopathic Scoliosis Treatment in 147 Patient While Using the RSC brace.

P8
Impact of manual therapy in children with Adolescent Idiopathic Scoliosis
Stefanie Reid*, Channing Tarsone, John Thometz, XueCheng Liu
Aegis Therapies, Milwaukee, WI, USA
Scoliosis 2013, 8(Suppl 2)P8

Background: Using a manual therapy and a motor relearning approach to treatment of adolescent idiopathic scoliosis (AIS) operates from the premise that it is related to muscle imbalances at the core spinal stabilizers. The therapy will result in decreased lateral decompensation at the trunk and assist in improved postural alignment and stability of the spine.

Purpose: The goal of this study was (1) to determine the correction of spinal curvature, shoulder girdle, pelvic obliquity and 3-dimensional back contour deformities following the use of manual therapy and (2) to investigate changes of shoulder girdle, core and hip muscle strength.

Methods: We recruited 11 children with AIS, with a mean age of 14 years of age. Children with AIS who received manual therapy and the motor relearning approach were followed for an average of 4.5 months. Physical therapy intervention consisted of 60-minute treatment sessions two times per week. An impairment-based manual physical therapy method was utilized, consisting of passive force application and specific mobilization and manipulation techniques along planes of movement parallel or perpendicular to the anatomic planes of joint surfaces. Our motor relearning approach consisted of a segmentation approach to postural control, performed during specific functional and exercise-based tasks. The 3-dimensional back contour was measured using the Milwaukee Topographic System (MTS) before and after the therapy. The Wilcoxon Sign Rank test was used for comparison of muscle strength and 3-dimensional back contour variables before and after the therapy.

Results: Except that the quadratus lumbarum muscle did not show an increased strength, other muscles significantly improved strength, ranging from 3.7 to 4.5 (P<0.01). There were essentially no changes in the analog angle to Cobb in the coronal plane (from 8.4º to 8.3º). Differences were noted pre- and post-therapy with shoulder discrepancy, rotation in the transverse plane (axial surface rotation and Suzuki score), kyphosis and lordosis, the midline deformations and angles as well as the back height, but these changes never reached statistical significance (P>0.05).

Conclusions and discussion: A short-term follow-up of the manual therapy and motor relearning approach significantly increased strength at abdominal, shoulder girdle and hip. Asymmetries in shoulder girdle and rib humps will be further investigated.

P9
Comparison of treatment for idiopathic scoliosis based on 2D radiographic analysis and the GOSS system
Jose Miguel Gomera, Stefanie Reid
Gomez Orthotic Systems, St Petersburg, FL, USA
E-mail: agomez@gorthoticsystems.com
Scoliosis 2013, 8(Suppl 2)P9

Background information: Conservative treatment of the spine has been used for many more years than surgical treatment, especially for the management of idiopathic scoliosis. In general, the bio-mechanical plan of the orthotic treatment is based mainly on 2-dimensional radiographic studies from which the Cobb angle, Risser sign, pelvic obliquity and vertebral rotation are obtained. This is true despite the 3-dimensional nature of scoliotic deformities. “Gomez Orthotic Spine Systems” (GOSS) is a method based on the treatment of the patient as a whole structure. Taking into consideration the alignment in all three body planes, beginning with the localization of the lines of greatest stability: coronal center line (CCL), sagittal central line (SCL) and transverse center line of rotation (TCL). All these lines will emerge from the base of support on the feet, allowing the clinician to understand and quantify the overall alignment and the capacity of the patient’s balance and stability. The GOSS method consists of an established protocol that evaluates the patient using photometry, followed by the analysis of the ideal corrective shape in three dimensions of each patient. Using the protocol in the correct order, the evaluation/fabrication of a custom asymmetrical TLSO can be accomplished.

Purpose: The goal of this study was to compare and contrast the results of 2-dimensional radiographic and 3-dimensional photometry postural evaluation in a single case of idiopathic scoliosis before and after conservative treatment using the GOSS method.

Methods: This study was developed in the following phases:
(1) Pre-treatment evaluation: 3-dimension photometry postural and corrective shape evaluation based on the GOSS method vs. 2-dimensional radiographic evaluation.
(2) Treatment: Fabrication of orthoses based on 3-dimension corrective shape.
(3) Post-treatment evaluation: 3-dimensional postural and corrective shape evaluation based on the GOSS method vs. 2-dimensional radiographic evaluation.
(4) Analysis of pre/post evaluation results.

