Spinal Deformities emphasize the need for an early detection system for scoliosis at skilled in the management of spinal deformities, induces us to insufficiency of both specialized organizations or qualified teams.

Outcome: The Algerian Population has recently reached 33.8 million, with nearly 27.5% under the age of 15. The considerable number of young people the Algerian population, along with the insufficiency of both specialized organizations or qualified teams skilled in the management of spinal deformities, induces us to emphasize the need for an early detection system for scoliosis at school. We felt that the epidemiologic data we obtained would show us the magnitude of the problem and oblige our ministry to act by changing the public health policies to react to the conclusions of our study. We expected that this study would supply some recommendations as to how to improve the training of school doctors and the specialists who are in charge of the orthopaedic pathology. We hoped it would lead to the identification of services for children with scoliosis and empower them to act, and we also hoped to develop the culture of multidisciplinary practice within our country.

Conclusion: This work resulted in recommendations that were not considered by our government until last year. At last, a program of school screening for scoliosis has become mandatory, just as the detection of defective vision, hearing problems or cardiac diseases has been. Currently, we are trying to organize some seminars about spinal deformity and its treatment. The management of all the students whose scoliosis will be detected by this program is yet another problem to consider.

ORAL PRESENTATIONS

O1 School screening for scoliosis in Algiers. Results of a survey conducted in 1995-96
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Scoliosis 2009. 4(Suppl 2):O1

Objectives: The main aim of this study was to estimate the prevalence of Idiopathic Scoliosis among the Algiers school population. However, the analysis of the results also enabled us to sketch a profile of the typical Algerian child with scoliosis.

Background: The epidemiological profile of this disease has scarcely been studied in our country. In fact, management of Spinal Deformities was only effective in a few specialized centers in Algiers City, and thus all the patients with scoliosis who are diagnosed throughout the country had to move to the capital for treatment. Considering the frequency of severe deformities we had been treating, we deemed it important and urgent to focus our efforts on the timely detection of childhood curvatures before it becomes too late for conservative treatment.

Methods and results: A screening survey for scoliosis was conducted on a sample of Algiers school children in 1995–1996. Our methodological steps corresponded to a prospective evaluation. It was based on a cross-sectional survey that had been executed in a restricted period and on a defined population where the information had been collected only once on each individual. In fact, 19,529 boys and girls, ages 5 to 16 years, were examined and 9.6% of them were referred to a specialized center because of their examination findings. The criteria for referral were mainly increased thoracic kyphosis, trunk rotation or spinal deviation in the coronal plane. Structural scoliosis was diagnosed in 25.35%. The prevalence of Idiopathic Scoliosis (curves > 5°) was 2.38% with a female predominance; and the overall incidence of scoliosis of all types was 2.43%.

Outcome: The Algerian Population has recently reached 33.8 million, with nearly 27.5% under the age of 15. The considerable number of young people the Algerian population, along with the insufficiency of both specialized organizations or qualified teams skilled in the management of spinal deformities, induces us to emphasize the need for an early detection system for scoliosis at school. We felt that the epidemiologic data we obtained would show us the magnitude of the problem and oblige our ministry to act by changing the public health policies to react to the conclusions of our study. We expected that this study would supply some recommendations as to how to improve the training of school doctors and the specialists who are in charge of the orthopaedic pathology. We hoped it would lead to the identification of services for children with scoliosis and empower them to act, and we also hoped to develop the culture of multidisciplinary practice within our country.

Conclusion: This work resulted in recommendations that were not considered by our government until last year. At last, a program of school screening for scoliosis has become mandatory, just as the detection of defective vision, hearing problems or cardiac diseases has been. Currently, we are trying to organize some seminars about spinal deformity and its treatment. The management of all the students whose scoliosis will be detected by this program is yet another problem to consider.

O2 Static pelvic obliquity can influence clinical assessment of trunk rotation in idiopathic scoliosis
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Scoliosis 2009. 4(Suppl 2):O2

Background: The Bunnell scoliometer is widely used for scoliosis screening; however the cut-off value for the angle of trunk rotation is still debated. It is not clear whether and how much the scoliometer measurements are sensitive to a non-level pelvis.

Study goals: The aim of this study was to verify whether the angle of trunk rotation is related to the functional pelvic obliquity. To answer this question, we measured the angle of trunk rotation (ATR) in the classical forward bending position while the unlevel pelvis was adjusted with a shoe lift.

Materials and methods: The ATR was measured in 25 girls with idiopathic scoliosis (study group), age 13 to 19 years (mean 15.6 ± 1.8 years) and in 25 healthy girls (control group), age 12 to 16 years (mean 14.2 ± 0.9 years). In the study group the Cobb angle revealed curves ranging from 35.0° to 92.0° (mean 54.4° ± 18.0°) in the lumbar spine and 38.0° to 93.0° (mean 54.4° ± 18.0°) in the thoracic spine.
60.7° ± 17.3°) in the thoracic spine. The Bunnell scoliometer was then used in two positions: sitting and standing, both forward bending positions. The scoliometer readings were noted at four levels of the spine: high thoracic, main thoracic, lumbar and sacral. Then, the measurements were repeated in the same subjects and at the same four levels of the spine, but after leveling the left or the right side of the pelvis using a 1-2 cm thick shoe lift.

**Results:** When compared to the classical forward bending position, the ATRs were significantly different after the shoe lifts were applied. Typical patterns of alternatively raised or lowered ATRs within adjacent spinal levels were also identified. The difference depended on the shoe lift height and on the spinal level: the change was 1.5°-4.5° of rotation within the lumbar spine; 1.2°-3.8° of rotation within the thoracolumbar spine, and 0.7° to 2.4° of rotation within the high thoracic spine.

**Conclusion:** The measurement of the ATR with the Bunnell scoliometer is affected by a non-level pelvis, especially within the lumbar spine. This should be taken into consideration when using the scoliometer in school screening.

**O3**

**Adolescent soccer is correlated with an increase of kyphosis but a reduction of low back pain: a controlled cross-sectional survey**

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Scoliosis 2009, 4(Suppl 2):O3

**Objectives:** To verify the relationship between LBP and posture in adolescent soccer players.

**Background:** In both adults and children a correlation has been shown between sports participation and low back pain (LBP). A long debate exists regarding the possible influence of sports participation on spinal growth in children. Soccer is a very popular sport played by many children worldwide.

**Methods:** We performed a clinical evaluation on 102 males age 11-16 who played competitive soccer two to three times per week. We compared them to a normal sample of 180 boys of the same age range who did not play soccer. In addition, we proposed a validated questionnaire on LBP prevalence and clinical characteristics that were compared to a normal sample of 668 schoolboys. The validated measurements we collected were plumbline distances from kyphosis apex (C7, T12 and L3) and ATR according to the Bunnell method. We calculated the Sagittal Index (SI: sum of the distances of C7 and L3), and the Sagittal Ratio (SR: C7/L3 - relationship between kyphosis and lordosis). According to previous studies, we considered the following to be normal references: ATR of less than 5°, Sagittal Index of 1.5-5.5 cm (C7), 2.8-7.0 cm (L3) 5.5-11.0 cm, and Sagittal Ratio of 0.37-1.31. Our analysis used normality tests, ANOVA and chi-square; the Kruskall Wallis test for non parametric data was also applied.

**Results:** We found statistically significant increases of the plumbline distances from kyphosis apex in C7 (36.6 ± 1.0 vs 33.6 ± 0.7) and T12 (23.0 ± 0.6 vs 21.3 ± 0.8) as well as an increase of SR (0.80 ± 0.03 vs 0.73 ± 0.02). We did not find more pathological cases in soccer players than in normals for any of the parameters we evaluated. When compared to normals, soccer players had a statistically significant reduction in most of the LBP parameters. Among LBP sufferers, the intensity of LBP was similar in the two populations.

**Conclusion:** Apparently, adolescent soccer players have less LBP than controls, while they have a group a tendency to have increased kyphosis, with an unbalance between the two sagittal curves in favor of kyphosis (ie, an increase in the Sagittal Ratio).

**O4**

**Muscle assessment in healthy teenagers.**

**Comparison to teenagers with low back pain**

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Scoliosis 2009, 4(Suppl 2):O4

**Objectives:** To describe muscle parameters in healthy teenagers and to compare them with teenagers who have chronic low back pain (CLBP).

**Methods:** A comparative study of 276 control teenagers and 51 teenagers who were being treated for CLBP. Both groups had an average of 14.5 years. The control group was made up of teenagers without back pain as well as teenagers who reported some back pain when asked, but who had never had specific treatment. The results of four static tests assessing trunk flexors, trunk extensors, hip extensors and quadriceps endurance were compared statistically. In the control group, the association between a number of clinical measures and back pain were evaluated.

**Results:** The two groups were homogeneous in terms of their age, weight, standing height, sitting height and BMI (p > 0.05). Low back pain was more common in girls, both in the control group (69% of girls) and in the group with CLBP (78%). CLBP was associated with a poor endurance strength of the trunk extensors (151 sec in the control group to 105 sec in the CLBP), with hip extensor weakness (140 sec in the control group to 84 sec in the CLBP), and with quadriceps weakness (159 sec in the control group to 140 sec in the CLBP), (p = 0.000). No significant difference was found between trunk flexor endurance in the two groups (131 sec in the control group to 133 sec in the CLBP). In the control group, 48 teenagers reported back pain “often”, “very often” or “all the time” although no links were found between pain and muscle flexibility (measured with finger-floor distance, heel-cheek distance, and popliteal angle). Only the sitting height was found to be statistically different (p = 0.003) in the control teenagers who reported back pain (87 cm) related to the ones who did not have pain (85 cm).

**Conclusion:** Sport influences global strength in the lower limbs and changes the ratio of strength in the quadriceps to hip extensors, in favor of the quadriceps. Neither pain nor the ratio of trunk flexors to trunk extensors are modified by sports participation. Trunk extensors, hip extensors and quadriceps endurance is lower in the those with CLBP.
O5
Static & dynamic balance of schoolgirls with hyperkyphosis
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Scoliosis 2009, 4(Suppl 2):O5

Objective: The purpose of this study was to examine the effects of hyperkyphosis on static and dynamic balance control in school-aged girls.

Background: Biomechanical factors such as spinal deformity can result in balance control disorders. Many studies have shown balance control disorders in scoliotic subjects.

Materials and methods: In a comparative study, a Bertec force platform was used to record center of pressure (COP) data. Ten female adolescents with hyperkyphosis (mean age: 13.9 years, mean Cobb angle 52°) were compared to 14 age-matched controls (average age 14.8 years) in static and dynamic balance tests. In static tests, we used two visual conditions (eyes open and closed) and the subjects were asked to perform the tests on their dominant limbs and on both limbs. Dynamic tests included forward, right and left reach, using a standard reach device.

Results: Statistical analysis showed no significant difference in static balance tests. But in dynamic tests, significant differences were seen between the normal and hyperkyphotic subjects. The mean value of each parameter was higher in normal subjects in right and left reach tests, performed with right and left hand respectively (p < 0.05).

Conclusion: The present results reveal that hyperkyphotic subjects might have less range of motion in lateral trunk movements and hence less limit of stability than normal subjects, since they probably showed poorer performance than normal controls in order to keep their balance.

O6
A simple functional classification for unspecific chronic low back pain with special respect to the sagittal plane
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Scoliosis 2009, 4(Suppl 2):O6

Background: Up until now, chronic low back pain without radicular symptoms were not classified and attributed in the international literature as being “unspecific”. For specific bracing of this group of patients suffering from low back pain we use simple physical tests to predict the brace type the patient might benefit from. Based on these physical tests we have developed a simple functional classification of “unspecific” low back pain in patients with spinal deformities.

Materials and methods: Between January 2006 and July 2007 we tested 133 patients (116 females and 14 males) with spinal deformities (average age 45 years, ranging from 14 years to 69) and chronic unspecific low back pain (pain for > 24 months). We applied the “sagittal realignment test” (SRT), a lumbar hyper-extension test, and the “sagittal delordosation test” (SDT). Results: 117 Patients reported significant pain relief in the SRT and 13 in the SDT (>2 steps in the Roland & Morris VRS). Three patients had no significant pain relief in both of the tests (< 2 steps in the Roland & Morris VRS). Pain intensity was high (3.29) before performing the physical tests (VRS-scale 0-5) and low (1.37) while performing the physical test for the whole sample of patients. The differences where highly significant in the Wilcoxon test (z = -3.79; p < 0.0001).

Discussion: With the exception of three patients (2.3%) a clear distribution to one of the two classes has been possible. One hundred seventeen patients were supplied successfully with a sagittal realignment brace (physio-logic brace®) and 13 with a sagittal delordosation brace (spondylogic® brace). Therefore a clear distribution of the patients from this sample to a treatment plan that included either chronic postural or chronic instability back pain was possible. In 2.3% a combined chronic low back pain from the findings obtained seems reasonable to assume.

Conclusion: Chronic unspecific low back pain can be clearly classified using these physical characteristics. This functional classification is necessary to decide on which specific conservative approach (physical therapy, braces) should be used. Factors other than spinal deformities contribute to chronic low back pain.

O7
Developing a new brace with pressure measurements
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Scoliosis 2009, 4(Suppl 2):O7

Introduction: Pressure measurements are being used to understand the working mechanism of the brace, because the forces exerted by a brace cause correction of the scoliotic curve. The aim of the study was to understand the mechanism and effectiveness of adjustments in a newly developed brace by using pressure measurements.

Materials and methods: Adjustments of a new developed were performed on a silicon doll and on one person. The effectiveness of the adjustments was checked by pressure measurements.

Results: Eight adjustments were performed on the thoracic pelotte of a newly developed brace. One of the adjustments gave the maximum pressure of 41.3 kPa at the apex of the thoracic curve. The total pressure of the thoracic pelotte was 253.6 kPa. We assume that this adjustment would improve the acceptance and comfort of the brace, and therefore could improve the compliance.

Conclusion: We conclude that brace adjustments on a new brace should be performed with the help of pressure measurements.
Discussion: The bone-protecting effect of melatonin is well documented in ovariectomized rats which can depend in part on the free radical scavenging properties of melatonin. Additionally, melatonin may impair development of osteopenia associated with senescence by improving non-rapid eye movement sleep and restoring GH secretion. Whether modulation of blood levels of melatonin can be used as a novel mode of therapy for scoliosis and augmenting bone mass in diseases deserves to be studied [3].

References


O9

Study of body mass (BMI) index and truncal asymmetry (TA) in healthy adolescents

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Introduction: Recent findings have linked BMI in girls with thoracic adolescent idiopathic scoliosis (AIS) to skeletal asymmetries of the spine and upper arm.

Purpose: The aim of this study in healthy adolescents is to evaluate the association between BMI and back shape asymmetry, termed here TA.

Methods and materials: A group of 5953 adolescents, ages 11–17 years (2939 boys and 3014 girls) were examined in a school screening program using two standard positions: standing forward bending (FB) and seated forward bending. TA was evaluated in both positions using a Pruijs scoliometer which measured the angle of trunk inclinations (ATIs) across the back at each of three regions: thoracic, thoracolumbar and lumbar. An abnormal ATI was defined as being beyond 2 standard deviations from the mean for region, age, gender and position, and this was termed severe TA. Each child was assigned to a relatively lower or relatively higher BMI group.
using a median value of BMI by age and sex. The sitting FB position is thought to express intrinsic TA free from extrinsically-induced effects of any leg-length inequality. **Results:** In the sitting FB position relatively lower BMIs, after correcting for age, are associated with a greater number of severe TAs than with relatively higher BMIs in both boys (thoracolumbar and lumbar regions) and girls (thoracolumbar region).

**Conclusion:** It appears that body fat, BMI, menarche and TA have mechanisms in common during development. BMI is a surrogate measure for body fat and circulating leptin levels. We suggest, analogously to a recently suggested hypothesis for AIS pathogenesis, that severe TA is caused by a genetically-determined selectively increased hypothalamic sensitivity to leptin mediated via the sympathetic NS as an adverse response, exacerbated by lower circulating leptin levels probably associated with relatively lower BMIs. This hypothalamic functional asymmetry is expressed phenotypically via the sympathetic NS acting bilaterally to produce left-right asymmetry in ribs and/or vertebrae leading to severe TA when beyond the capacity of postural mechanisms of the somatic NS to control the shape distortion of the trunk. A test of the hypothesis involving skin sympathetic responses is suggested. Significance: TA, BMI and menarche are related in healthy adolescents. Lower BMIs, are associated with TAs and possibly AIS. [1, 2].

**References**


**O10**

A comprehensive model of idiopathic scoliosis (IS) progression, based on the patho-biomechanics of the deforming “three joint complex”

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Scoliosis 2009, 4(Suppl 2):O10

**Introduction:** It was previously postulated that the intervertebral disc wedging is a significant progressive factor for mild idiopathic scoliosis (IS) curves. The present report introduces an innovative comprehensive model of IS curve progression based on intervertebral disc diurnal variation and the subsequent patho-biomechanics of the deforming “three joint complex”.

**Methods and materials:** Throughout the day and night, due to sustained loading and unloading, the wedged intervertebral disc space in the scoliosis patient expels fluid and reabsorbs it more on the convex side. The convex side of the disc sustains a greater amount of cyclic expansion than the concave side.

**Results:** Consequently, the imposed convex-wise, asymmetrically concentrated cyclical loads on the adjacent immature vertebral end plates and posterior elements of the spine lead to asymmetrical vertebral growth. More specifically the loading on the two facet-joins asymmetrically increases during the day, as the wedged disc space narrows due to expelled water and it asymmetrically decreases during the night, as the disc space swells due to reabsorbed water.

**Discussion:** This 24 hour period of cyclic asymmetric loading leads both to asymmetric growth of the end plates and wedging of the vertebral bodies, and to similarly asymmetric growth of the pedicles and arches posteriorly as an effect of Hüeter-Volkmann law. It is well described that the pedicle in the convex side is more elongated than in the concave side and the facet joint larger respectively.

**Significance:** The proposed model may help to explain the beneficial effects of exercises, night time bracing in idiopathic scoliosis and of fusionless surgery with staples for progressive IS [1–3].

**References**


Methods: We performed 4 different studies in 4 different populations of adolescent idiopathic scoliotic and hyperkyphotic patients. In the first study we report the normative data of the plumbline measures in a general population of 180 adolescents. In the second study we compared the sagittal distances from the plumbline of C7, T12 and L3 with the measures of the Video Rasterstereography at the same levels and the angles of Kyphosis and Lordosis in 100 AIS patients. In the third study we evaluated the intra and inter-rater repeatability and the measurement error of kyphosis and lordosis angles measured with the Inclined in 100 AIS patients. These data have been compared with the plumbline measures. In the last study we evaluated the repeatability of the sagittal distances from the plumbline by using a 1 mm change instead of 5 mm in a population of 40 patients. Statistical analysis: Repeatability has been evaluated according to Bland and Altman, to identify the limits of variation that are clinically significant.

Results: Study 1: the normative data were 34 ± 11 mm for C7 and 34 ± 15 mm for L3 for females and 34 ± 10 mm for C7 and 48 ± 10 mm for males. Study 2: a coefficient of correlation was calculated in order to compare measures. Study 3: the k value for Inclined varied from fair to good. Study 4: the repeatability was fair for this measure.

Conclusion: Some clinical instruments are now available for sagittal plane assessment in AIS and Hyperkyphosis. The results of the present study give the limits during measurements in a clinical setting of parameter that are routinely collected by some clinicians.

O12 Prediction of the scoliotic deformity correction in brace
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Scoliosis 2009, 4(Suppl 2):O12

Background: Predicting the amount of scoliosis correction provided by a brace has been routinely done using radiographs. This method is not desirable, however because of the risk of malignancy due to repeated radiation exposure. A diagnostic device called the “Spinal Mouse” has been widely used as a measurement tool in patients with scoliosis. This diagnostic method may also be useful for the prediction of scoliosis correction in a brace.

Objective: To study the correlation between spinal position measured with the “Spinal Mouse” and spinal position measured radiographically in the brace.

Materials and methods: Forth three scoliosis patients (12 males, 31 females) were enrolled in this study. Mean age was 10.3 years (range 6-15). Mean Radiographic Cobb angle before treatment was 37.2°. All the patients were investigated before bracing with “Spinal Mouse” in convex side bending position. After three months of bracing we assessed the radiographic Cobb angle and defined a correlation between the spinal correction in the brace and the results of the “Spinal Mouse” test.

Outcome: The mean deformity angle for the “Spinal Mouse” measurement was 17.5°. The mean Cobb angle after bracing was 15°. The correlation coefficient between these data was 0.68.

Conclusion: The “Spinal Mouse” device allows the clinician to perform non-invasive spinal mobility evaluation and may be used as the method for prediction of the scoliotic deformity correction during brace treatment.

O13 Sagittal spinal profile changes in scoliotic children during the brace treatment
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Background: Correction of the sagittal spinal profile is important in scoliosis brace treatment. There are few papers that evaluate the sagittal spine evolution during the brace treatment. We suggest that the brace treatment reduces thoracic kyphosis and lumbar lordosis to normal values.

Objective: To study the sagittal spinal profile evolution in scoliotic patients during brace treatment.

Materials and methods: Forty four scoliosis patients (10 boys, 34 girls) who were treated with a Cheneau brace were enrolled. The age range was 9-16 years old. The Cobb angle of the major curve ranged from 22° to 56°. Sagittal spine profile was evaluated with a diagnostic tool called the “Spinal Mouse” before and during the brace treatment.

Outcome: We found a nearly perfect correlation between radiographic sagittal spine profile and sagittal spinal profile measured with the “Spinal Mouse” (correlation coefficient was 0.97). After three months of brace treatment we showed that thoracic kyphosis and lumbar lordosis was decreasing in both groups. This investigation showed an increased sagittal range of motion in the thoracic spine and a restricted range of motion in the lumbar spine (Table 1).