Pre-treatment evaluation: Sagittal plane: GOSS 1 centimeter anterior-decompensated; vs x-ray 10 centimeters posterior-decompensated
Transverse plane: GOSS 7.2 degrees clockwise at thoracic segment by Adam’s test vs. x-rays grade C under Nash-Moe method.
Coronal plane: GOSS 3 centimeters to the right vs. x-ray no imbalance shown from C7-S1.

Results: Re-alignment to the most stable lines, SCL, TCL, and CCS; plus permanent reduction of the Cobb angle from 53 degrees to 28 degrees without an orthosis.

Conclusions and discussion: The GOSS method of evaluation and treatment of idiopathic scoliosis is effective based on the results seen following treatment with an orthosis fabricated based on the 3-dimensional corrective shape of the patient presented in this case study. Under the right conditions with trained professionals, results like these would be ideal with a higher number of patients.

P10
Analysis of Anterior Trunk Symmetry Index (ATSI) in healthy school children based on 2D digital photography: normal limits for age 7-10 years
Lukasz Stolinski*, Dariusz Czarpowski, Mateusz Kozinoga, Krzysztof Korbel, Piotr Janusz, Marcin Tyrawski, Katsuki Kono, Nobumasa Suzuki, Tomasz Katwicki
Rehasport Clinic, Poznań, Poland
E-mail: stolinski.lukasz@op.pl
Scoliosis 2013, 8(Suppl 2)P10

Background: Digital photography for a 2-dimensional assessment of the body shape is a valuable method to both document the human posture and calculate the main quantitative parameters of it.

Purpose: The goal of this study was to assess the frontal plane symmetry of the anterior trunk in healthy school children based on the digital
photography by measurement of the Anterior Trunk Symmetry Index (ATSI).

Methods: The study comprised 421 school children, both sexes, aged 7-10 years, with no clinical evidence of scoliosis (Angle of Trunk Rotation <5º). One frontal photograph of anterior trunk in spontaneous standing position was taken with a digital camera in standardized manner. The semi-automatic software for calculation of photogrammetric parameters was developed in collaboration with an IT specialist. The photographs were analyzed to obtain a quantitative assessment of the ATSI parameter. The intra-observer error was calculated by the first author by measuring the pictures of 14 children three times, selected randomly, at the interval of at least two days. The inter-observer error was calculated by one surgeon and two experienced physiotherapists by measuring the pictures of 60 children, selected randomly. The normal upper value limit was calculated as mean +2SD.

Results: The mean ATSI value for 421 children was 24.3±12.7 (girls 24.4±12.1, boys 24.0±13.5). The ATSI values for each age group were: (1) 7-year-old children (N=117): 26.0±12.9 (girls 25.9±12.5, boys 26.2±13.4); (2) 8-year-old children (N=85) 23.3±13.7 (girls 23.0±12.2, boys 23.7±16.1); (3) 9-year-old children (N=109) 24.5±12.7 (girls 23.9±11.9, boys 26.1±14.1); and (4) 10-year-old children (N=110) 22.9±11.7 (girls 24.5±11.6, boys 21.8±11.5). For all age groups, the mean ATSI for boys did not differ significantly from the mean ATSI for girls (P>0.05). For both boys and girls, the mean ATSI did not differ among the four age groups (P>0.05). The intra-observer error was 1.07. The inter-observer error for the three observers was 4.06. The upper value limit was: (1) for 7-year-old children: girls=50.9 and boys=53.0; (2) for 8-year-old children: girls=47.4 and boys=55.9; (3) for 9-year-old children: girls=49.9 and boys=47.7; and (4) for 10-year-old children: girls=47.7 and boys=44.8.

Conclusions and discussion: Using semi-automatic software, the ATSI parameter could easily be calculated on regular digital photographs. The mean value of ATSI did not differ between boys and girls for the age group range of 7-10 years. Clinical usefulness of the ATSI parameter is yet to be determined by undertaking studies on larger groups of healthy and scoliotic children at different ages.

Reference