Conclusion: In our investigation we observed the flattening of the sagittal spine profile during brace treatment. Posterior expansion room forming at the thoracic spine and pressure

Table 1 (abstract O13) Evolution of the sagittal profile in scoliosis patients during brace treatment

<table>
<thead>
<tr>
<th>Kyphosis</th>
<th>Lordosis</th>
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<tr>
<td></td>
<td>Standing</td>
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<tr>
<td>Before treatment</td>
<td>19.04</td>
</tr>
<tr>
<td>After 3-4 months</td>
<td>14.13</td>
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</table>

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zones forming at the lumbar spine is not enough for good control of the sagittal spine profile in the Cheneau brace.

O14
The influence of examiner experience on the reliability of surface topography measurements in patients with AIS

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Scoliosis 2009, 4(Suppl 2):O14

Background: The Ortelius 800 is a device for measuring scoliosis curves in AIS using surface topography. Initial experience with this machine was found to be unreliable, but more recent techniques have been shown to greatly enhance the reliability and reproducibility of Cobb angle measurements. If this machine can be used to obtain consistent measurements, then in addition to its use by spinal deformity specialists, it could be employed as a screening device by school personnel or by general pediatricians. But, more widespread distribution of the Ortelius 800 would mean that less experienced examiners would be using the machine.

This study looked at the relationship between the experience of the examiner and the reliability of the Cobb angle measurements. If only very experienced examiners can obtain reliable measurements, then distribution of this tool should be more limited.

Methods: In this study, volunteer patients were measured by a clinician with more than 20 years experience, and then again by health science students with less than one year of physical examination experience. Measurements were compared to see the influence that experience had on the reliability of this screening tool.

Results and conclusion: The inexperienced examiners were able to perform measurements of leg length, thigh circumference, angle of trunk rotation and knee flexion with the same level of reliability as the experienced examiner. There were no statistically significant differences between the measurements performed by these groups.

When using the Ortelius 800 to measure scoliosis curves, the inexperienced examiners obtained measurements that were very similar to those of the experienced examiner, and both groups had standard deviations of these measurements that were between 1.2 and 3.8 degrees. Measurement of kyphosis yielded the same results, with both groups obtaining similar angular measurements for kyphosis, and having standard deviations that were between 1.2 and 4.4 degrees.

Our conclusion was that measurements from a group of inexperienced examiners did not differ significantly from those of an experienced examiner when using the Ortelius 800 device to measure scoliosis [1–4].

References

O15
Test-retest standard error of measurements for full-torso surface topography parameters in healthy teenagers

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Scoliosis 2009, 4(Suppl 2):O15

Objectives: To assess the test-retest standard error of measurement (SEM) of full-torso surface topography (ST) parameters in adolescents without spinal deformities.

Background: ST is used to quantify the external deformity of the torso due to scoliosis. A normative ST database is being developed to help interpret the ST parameters used to describe scoliosis. Test-retest SEM has not been estimated for most parameters in this population.

Methods: Twenty-two healthy volunteers between 10-17 years old, with a body mass index of 19.1 ± 3.3 kg/m², scoliometer measure of 3.6° ± 2.5°, and without pain were included. Four Minolta 910 Laser Scanners and a standard positioning frame were used to record ST scans. One evaluator positioned all subjects, marked 11 reference points, and scanned. Immediately after, reference points were erased, landmarking and scanning repeated. ST parameters were extracted with custom designed software in Matlab by one evaluator digitizing reference points. Nineteen previously published and 7 newly proposed ST parameters were extracted. Test-retest standard error of measurement was calculated for each parameter. SEM was estimated for the minimum, maximum and the range of within-subject values for parameters extracted. SEM < 4 mm, < 5°

Figure 1 (abstract O15)
or < 0.2 for a ratio were considered adequate based on values in patients with scoliosis. (Figure 1).

**Conclusion:** Test-retest SEM of 15 of 26 ST parameters in healthy adolescents were found adequate for developing a normative database. Six of the 7 newly developed parameters had adequate SEM.

**O16 Dynamic 3D (4D) in objective classification of severe back deformities**

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**Objectives:** To perform a non-invasive dynamic analysis of movement ranges, asymmetries in scoliosis, and other back deformities and to average a series of images.

**Background:** Objective parameters in diagnostics and treatment of back problems are normally acquired through invasive, time-consuming and/or expensive methods. Non-invasive and significantly objective parameters can be extracted from a dynamic 4D reconstruction.

**Methods:** The Formetric 4D measurement system dynamically scans and reconstructs human back surfaces with a frequency of up to 24 Hz. Automatically detectable fixed points and invariant features on the surface correlates to a high degree of accuracy with the spinal processes and pelvis. Thus, it is possible to calculate parameters derived from spine and pelvic position, displacement and rotation, things such as kyphotic and lordotic angles, pelvic symmetry and torsion, spinal rotation and displacement. Variations in postural movements in upright position of patients may, however, lead to significant reduction of repeatability of examinations. A series of images taken with automatic calculation of the average values will solve this problem. In a dynamic examination, predefined movements are analyzed according to symmetry and range of motion.

**Results:** The robustness and reproducibility of reconstruction parameters significantly improves by taking the average of a series of images recorded over a period of 3-10 sec. In the Matthias’s test, kyphotic and lordotic angles show the break-up of the standing posture over time. The Romberg test gives information about fluctuation movements of the upper body relative to the pelvis. Asymmetry by stepping gives information about pelvic and spinal blockages.

**Conclusion:** Significant objective dynamic parameters can be calculated without invasive methods or the use of ionizing radiation.

**O17 Classification of objective aesthetic parameters in idiopathic scoliosis**

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**Objectives:** To use non-invasive surface instruments to define Objective Aesthetic Parameters and to obtain an Aesthetic Classification System in idiopathic Scoliosis.

**Background:** Aesthetic correction is a main aim in scoliosis treatment as defined by SOSORT. Objectively defining aesthetic parameters is difficult; recently TRACE has been proposed as a possible option, being the standardization of the subjective medical expert evaluation. Objective measures are needed for an automatic classification of aesthetics in scoliosis and for other severe back deformities. A 3D reconstruction of the back surface delivers a set of objective parameters used as a basis for this aesthetic classification.

**Methods:** The Formetric measurement system reconstructs human back surfaces in semi-real time. From the acquired 3D data a set of objective anatomical and aesthetic parameters, one can automatically calculate:

- shoulder rotation, slope angle and height difference
- scapular symmetry
- symmetry of flanks and waist triangles
- rib humps and asymmetry in waist region
- pelvic displacements

The above parameters form a basis from which classification indexes can be calculated and derived according to a specific set of expert rules.

**Results:** Especially in severe cases it is possible to transfer the essentials of relative subjective classifications to objective measures and parameters. Vague and hard-to-catch impressions like “it doesn’t look good” can to a certain degree be judged by neutral criteria: Shoulder and pelvic symmetry; angles, area- and height-differences of scapula; differences in waist triangles, etc.

**Conclusion:** The visual impression of aesthetics correlates closely to the objective parameters described above.

**O18 Arm positioning and postural sagittal variation: are kyphosis and lordosis measurements using X-ray reliable?**

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**Objectives:** To verify how changing the position of the arms, done during standard radiographs to allow visualization of the spine, can change the spinal sagittal angles.

**Background:** X-rays are the gold standard evaluation in scoliosis, and this is considered true also for sagittal plane deformities. While it is very well known that posture can change scoliosis curves, this has never been verified for the sagittal plane. In the case of sagittal alignment, it is even more important because to see the spine, there is the need to move the arms from the resting physiological position to a forward position, which may change spinal posture. Today there is not a universally accepted standard for arm positioning during radiographs, nor is it known how it influences spinal measurements. Surface devices may possibly be more reliable measurement instruments than radiographs because they allow the patient to maintain the normal position of their arms. Comparing the two methods is difficult because it would not be ethical to expose patients to repeated doses of X-ray. Surface methods may be tested using these methods, however.

**Methods:** Study Design: transversal study. Population: 85 subjects (50 hyperkyphosis, 33 scoliosis, 2 normals). Hardware: 4-D
Formetric. Methods: each subject has been consecutively evaluated in normal standing, then with progressive extension of the shoulders with extended arms (45°, 90°, 135°, 180°), then with arm crossing on the chest (CROSS) and with flexion of the shoulders and elbow to let the hands rest on the shoulders (REST). All sagittal parameters given by Formetric have been considered. Statistics: ANOVA for total and sub-groups.

Results: The absolute differences from the standing position of kyphosis angles ranged from 4.8 to 13.3° and were statistically significantly different with rare exceptions. For lordosis the differences were always statistically significant and ranged from 4.6 to 10.4°. The biggest differences have been found with REST and 180°; the lowest with 45°, and CROSS in some cases. The variation of angles measured depended on changes of spinal horizontal condition, with displacements of the spine in both the sagittal and horizontal axis.

Conclusion: According to these results, X-rays should be used to determine bone deformities and for diagnosis, while monitoring spinal position can be more reliably and safely done using non-invasive, surface measurements.

O19
A study of vertebral geometry before and after conservative treatment in thoracic Scheuermann's disease
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Scoliosis 2009, 4(Suppl 2):O19

Background: The study of the vertebral changes in Scheuermann's disease during conservative treatment is generally based upon the magnitude of the curve according to the Cobb method and the magnitude of the vertebral deformation in the sagittal plane. In the present study, an X-ray analysis of vertebral changes before and after bracing has been performed to assess whether additional radiographic parameters may aid in assessing the impact of the disease and the response to conservative treatment.

Methods: There were 16 patients with thoracic Scheuermann's disease undergoing treatment with an anti-gravity brace. Mean age at the onset of treatment was 13 years and patients had a mean curve value of 54.4° kyphosis at the beginning of treatment. The following parameters were analyzed on a standard LL X-ray film taken before and at the end of treatment: cuneization angle (ALFA), anterior wall tilt (AANT), and posterior wall tilt (APOS). Each value was determined by two independent observers. Vertebral bodies were subdivided into three sectors: apical vertebrae (sector 4), those above the apical vertebra (sector 3), those below the apical vertebra (sector 5) and the marginal vertebrae (sector 2 and sector 6). The L1 vertebra was used as control (sector 1). Variations in each value were analyzed by means of the t-test for paired data. Significance was set at P < 0.05.

Results: For the hyperkyphotic curve: Parameters in all the kyphotic vertebrae show a significant reduction in the wedging angle ALFA (P < 0.01) and in the posterior wall inclination APOS (P < 0.0002). There was no significant variation in the anterior wall inclination. In sector 2: the posterior wall inclination decreased by about 50% in value (P < 0.02). In sector 3: the variation in values was not significant. In sector 4: at the apex vertebra level, body wedging decreased by 50% after treatment (P < 0.004). In sector 5: the posterior wall inclination decreased (P < 0.009). In sector 6: the posterior wall inclination recorded a significant decrease of about 2° (P < 0.001).

Conclusion: The analysis of results shows that additional parameters, particularly the anterior and posterior wall tilt that express the magnitude of trapezoidal deformation, may account for the response of vertebral geometry to conservative treatment in thoracic Scheuermann's kyphosis. Radiographic assessment of treatment outcome should therefore encompass both the traditional measures of curve and cuneization magnitude and the anterior and posterior vertebral wall tilt changes.

O20
The use of axial loaded MRI in place of radiographs for surveillance of Adolescent Idiopathic Scoliosis: one practice's experience and recommendations
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Scoliosis 2009, 4(Suppl 2):O20

Background: There have been several recent research studies published suggesting that MRI scans may prove to be a viable alternative to radiographs in the surveillance of curves for patients with AIS. This orthopaedic practice began a prospective study of whether these scans provided reliable curve measurements when compared to traditional radiographs. While enrolling patients in this study and obtaining axial loaded MRI's during regular clinic hours, we were able to gain experience in how to schedule patients, obtain scans efficiently, provide axial loading to simulate gravity during the scan (Figure 1), use MRI images to obtain Cobb angles, and incorporate this all into our regular patient care routine.

Methods: Our experiences are recorded in order to share them and to give recommendations to physicians interested in incorporating these techniques into their scoliosis clinics.

Results and conclusion: Our experience using axial loaded MRI to evaluate scoliosis curves led to a number of important lessons. We found that parents of adolescent patients were very aware of the dangers of repeated spinal radiographs, and were very interested in using a non-radiographic method. They were not overly concerned with the increased cost, and were willing to go through a more inconvenient process to obtain the MRI compared with the ease of obtaining an X-ray in the clinic. The MRI scan was initially about ten times the cost of a radiograph, but after working on a shortened protocol to obtain only a few coronal images on the MRI, we were able to bring the cost of the MRI down so that it was only about two times the cost of a radiograph. Doing an abbreviated MRI during clinic added between 30 and 60 minutes to the patients office visit time.
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Axial Loading Device

Fitting in scoliosis MRI’s between those of regular MRI patients was difficult, and sometimes resulted in increased waiting time for the scoliosis patients. Having the patient stand in the waiting room rather than sit helped alleviate the need to put on the axial loading device for 10 minutes before having the patient enter the MRI scanner [1–5].

References

O21
Treatment of psychological disturbances in scoliosis patients treated with a brace
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Scoliosis 2009, 4(Suppl 2):O21

Background: In spite of a positive attitude towards brace treatment, some scoliosis patients have psychological stress during the initial bracing phase. Even when the curve correction is good, the patient may have a bad clinical outcome because of the psychological stress they have undergone. This situation may result in the psychosomatic illness.

Objective: To study psychological disturbances in patients with scoliosis during their brace treatment.

Materials and methods: We studied the clinical outcomes in 380 consecutive scoliosis patients (age range 10 to 18 years old) treated using a Cheneau brace. Psychological, psychosomatic and psycho-physiological symptoms were analyzed. Psychological therapy included cognitive and expositional therapy, art-therapy and group therapy. The psychological assessment was performed using a questionnaire before and after brace treatment.

Results: Psychological symptoms were found in 79.3% of patients; psychosomatic symptoms were found in 34.1% of patients; and 45.5% of patients had psycho-physiological symptoms. Psychological therapy reduced these symptoms in 73.5% patients.

Conclusion: Psychological and emotional disturbances may impact the clinical outcome in patients with scoliosis treated with a corrective brace. Appropriate treatment of these symptoms allows the symptoms to be reduced, and improves the quality of life and the treatment outcomes.

O22
The necessity to differentiate between thoracic hyperkyphotic curve types based on architecture in order to propose an appropriate treatment strategy
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Scoliosis 2009, 4(Suppl 2):O22

Introduction: Regardless of etiology, a morphologic classification of thoracic hyperkyphosis is needed for health care professionals to treat their patients adequately. Traditionally, thoracic hyperkyphosis has been defined as a kyphosis of more than 50° using the Cobb angle at differing vertebral levels. This radiologic curvature cut-point offers limited understanding of the overall deformity that occurs in the spines of hyperkyphotic patients. For example, hyperkyphosis can be created by different postures in the sagittal plane and can be localized to different regions in the thoracic spine for a given Cobb angle. Recently, ideal geometric, average geometric, and individual optimized geometric sagittal plane curve models for thoracic kyphosis have been presented in the literature. Using these models as a normative starting position of thoracic kyphosis, it may be possible to describe and differentiate types of hyperkyphosis.

Methods: According to our clinical experience and based on the Harrison Sagittal Spinal Model (HSSM), we have chosen to distinguish between at least three (3) major morphologic categories of hyperkyphosis in the general population, plus a fourth one in the geriatric population, which has already been described in depth in the scientific literature. Postural analysis included an analysis of the lumbo-sacral spine/upper limb position relative to the feet, and shoulder/cervical spine position relative to the ribcage, as well as any posterior or anterior position of the ribcage relative to the pelvis and to the shoulders/ribcage.
A new classification system was developed in order to define specific principles of correction with a brace. The classification includes clinical as well as radiological criteria. The main criteria to define specific principles of correction with a brace. The classification includes clinical as well as radiological criteria. The radiological system differentiates five basic types called: imbalanced thoracic (or three curves pattern), true double double (or four curve pattern), balanced thoracic and false double (non 3 non 4), single lumbar and single thoracolumbar. The main criteria are the curve pattern according to SRS terminology, the balance/imbalance at the transitional point and the L4-5 counter-tilting. To test the intra-and inter-observer reliability of the classification, three observers (1 MD, 1 PT and 1 CPO) have measured (and one of them, the MD, re-measured) 51 AP radiographs including all the types.

**Results:** The intra-observer Kappa value was 0.87 (acceptance > 0.70). The inter-observer Kappa values fluctuated from 0.61 to 0.71 with an average of 0.71 (acceptance > 0.70).

**Conclusion:** A specific scoliosis classification system that correlates with brace treatment has been proposed with an acceptable intra- and inter-observer reliability.

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**O23**

A specific scoliosis classification correlating with brace treatment: description and reliability

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**Purpose:** To show the intra- and inter-observer reliability of a scoliosis classification system correlating with brace treatment.

**Background:** Different classification systems have been used mainly correlating with surgical treatment. Few consider brace principles and design.

**Methods:** A new classification system was developed in order to define specific principles of correction with a brace. The classification includes clinical as well as radiological criteria. The radiological system differentiates five basic types called: imbalanced thoracic (or three curves pattern), true double double (or four curve pattern), balanced thoracic and false double (non 3 non 4), single lumbar and single thoracolumbar. The main criteria are the curve pattern according to SRS terminology, the balance/imbalance at the transitional point and the L4-5 counter-tilting. To test the intra-and inter-observer reliability of the classification, three observers (1 MD, 1 PT and 1 CPO) have measured (and one of them, the MD, re-measured) 51 AP radiographs including all the types.

**Results:** The intra-observer Kappa value was 0.87 (acceptance > 0.70). The inter-observer Kappa values fluctuated from 0.61 to 0.71 with an average of 0.71 (acceptance > 0.70).

**Conclusion:** A specific scoliosis classification system that correlates with brace treatment has been proposed with an acceptable intra- and inter-observer reliability.

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**O24**

Establishing a normative database for the sagittal configuration of the spine using an objective three dimensional measurement tool (the MIDAS System)

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**Methods:** One Hundred healthy subjects aged 20-40 years old were recruited. Ethical approval was granted by the Health and Social Care Ethics committee. Instrumentation: A relatively low-cost, portable system, known as the MIDAS system (Middlesbrough Integrated Digital Assessment System) was used with software specifically designed for the assessment of back posture. (Figure 1).

**Procedure:** Data collection involved one tester touching the MIDAS stylus tip to each of the marked spinal points in a standardized order and pressing the foot pedal of the MIDAS to store the position on the computer.

**Results:** The overall mean thoracic Sagittal value was 49.2 (SD 10.55) degrees and the overall mean lumbar value was -44.93(SD 15.57) degrees. The overall sagittal profile of the back demonstrated that overall the left shoulder, scapula and pelvis were rotated forward by a mean of 8.04 mm, 5.9 mm and 0.15 mm respectively over the right side of the back.

**Conclusion:** Our results should provide a normative database for clinicians (physiotherapists, chiropractors, spinal surgeon) who routinely assess back posture. The method we have devised will also provide an evidenced based objective alternative to just “eyeballing” the patient’s posture during clinical evaluation. It is hoped that the MIDAS system can be implemented as a means of quantifying posture in physiotherapy departments in the near future.

**Figure 1 (abstract O24)**

Middlesbrough Integrated Digital Assessment System (MIDAS)
- low-cost,
- portable system
- software specifically designed for the assessment of back posture in physiotherapy practice
- Very versatile—could be adapted for the assessment of other joints
O25
Can back shape screening be used to predict the risk of falls in the elderly? An exploratory study investigating the relationship between spinal curvature and postural sway in healthy subjects
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Objectives: The primary objective of this study was to evaluate the relationship between spinal curvature and postural sway in the frontal and sagittal planes in asymptomatic young adults. A secondary objective was to look at this relationship over a time period of 15 minutes.

Background: One in three people over the age of 65 years experiences a fall every year in the UK. A significant factor contributing to the higher risk of falling in the elderly is attributed to an increase in postural sway which is a good indicator of static standing balance. Alterations in back shape with age have also been linked to an increase in postural sway. There is however a scarcity of research that has investigated this relationship. It may be possible to predict those at risk of falling through back shape screening, thereby preventing accidents before they occur.

Methods: Twenty five healthy young adults, ages 20 to 32 years volunteered to take part in this study. Approval was gained from the University of Teesside, Ethics committee. A Microscribe 3DX Digitizer was used to measure spinal curvature and a Kistler Force Plate calculated postural sway values. Each participant stood on the force plate for a period of 15 minutes. Back shape measurements and a 30 second force plate reading were taken simultaneously at the start and again at 15 minutes.

Results: A significant positive correlation was found between Lumbar Lordosis and Anteroposterior Sway measured at the start (r = 0.398, p < 0.05). The change in Mediolateral sway over 15 minutes was also significantly different (p < 0.05). Further, general trends demonstrated that increasing spinal angles in the sagittal plane correlated with increasing anteroposterior sway while increasing spinal angles in the frontal plane correlated with increasing mediolateral sway.

Conclusion: The research demonstrated the possibility of identifying those at risk of falling, from back shape and postural sway values. Those at risk could then be referred to essential balance and falls rehabilitation classes. The authors acknowledge the limitations of this study, and that it was conducted on normal healthy young subjects. A larger sample on elderly patients is required to further evaluate these preliminary results.

O26
Lower limb muscle shortening in structural versus non-structural spinal deformity
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Scoliosis 2009, 4(Suppl 2):O26

Background: Muscle shortening within the lower limbs can be observed in adolescents with either structural or non-structural spinal deformities. Whether or not it is related to the spinal deformity remains unclear. The aim of the study was to evaluate the lower limb muscle shortening in a group of adolescents with structural spinal deformity (idiopathic scoliosis, Scheuermann’s juvenile kyphosis) compared to adolescents with non-structural postural trunk asymmetry. The hypothesis was that structural spinal deformities are related to a specific pattern of muscle shortening.

Materials and methods: Sixty-one adolescents, ages 10 to 17 years, were divided into four groups according to their diagnosis. Nineteen had idiopathic scoliosis with Cobb angles from 25° to 60°, seventeen had idiopathic scoliosis with Cobb angles from 10° to 25°, eight had Scheuermann’s juvenile kyphosis, and seventeen had non-structural postural trunk asymmetries having the Bunnell angle of trunk rotation of 3° or less (therefore, neither scoliotic nor kyphotic structural deformity was present in the last group).

All children were examined by the same observer (first author), using clinical tests to detect muscle shortening within the lower limbs and additionally within the pectoralis major, latissimus dorsi and quadratus lumborum muscles.

Results: The results were recorded as 0 (no shortening) or 1 (presence of muscle shortening).

The results showed a broad spectrum of muscle shortening in each of the four groups. The muscles which were most often shortened comprised: hamstrings, gastrocnemius, soleus, rectus femoris, and hip adductors. The non-shortened groups comprised: pectoralis major, latissimus dorsi, piriformis and quadratus lumborum.

Conclusion: Lower limb muscle shortening seems to be very common both in structural spinal deformities and in non-structural trunk asymmetries (“poor posture”). The initial hypothesis could not be confirmed; no relationship between spinal and limb pathology could be put into evidence. Larger study groups are needed to explore the question why some lower limb muscles undergo shortening in patients with structural spinal deformities and whether this shortening presents a separate therapeutic problem.

O27
Correlation between the sagittal plane in adults and the automatic postural system: a longitudinal study with a 24 month follow-up period
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Scoliosis 2009, 4(Suppl 2):O27

Objectives: The Sagittal Plane is governed by the correct balance of the pelvis. The muscle chains are governed by the exoreceptors. Therefore, newly corrected exoreceptor information brings about a subsequent realignment of the musculoskeletal axis.

Background: Since the early 1980’s a cybernetic concept of governing balance was introduced. In 2005 J. C. De Mauroy, introduced the existence of a strange attractor, and in 2008, A. Fimiani hypothesized the role of the pelvis as the strange attractor of the postural system.
Materials and methods: The research subjects were made up of 68 adults between the ages of 18 and 70, of which 48 were female and 20 were male. The patients underwent only receptor treatment, following the techniques by B. Bricot and by Bourdiol. All patients were checked with X-rays and photographic evidence, measured on the dynamometric platform, and tested with the S. F. McGill Questionnaire. The time of observation was 24 months.

Results: Comparing photographs of the patients’ backs showed that after 24 months all the patients adopted a new posture. From the X-rays it was possible to note only lumbar and dorsal curvature. Two subgroups of patients were individually characterized by age. Group A consisted of 22 people between 40 and 70 years old. Group B consisted of 30 people between 18 and 30 years old. In group A, both the lumbar curvature (p = 0.38) and dorsal curvature (p = 0.067) do not show any significant variation between them. In group B, both lumbar curvature (p = 0.0349) and dorsal curvature (p = 0.0484) show significant variation. An evaluation of lumbar pain demonstrated a significant statistical improvement (p <= 0.000001).

Conclusion: The fundamental problems for the patient are represented by pain and aesthetic deformity. In both cases, observation shows that patients experienced and obtained a significant improvement. Analysis of the X-rays points out that if the skeleton isn’t compromised in any way, it modifies itself following the new muscular equilibrium, even in adults. So we can conclude that correct external stimulation of the automatic postural system influences the position of the body in relation to its surrounding space.

O28 Clinical measurements, radiological and cosmetic improvements in a girl with adolescent idiopathic scoliosis treated with a Schroth rehabilitation program: a single case study

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Scoliosis 2009, 4(Suppl 2):O28

Background: The Scoliosis Intensive Rehabilitation (SIR) program is commonly used as a conservative three dimensional treatment for scoliosis. SIR consists of individualized correction of scoliotic posture and breathing pattern with the help of proprioceptive stimulation and physiotherapeutic methods. Adolescent idiopathic scoliosis (A.I.S.) is a three dimensional deformity of the spine defined as a series of vertebral segments placed in extension, which deflect and axially rotate towards the same side. It represents the combination of torsional regions joined by junctional zones. Established biological risk factors of A.I.S. are growth velocity and potential residual spinal growth assessed by maturity indicators. The following four factors were established as progressive factors that are related to the “vicious cycle concept”:

- asymmetrical loading of the spine;
- vertebral growth modulation;
- c) spine slenderness;
- d) growth potential.

The aim of the current single case study was to demonstrate the significant improvement of Cobb angle, clinical measurements and cosmetics using the SIR treatment.

Methods: A 15 year old girl (menarche age 13.3 years, Tanner Stage 5) was referred for an intensive scoliosis rehabilitation after she refused surgical intervention. The following spinal parameters were measured initially: Thoracic Cobb angle = 52°; Risser Sign = 4; angle of trunk rotation (ATR) = 14°; angle of axial rotation = 22° (Perdriolle); Lumbar lordosis = 24°; thoracic kyphosis = 17° (inclinometer). Using the SIR, the goal of treatment was to facilitate correction of the asymmetric posture and to teach the patient how to maintain the corrected posture during her ADL.

Results: After 6 months of individual SIR treatment, the above measured parameters had changed to the following: the thoracic Cobb angle decreased to 42°; ATR decreased to 10°; angle of axial rotation decreased to15°; lumbar lordosis and Thoracic kyphosis remained almost the same (23° and 16°, respectively). The patient felt comfortable with cosmetic results.

Conclusion: This single case study indicates that SIR can improve Cobb angle, clinical measurements and cosmetic appearance, avoiding an operation in a young girl with a Cobb angle of above 50° degrees and Risser sign of 4. Further studies are surely required for validating this conclusion.

O29 Stabilization of progressive thoracic adolescent idiopathic scoliosis using brace treatment and DoboMed physiotherapy

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Scoliosis 2009, 4(Suppl 2):O29

Background: Conservative management of progressive idiopathic scoliosis, consisting of bracing and physiotherapy, aims to stabilize the curvature during rapid adolescent growth. Prospective study using pre-defined inclusion criteria is a method of objective verification of this treatment.

Goal: The aim of this study was to prospectively evaluate patients with progressive idiopathic scoliosis managed with Cheneau brace and DoboMed physiotherapy.

Materials and methods: Twenty-eight consecutive pre-menarchial girls aged 10 to 14 years (mean 12.6 ± 1.1 years) started a treatment plan for thoracic idiopathic scoliosis, having radiological proof of progression. Eighteen of them had an additional structural lumbar curvature. The Cobb angle revealed a magnitude of 21.0° to 40.0° (mean 30.8° ± 5.5°) in the thoracic curvature and 17.0° to 40.0° (mean 29.1° ± 8.2°) in the lumbar curvature. The Perdriolle angle of axial rotation of the apical vertebra was between 2.0° and 28.0° (mean 8.7° ± 5.6°) in the thoracic curvature and between 4.0° and 30.0° (mean 11.9° ± 8.8°) in the lumbar curvature.

A Cheneau brace was ordered to be worn full-time, accompanied by DoboMed daily physiotherapy. The initiation of treatment took place during a 2 week in-patient stay at the rehabilitation department in order to adjust the brace and teach the patient and the parents the technique of exercises. The Cobb angle was
measured once a year with an out-of-brace standing radiograph. The duration of therapy is now 30 to 68 months, mean 43 ± 9 months. Eleven patients completed therapy.

**Results:** The effective time of daily brace wearing was from 8 to 23 hours (mean 12.9 ± 5.0 hours). At the time of the final radiograph the thoracic Cobb angle was between 17.0° and 53.0° (mean 34.0° ± 9.2°), the lumbar Cobb angle was between 15.0° to 51.0° (mean 29.2° ± 10.4°). Three patients (11%) exceeded the limit of a 50° Cobb angle, and were considered to be surgical patients: two in the thoracic and one in the lumbar curvature. Stabilization of the Perdriolle angle of axial rotation was noted: 0.0° to 28.0° (mean 10.5° ± 7.0°) in the thoracic curvature and 2.0° to 33.0° (mean 13.4° ± 9.2°) in the lumbar curvature.

**Conclusion:** Stabilization of progressive thoracic scoliosis during the period of rapid adolescent growth was achieved in 89% of girls using the brace and specific physiotherapy.

**O30**

**The short-term effects of simultaneous treatment using two different methods of physiotherapy in the treatment of Adolescent Idiopathic Scoliosis: a pilot study**

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Scoliosis 2009, 4(Suppl 2):O30

**Goal:** The assessment of the influence of joint physiotherapy (DoboMed and OTM Kaltenbou - Evjenth) on the function of the respiratory system and the morphology of the ribcage in short-term intensive physiotherapy within the Department of Rehabilitation.

**Materials and methods:** Thirty girls with AIS (mean age = 14.5 y; Cobb angle = range 12-40 degrees) were examined. The group was divided into two randomized subgroups. DoboMed alone was applied in group “D”. DoboMed and manual therapy was applied in the group “DK”.

The physiotherapy was continued for 3 weeks. Using spirometry, the strength of respiratory muscles (maximal inspiratory and expiratory pressures- MIP, MEP) was measured. Kyphosis (plurimeter-V) and the angle of trunk rotation (ATR) in thoracic spine (Bunnell scolometer) were measured twice: once before and once after therapy.

**Results:** The values of MIP and MEP (p < 0.01) were significantly increased in both groups (before and after therapy). The group “DK”, compared to the group “D”, showed significant improvement in forced expiratory volume in one second - FEV1 (p < 0.05), an increase in kyphosis (p < 0.01) and a decrease in ATR (p < 0.05).

**Conclusion:** The use of joint physiotherapeutic methods in the treatment of AIS adds to the functional improvement of the respiratory system and the morphology of the ribcage in a short time.

**O31**

**Efficacy of specific SEAS exercises for adolescent idiopathic scoliosis: end-growth results of a controlled prospective study**

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Scoliosis 2009, 4(Suppl 2):O31

**Objective:** The aim of this paper is the evaluation of end-growth results in three groups of adolescent patients with mild scoliosis treated only with exercises.

**Background:** Systematic reviews on conservative treatment using physical exercise to counteract scoliosis progression have been proven effective. It is still unclear which kind of exercise is most effective; although the higher short term efficacy of SEAS.02 has already been shown in previous research.

**Materials and methods:** A prospective controlled study was done with 38 adolescent idiopathic scoliosis patients (6 male; 32 female, 13.5 +/- 3.5 years of age; Risser 0-3; Cobb Angle > 10°, Bunnel Angle > 5°) who were prescribed only exercises to avoid progression at the time of their first evaluation. All patients were enrolled consecutively. Patient were then divided into three groups: SEAS group treated with specific SEAS exercise, CONTROL group with no treatment and an OTHER group treated with a different protocol.

The outcome criteria were as follows: Percentage (%) of patients who needed bracing; % of patients who improved, were stable, or worsened according to SRS criteria (Cobb Angle change > 5° and Bunnell Angle change > 3°); worst curve mean PRE/POST treatment Cobb degrees (C°); worst curve mean PRE/POST treatment ATR (Bunnell degrees - B°). Statistical analysis was done with ANOVA and chi-squared tests, Table 1.

**Results:**

**Conclusion:** Not all exercises for scoliosis have the same efficacy. This study proves again the efficacy of SEAS.02 when compared to usual care. In an age at risk, the group with the qualitatively better treatment (SEAS) has demonstrated an improvement of mean values. Also, though, the less effective treatment has shown a better stabilization when compared to natural history. In our view, the most important difference is the one in terms of bracing, because when scoliosis is small, the aim of treatment is mainly avoiding more aggressive treatments, with a higher impact on patient’s quality of life.

<table>
<thead>
<tr>
<th>Table 1 (abstract O31)</th>
<th>BRACED</th>
<th>% IMPROVED PATIENTS B°/C°</th>
<th>% STABLE PATIENTS B°/C°</th>
<th>% WORSENED PATIENTS B°/C°</th>
<th>PRE C°</th>
<th>POST C°</th>
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</thead>
<tbody>
<tr>
<td>SEAS</td>
<td>8% (*)</td>
<td>8%-16%</td>
<td>76%-54%</td>
<td>16%-30%</td>
<td>14° ± 4°</td>
<td>13° ± 5°</td>
</tr>
<tr>
<td>CONTROL</td>
<td>55% (*)</td>
<td>9%-9%</td>
<td>36%-36%</td>
<td>55%-55%</td>
<td>13 ± 6°</td>
<td>15 ± 5°</td>
</tr>
<tr>
<td>OTHER</td>
<td>29% (*)</td>
<td>6%-7%</td>
<td>65%-50%</td>
<td>29%-43%</td>
<td>16 ± 2°</td>
<td>14 ± 5°</td>
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</tbody>
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(page number not for citation purposes)
O32
Is in-patient scoliosis rehabilitation clinically effective: a systematic PubMed review
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Scoliosis 2009, 4(Suppl 2):O32

Background: In-patient scoliosis rehabilitation has been assessed in a prospective controlled study. This study is out-of-date as it was performed 1991, when the program lasted 6 weeks on average, and more recently the length of rehabilitation has been significantly reduced. The results of postural changes during this shortened period of treatment are not significant, and the improvement of vital capacity is far from the values that were obtained in 1991. Meanwhile, there is evidence that improvement of health-related measures can be achieved on an out-patient program, and that these more modern programs have similar rates of surgery when compared to the in-patient approach described in the literature.

Goal: The goal of this study was to find evidence for the application of in-patient rehabilitation programs. Types of studies included: clinical evaluation of in-patient rehabilitation (prospective controlled or randomized controlled trials). Meta analyses, due to their typical high standards, have also been included. To attempt to detect the true effects of the treatment, the control group inclusion criteria consisted of patient groups with observation as the only intervention. Only studies better than level III have been taken into account, as these have been shown to be of high quality in health care research. The search strategy for identification of the studies was to use Pub Med and Medline, using key words such as: "in-patient rehabilitation", "prospective controlled study", "in-patient rehabilitation", and "randomized controlled study".

Results: Two papers were found when searching for prospective controlled studies, none were found searching for a randomized, controlled trial. The two papers found were reviews citing the prospective controlled study on scoliosis rehabilitation mentioned above. Discussion: There is no evidence that in-patient scoliosis rehabilitation with reduced rehabilitation times (3-4 weeks) is superior to out-patient rehabilitation. Without a doubt, the psychological effects of in-patient rehabilitation may be an advantage over the outpatient approach, but there is no evidence that, with respect to health related issues, in-patient rehabilitation is superior to out-patient based concepts.

Conclusion: There is no evidence for in-patient rehabilitation in terms of health related issues. To gain the psychological benefits, a two-week program can be considered as being sufficient. There are obvious cost effective advantages of an outpatient program compared to an in-patient program.

O33
A comparative study of the stability ball vs. the desk chair in healthy young adults: sagittal curvature, sitting duration and usability
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Scoliosis 2009, 4(Suppl 2):O33

Objectives: The purpose of this study was to evaluate the effect of seating type on sitting posture through comparison of a modified desk chair and a stability ball in the sagittal plane over a duration of 30 minutes. The usability of the stability ball was assessed through the completion of a purposely designed questionnaire.

Background: Lower back pain affects a significant number of people throughout working life, meaning treatment and prevention are key topics in back care. In recent years the stability ball has increased in popularity as a common tool used in physiotherapy practice. However its uses have been taken out of the gym and into the workplace as an alternative to the traditional desk chair in an attempt to combat back pain through the belief of encouraging a better sitting position.

Method: Twenty eight subjects participated in the study, sourced from the student population of the University of Teesside. Postural information was collected using the Microscribe 3DX Digitiser from Immersion Corp Ltd. (California). A desk chair with the back rest removed was used and categorized as a stable seating type, allowing comparison to the unstable stability ball. Spinal curvature was recorded at the point of initial sitting, and through 10 minute intervals for a total of 30 minutes on each of the seating types. A usability questionnaire was completed by each subject following each sitting trial.

Results: The results showed no significant difference with regard to spinal curvature between seating types (p > 0.05). Initial sitting curvature was found to increase significantly over 30 minutes in both the desk chair and stability ball (p < 0.05). In addition the results of the usability questionnaire showed a significant difference in 3 of the 8 questions (p < 0.05), in favor of the desk chair.

Conclusion: No benefits were found through sitting on a stability ball over that of a desk chair in prolonged sitting as both seating types were found to replicate a poor sitting position through a kyphosed and slumped posture. The clinical implications of this study serve to benefit any healthcare professional considering use of the stability ball as a replacement desk chair.

O34
Efficacy of specific SEAS exercises for hyperkyphosis: end-growth results of a controlled prospective study
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Scoliosis 2009, 4(Suppl 2):O34

Objective: The aim of this prospective controlled study is to present end-growth results of different exercise for Hyperkyphosis.

Background: In the scientific literature there are not available papers on exercise in the treatment of adolescent hyperkyphosis. It is only possible to find papers on exercise to avoid progression of kyphosis and risk of falling in the elderly. Nevertheless, this is a diffuse approach to this pathology especially in Europe and Japan.

Methods: This study design is a controlled prospective study using a population of 40 adolescent outpatients (19 male,
21 female) with hyperkyphosis who were divided into 2 exercise groups and treated with exercise until end-growth. SEAS Groups (18 subjects) were treated with specific SEAS exercises at our centers. The control group (22 subjects) were treated with “classical” exercises at different facilities. The outcome criteria that were evaluated were: the difference in the number of braces prescribed; the mean plumbline distances at C7 and L3; the number of patients who had clinical changes. According to a previous study we considered a clinically significant change one to be at least 10 mm. Statistical analysis was done with Anova, t-test, Chi square.

Results: Three patients in the control group had a brace prescription versus none in the SEAS. No significant statistical differences between pre treatment values were found between the two groups. No significant statistical differences between post treatment values were found between the two groups. Statistically significant Improvement of the plumbline distance after treatment were found in both groups. The number of improved patients was significantly higher in the SEAS Group (p < 0.05) while the number of worsened patients significantly higher in the controls. Conclusion: Physical exercises to improve hyperkyphosis in adolescents are effective. The quality and type of exercises seems to be relevant to reduce brace prescription and to achieve a better result.

O35 An early stage brace wear pattern during daily activities for AIS
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Scoliosis 2009, 4(Suppl 2):O35

Objective: To evaluate changes in compliance including both wear tightness and wear time during early brace treatment for AIS.

Background: The efficacy of brace treatment for children with AIS has been hampered by the lack of comprehensive information about wear characteristics. Our group developed a reliable brace compliance monitoring system to measure and record the temporal profile of the loads on the pressure pad imposed on the trunk during daily living.

Method: The brace compliance monitoring system was used to monitor how new brace subjects used their braces during first 4 months. Six AIS subjects (5 F, 1 M), between 10 and 13 years old (12.3 ± 1.0 years), prescribed TLSO with full time wear (22 hours per day) were monitored starting at the beginning of their brace treatment. The Cobb angles were measured at the initial visit, 4 weeks after the final brace fitting (in-brace) and the first follow-up visit (out-of-brace) approximately 4 months after initiation. The force average relative to the prescribed tightness level (set as 1.0) and the monthly force comparison were reported. The average wear time and monthly wearing pattern were calculated.

Results: The brace monitor logged the data for 4 months without any data loss. The initial, the in-brace and the follow-up Cobb angles were 33 ± 4, 21 ± 3, and 35 ± 5 degrees, respectively. During this study period, the daily force average relative to the prescribed level was 0.97 ± 0.20. The average force from month 1 to 4 was 1.12 ± 0.23, 1.02 ± 0.20, 0.92 ± 0.18, 0.83 ± 0.19, respectively. The average wear time relative to the prescribed time was 56 ± 15%. The monthly wear time from month 1 to 4 were 52 ± 8.6, 54 ± 13, 59 ± 16, 59 ± 21%, respectively. All subjects are still on their brace treatment.

Conclusion: During the first 4 months of brace use, the wear time improves but brace tightness is lower.

O36 Evaluation of conservative scoliosis treatment compliance
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Scoliosis 2009, 4(Suppl 2):O36

Background: The main purpose of this study is to evaluate orthosis treatment compliance of patients affected by adolescent idiopathic scoliosis (AIS).

Methods: We examined 106 patients (96 females, 10 males) affected by AIS. The patients were treated with different types of orthoses (Lionese, Milwaukee, P.A.S.B., Lionese+P.A.S.B., Milwaukee+P.A.S.B., Milwaukee+Lionese). In order to evaluate the compliance and the final results related to the patient’s behavior, we considered the following: the patient’s compliance as related to bracing method, sex, trend of the spine curve, and age; the degree of scoliosis; and the duration of treatment.

Results: Our study indicated a greater number of highly compliant patients (66) than inconsistent (40). For the inconsistent group, 52.5% had not worn the brace for long time (more than 3 months), and the others only wore the brace in the summer or at school. Inside the inconsistent group, 50% had been treated with the Milwaukee brace. It was also noticed that in mixed-brace treatments, the Milwaukee brace raised the percentage of inconsistency. For the compliant group, 47% had been treated only with the P.A.S.B. brace and 6% with a mixed-brace treatment, including P.A.S.B. 28.3% of the patients had ceased the treatment before the scheduled date. Patients who terminated the treatment at an age of more than 17 years had a higher degree of improvement (10.81%) compared with an age lower than 17 years (9.38° Cobb). When the brace was discarded, patients who did not complete the treatment course (more than 50% wore P.A.S.B.) showed a slightly greater improvement than those who completed the treatment.

Conclusion: The study indicated that brace type, patient compliance, and completion of the treatment until skeletal maturity are very important for patient outcome in the improvement of AIS. Patient compliance depends on the orthoses type and not on the sex. The compliance of Milwaukee brace is lower than the P.A.S.B., because the Milwaukee brace is more visible and has the chin support, while the P.A.S.B. fits better and is less visible.
Scoliosis 2009, 4(Suppl 2)  

Treatment incompliance is caused by several factors, including psychological elements and radiologic improvement of the spine curve that the patient mistakenly interprets as full recovery.

O37  
**Correlation between hump dimensions and side deviation in idiopathic scoliosis before and after a conservative treatment**

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**Scoliosis 2009, 4(Suppl 2):O37**

**Background:** The purposes of our study are to verify a potential correlation between hump dimensions and scoliosis curve severity and to evaluate how treatment can influence the main characteristic parameters.

**Methods:** 134 patients (13 males and 121 females) with an average age of 12.83 ± 1.93 years (range 6-18 years) affected by adolescent idiopathic scoliosis (AIS) were treated with bracing until complete skeletal maturity (72 Lionese, 41 P.A.S.B., 4 Milwaukee -13 mixed treatment P.A.S.B. + lionese, 3 Milwaukee+Lionese, 1 P.A.S.B.+Milwaukee). Evaluation of treatment progress took into account two parameters: the hump (clinically measured with a hump-meter) and the Cobb angle (measured by x-rays of whole spine under load). Measurements were taken at the beginning and end of the treatment. Statistical analysis was performed using non-parametrical tests to compare averages and make linear regressions between parameters. The same evaluations were made later, dividing the whole group into 4 sub-groups: patients with lumbar curves (66), thoracic curves (68), patients with age over 14 years (45), and under 13 years (89).

**Results:** Results demonstrated a correlation between hump and curve severity (significance was lower than p = 0.001 at the beginning and end of the treatment). Higher curve severity corresponded to a higher hump dimension. Furthermore, the effect of the orthosis treatment to correct the curve severity and remodel the hump was highlighted. Treatment started with a mean Cobb angle of 29.41° ± 8.53° and ended at 19.29° ± 9.84°. Hump dimensions began with a mean value of 11.61 ± 5.59 mm and ended with a mean value of 6.19 ± 4.61 mm. It was also noticed that the degree of hump correction was greater than the correction of the curve registered in Cobb degrees. In particular, this was more noticeable in thoracic curves and in patients younger than 13 years of age.

**Conclusion:** The hump is the effect of rotation of a scoliosis curve. At the thoracic level, the rib hump is covered and therefore averaged by the scapula, and for this reason, there is a less important correlation between increasing rib hump and increasing spinal deformity. Orthotic treatment of idiopathic scoliosis fixes the spine deformity and is very effective at remodeling the rib hump. This phenomenon is more noticeable when viewing the patient from behind, where the main influence has been on the rib cage.

O38  
**Prediction of curve progression for AIS patients treated with a TLSO Brace**

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**Scoliosis 2009, 4(Suppl 2):O38**

**Objective:** The objective of this study was to develop a curve progression model for patients with AIS receiving brace treatment by considering compliance measures and in-brace correction factors.

**Background:** Bracing is the most commonly used non-surgical treatment for adolescent idiopathic scoliosis (AIS). Prediction of brace treatment outcomes has not been well documented.

**Method:** Twenty subjects (17 females, 3 males), aged 13.4 ± 1.8 years, were prescribed a full-time TLSO (22 hr/day) and were monitored and followed for 3 years. All subjects met the SRS Brace Study inclusion criteria. The brace usage in terms of quantity (percent of wear time relative to the prescribed wear) and quality (percent of wear tightness relative to the prescribed tightness level) was logged with a compliance monitoring system. The Peterson's risk of progression at the time when the brace was prescribed was calculated based on 4 variables: Risser sign, apex of the curve, age, and imbalance. In-brace curve correction (flexibility) was calculated using the following: (Initial Cobb - in-brace Cobb)/Initial Cobb. A predictive model for curve progression using regression was developed based on the Peterson's risk of progression, quality, quantity, and the percentage of in-brace correction. Data from six new subjects who used a monitoring system and were followed for 2 years after bracing was used to assess the validity of the model.

**Results:** The Cobb angles of the subjects pre-brace (n = 9), in-brace (n = 8) and 3 years after weaning (n = 23) were 32, 11, and 35 degrees, respectively. The individual parameters, including Peterson's risk of progression, flexibility, quality, quantity, and quality*quantity, contributed to the curve progression model were 8%, 19%, 15%, 8% and 14%, respectively. Combining all variables, 56% of the variance in curve progression can be predicted. The curve progression model was: curve Progression (in degrees) = 33 + 0.11*Peterson Risk (%) - 0.07 in-brace correction (%) - 0.45*Quality (%) - 0.48*Quantity (%) + 0.62*Quantity*Quality. The results from the 6 new subjects are in table 1. The largest prediction error of the prediction model was 3 degrees.

**Conclusion:** It is possible to predict the curve progression for AIS patients who have brace treatment.

O39  
**The relationship between profit and risk, and the side effects of the orthopaedic treatment**

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**Scoliosis 2009, 4(Suppl 2):O39**

**Background:** The orthopaedic treatment by thermoformed material is often a long treatment process, and although there is not a contraindication in this type of treatment, there are many
known side effects. It is important to present to the patient the framework of the information about the treatment, including the various unwanted effects which he may meet [2, 3].

Results: A Cochrane analysis of existing data on corsets was published in 2008, but only 7 studies on prevention and 8 studies of treatment were analyzed in terms of the effect of this treatment on pain. The conclusions were not made by analysis of data concerning the tolerance or the possible side effects connected to wearing the brace. Biot indeed brings back the history of the orthopaedic treatment Lyonnais which developed in the mid 1950s with Stagnara. He explains the indications and details regarding treatment with plaster for a month followed by a brace for 6 months. He presents the results obtained by various treatment centers. Finally, he describes the following possible complications:

- Rare, but most serious is the cast syndrome which can arise during a circular plaster cast application. It involves a gastric draining by probe before the removal of the brace.
- Pulmonary complications, including a collapsed lung, can be provoked by a cast that is too stiff preservation on a major kyphoscoliosis.
- A possible destabilization of the abdominal internal organs (hernia, cystocele).
- Vasculo-nervous injury can also occur (lower limbs stasis, compression of the femoro-cutaneous nerve).
- Breast injury can occur from casting.
- Cutaneous injuries at pressure points, with erythema, tanning of the skin which can be irreversible, ulceration, bursitis, and finally microbial infections can occur.

Psychological and aesthetic problems also occur.

In this abstract we report the results of over 50 braces worn more than 6 months and we present the side effects reported by the patients.

O40
Long-term outcome after Boston brace treatment in adolescent idiopathic scoliosis
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Scoliosis 2009, 4(Suppl 2):O40

Objectives: The objective of this study was to evaluate the long-term outcome in adolescent idiopathic scoliosis (AIS) 12 years or more after treatment with the Boston brace. 

Background: Few studies have evaluated long-term outcome after bracing by using validated quality of life outcomes.

Materials and methods: 110 (78%) of 140 (7 men) patients with AIS treated with the Boston brace 12-28 years previously responded to a long-term follow-up examination. Patients were evaluated either by clinical and radiological examination (n = 66), postal questionnaire, or telephone interview. All patients answered a standardized questionnaire including demographics, work status, treatment, Oswestry Disability Index (ODI) (100-worst possible), General Function Score (GFS) (100- worst possible), EuroQol (EQ-5D 1 - best possible), EQ-VAS (100- best possible)) and Scoliosis Research Society -22 (SRS-22) (5 - best possible).

Results: The mean magnitude of the pre-treatment major curve was 33.2° (range 20°-52°) (n = 110). Upon ending bracing treatment after an mean of 2.9 years (0.5-9.3 years), and at the last follow-up, a mean of 19.8 years (12 - 28 years) after weaning, the corresponding values were 28.5° (9°-56°) (n = 110), and 34.0° (8°- 87°) (n = 66) respectively. Even if the average progression of the major curve after weaning was 5.5° (-7°-44°), the long time follow-up compared with the pre-treatment value was -0.6° (-21°-36°) (n = 66). The mean age at follow-up was 36 years (29-46 years). Work status was the following: full time (80%), on sick-leave (3%), on rehabilitation (4%), disability pension (4%), homemaker (7%), students (2%), changed job because of back pain (7%). 58% were educated at the university level, 77% were married or living together, 88% had children, 55% had pain in pregnancy. 28% had taken physiotherapy for back pain during the last year, and 12% had visited a doctor. Global back status was excellent or good in 81%. Mean ODI 6.4 (SD 9.8), mean GFS 5.4 (10.5), mean EQ-5D 0.84 (0.2), SRS-pain 4.2 (0.8), SRS-mental health 4.2 (0.7), SRS-self-image 3.9 (0.7), SRS-function 4.1 (0.6), SRS-satisfaction with treatment 3.7 (1.0).

Conclusion: Long-term results were satisfactory in most patients with AIS treated with the Boston brace.

O41
Effectiveness and quality of life of the brace 2000 compared with the Boston brace
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Scoliosis 2009, 4(Suppl 2):O41

Introduction: Currently the effectiveness of brace treatment is being undermined by a lack of patient compliance. Therefore, the brace 2000 has been developed to improve the comfort and acceptance for the individual patient.

Materials and methods: Pressure measurements were performed in 15 patients wearing the gold standard Boston brace and in 10 patients wearing the Brace 2000 in order to understand the efficacy between the two braces. The quality of life was measured by using the SRS 22 and Brace Questionnaire.

Results: Prior to participating the present study, the mean duration of brace treatment was 25.5 months for the Boston brace and 13.9 months for the Brace 2000. In the Boston brace group, the mean primary right thoracic curve was 35.8°, and the mean secondary curve measured 24.1°. The mean corrective force over the lumbar brace pad in standing position was 394 N, and over the thoracic brace pad was 567 N. In the Brace 2000 group, the mean primary right thoracic curve was 30.9°, and the mean secondary curve measured 16.0°. The mean corrective force over the lumbar brace pad in standing position was 404 N, and over the thoracic brace pad it was 567 N.

Conclusion: There is a tendency for the Brace 2000 to apply equal or greater pressure on the patient, but it is associated with a higher reported quality of life compared to the classic Boston brace.

O42
BrAIST: planning and current status of Bracing in Adolescent Idiopathic Scoliosis Trial
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Scoliosis 2009, 4(Suppl 2):O42

The randomized controlled trial has emerged as the gold standard for all clinical research. The combination of randomized assignment
to groups, use of strict inclusion and exclusion criteria, standardized protocols and ad hoc power analysis serve to rule out many threats to the internal validity of research results. Thus, it is the most powerful methodology available to researchers investigating the relative effectiveness of treatments.

To date, there have been only 2 randomized studies examining the effectiveness of bracing for adolescent idiopathic scoliosis. The purpose of this presentation is to discuss the planning and the current status of the Bracing in Adolescent Scoliosis Trial (BrAIST). This five-year, > $5 million project includes 27 healthcare centers, and is funded by the United States National Institutes of Health, the Canadian Institute of Health Research, and the Shriners Hospitals. Additionally, 3 institutions, including the Chinese University of Hong Kong, are participating using internal funding.

The protocol randomizes children with AIS who are at high risk for curve progression to treatment with a thoracolumbosacral orthosis or to clinical monitoring. The study is currently in its second year of recruitment.

BrAIST incorporates several innovations never used in a single study to date:
1) randomization,
2) objective brace dose monitoring,
3) standardized, objective radiographic measurement,
4) comprehensive radiographic, clinical, and psychosocial testing,
5) diversity of participating sites and
6) ad hoc determination of effect size, based on the risk/benefit considerations of potential patients.

Issues to be discussed include
• Ethics - rationale for the ethics of an observation arm
• Protocol development and implementation - endpoints, measures, quality assurance
• Recruitment and randomization - expectations and actuality
• Bracing quality control - independent review of in-brace films
• Patient/family decision-making - impact of information and being offered a choice
• Brace compliance monitoring - reliability/validity of temperature as proxy for dose

O43

Debate on: Bracing in Adolescent Scoliosis Trial (BrAIST) - will the expenditure pay?
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Scoliosis 2009, 4(Suppl 2):O43

Adolescent idiopathic scoliosis has been regarded as a disease of relatively benign character without disastrous effects on the individual's health [1]. Therefore, treatment indications can be primarily regarded as aiming to achieve psychological and cosmetic benefits for the patient [2]. In fact, level II evidence has been established for conservative treatment [3], while there is no evidence of higher level for operative treatment [4], and the real existing risks of surgery have not yet been clearly defined [5–7].

A five-year, > $5 million project is being funded by the United States National Institutes of Health, the Canadian Institute of Health Research, and other international spine centers. Although a randomization protocol can only be scientifically used in standardized and therefore comparable treatments and conditions, this study design has been chosen to follow-up patients with scoliosis. Neither the condition, with a variety of different curve patterns, curve stiffness, and different stages of maturity (even when the data show agreement), nor the braces of different standards and different approaches, can be standardized satisfactorily. Therefore, the RCT is not at all the appropriate protocol for attempting to answer the proposed question. Of course, RCTs offer the highest evidence, but only if the design can be estimated as being appropriate, and for this population it is not.

There is already evidence on a high level for bracing, and to expose the control population of this study to the high risks of surgery, in case the scoliosis progresses to an extent with which the patient cannot comply, seems rather negligent. Even more, when one considers (1) the high risks of surgery [5–7], (2) that there will be no guarantee for improvement of the clinical condition [8], and (3) that health related problems can neither be solved nor prevented by surgical treatment [5, 9], this study from the patient's perspective seems a risky endeavor.

How reliable can a scientific society be regarded, whose members do not believe in a prospective controlled study on bracing they have established themselves [10] and at the same time can go ahead with surgical treatment, which scientifically raises more questions than it can provide answers?

Last but not least, a measure for brace quality was not initially included in the study protocol! So with whatever strict or not strict inclusion criteria, if the subject (brace) investigated in a RCT cannot be clearly defined, the outcome of that study will say one thing: nothing at all!

References
O44
The treatment of adolescent idiopathic scoliosis with Cheneau brace: long term outcome
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Scoliosis 2009, 4(Suppl 2):O44

Aim: The aim of this study is to evaluate our results of the I.S. treatment with Cheneau bracing with a medium follow-up of 4.5 years.

Methods: The inclusion criteria included the following: diagnosis of evolutive idiopathic scoliosis (I.S.), exclusive treatment with the Cheneau brace, at least 30 months of treatment, and a minimum follow up of 20 months. Every patient was studied with anamnesis, clinic exam, and a radiographic examination. The following was obtained from the medical history: age, sex, BMI, type of scoliosis, period of treatment, type or protocol of treatment, time of follow-up, old radiographic collection, and re-evaluation of all curves with the Cobb method. All patients were asked to complete a five-question questionnaire (SRS-22 modified) about treatment satisfaction and to write a commentary about the main difficulties of treatment. At clinic examination, all anatomic findings were evaluated (height and weight, BMI, rib hump, shoulders and trunk asymmetry, etc.). The radiographic film was compared with old exams, evaluated with Cobb angle measurements, and measurements of vertebral rotation.

Results: From the 650 patients called, 152 met the inclusion criteria. 91.5% of the population was female. The middle time of follow up was 56.3 months (range of 20 to 132 months). The middle time of treatment was 56.1 months (range of 31 to 108 months). 40.8% of patients indicated that a parent was afflicted by scoliosis. 78.9% of the population was previously treated with a cast (40.3% utilized only one cast for 3 months). At the end of the treatment, we observed an average initial curve improvement of 23.3% (maximum 45.1%, minimum 28.9%). At follow up, we observed an average improvement of 15% from the beginning of treatment (maximum of improvement 37.2%, maximum of lost of 36.9%).

Conclusion: At the end of treatment we observed an improvement in correction around at 23% (p value < 0.05) from the beginning curves, and after 5 years there was stabilization at approximately 15% (p value < 0.05). Our results demonstrate that conservative treatment with the Cheneau brace is corrective for the treatment of I.S.

O45
Treatment of the congenital scoliosis by Cheneau brace: 2 year follow-up
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Scoliosis 2009, 4(Suppl 2):O45

Background: The treatment of congenital spinal deformities is a real challenge. The modern standard of treatment includes surgical interventions intended to correct or fuse the spine. In some cases, such an approach is impossible because of severe comorbidities. We hypothesized that a Cheneau brace might be effective in young patients with congenital spinal deformity. This paper is a continuation of our previous study.

Objective: The objective of this study was to study Cheneau brace treatment results in patients with congenital spinal deformities during 2-years follow-up.

Materials and methods: We investigated 7 patients with congenital formation failure. 2 patients had wedge vertebra, and 5 patients had hemivertebra. They were treated utilizing the Cheneau brace from 2007 to 2009. The mean age at the beginning of treatment was 5.6 years (range 2-9 years). A full-time regimen was prescribed for all the patients.

Outcome: We observed a significant improvement of Cobb angle, wedge angle, and Cheneau index after 1 year of bracing treatment. After 2 years, radiographic data did not change dramatically, but slightly improved (Table 1).

Conclusion: We conclude that Cheneau brace active correction principles provide correction and control of congenital spinal deformities.

O46
A new RSC brace design to treat single long thoracic scoliosis. Comparison of the in-brace correction in two groups treated with the new and the classical models
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Table 1 (abstract O45) Analyzed data during follow-up

<table>
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<tr>
<th>X-ray data</th>
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<th>Cheneau index</th>
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<td>2 year</td>
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<td>7. MSA Thoracic/Lumbar</td>
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</table>

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(page number not for citation purposes)
Purpose of the study: The purpose of this study was to compare two different scoliosis brace designs in the treatment of a particular curve pattern.

Background: The Chêneau brace is considered one of the standards in the treatment of juvenile and adolescent idiopathic scoliosis. The RSC brace, a Chêneau derivate, uses a specific clinical and radiological classification in order to define the most effective principles of correction. (Figure 1)

Methods: In this case control study, 11 patients with long thoracic curves (imbalanced three-curve pattern or A1 from the Rigo classification) were treated with a specifically designed RSC brace called “three curves brace with open pelvis.” These 11 patients were compared to a control group of 10 patients with the same age and curve magnitude, treated with a classical RSC brace for a three-curve scoliosis pattern. Patients with a combined upper thoracic structural curve were not included in any of the groups. The mean age was 10.5 years, mean Cobb angle was 29.5°, and mean axial rotation was 15°. The compared values were the in-brace correction of the Cobb angle and the axial rotation.

Results: The in-brace correction of the Cobb angle was 76.7% in the study group compared to 43.3% in the control group (p < .005). The in-brace correction of the axial rotation was 55.9% in the study group compared to 29.9% in the control group.

Conclusion: In-brace correction of the Cobb angle and axial rotation can be improved in patients with long thoracic curves treated with a recently described brace design (“three curves brace with open pelvis”) in comparison with the classic RSC model for this curve pattern.

O47
Our Lyon Brace with removable neck ring (preliminary study)
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Objectives: The purpose of this study is to present a spinal orthosis to treat High Apex Thoraco-Lumbar Scoliosis (HA-TLS) according to biomechanical criteria. Our orthosis is a Lyon brace modified by a removable elongation neck ring which is easily usable during nighttime, and which maximizes compliance during full-time brace treatment with a brace not visible during the daytime.

Background: HA-TLS is very difficult to correct using other braces except for the Milwaukee brace (MB). Since the introduction of the MB, a major problem has been poor patient compliance due to the perception of the brace as cosmetically unacceptable. The forces applied to the spine by the MB are well illustrated by White-Panjabi (1). According to circadian biological rhythm, a sleeping person R.E.M. has decreased muscular tone, and gravitational loading force on the horizontal spine is absent. Therefore, common sense tells us to strike scoliosis at night with two combined forces: torsional forces provided by the Lyon brace plus very important elongation forces provided by the neck ring.

Methods and results: Inclusion criteria were as follows: girls, idiopathic scoliosis with apex curves cephalic to T8, growing age (10-14 years), Cobb angle of minimum 25° and maximum 45°. The Risser sign value was less than 3. The group consisted of 32 girls wearing our brace for more than 3 months, with a minimum time of wearing of 21 hours per day and using the neck ring at night. The braces were all made in the same workshop, and the treatment was managed by the same physician (2).

Conclusion: HA-TLS represents a significant challenge for the physician. The neck ring makes the MB brace cosmetically unacceptable to many patients. Bracing is useless without compliance (3). During growth, we believe that the psychological factor is very important, helping to obtain early improvement of compliance and a positive body image in all patients. Our orthosis has a very minor effect on the quality of life and represents an alternative brace to treat HA-TLS in adolescents.
The combination of the two has never been presented in a study until now.

**Methods:** In this retrospective study, the population included all AIS patients meeting the SRS inclusion criteria (age 10 years or older, Risser test 0-2, Cobb degrees 25-40°, no prior treatment, less than 1 year post menarche) that reached the end of treatment since our database started in 2003. We had 44 females and 4 males, average age at the start of 12.8 years ± 1.6 years. According to individual needs, 2 patients were treated with Risser casts followed by Lyon brace, 40 with Lyon or Sforzescu braces (14 for 23 hours per day, 23 for 21 hours per day, and 7 for 18 hours per day), and 2 with exercises only. Outcome criteria included the following: SRS (unchanged; worsened over 6°; over 45° at the end of treatment; surgically treated; 2 years follow-up); clinical (ATR, hump, Aesthetic Index, plumbline distances); radiographic (Cobb degrees); and ISICO (optimum; minimum). ANOVA and chi-test were used for statistical analysis.

**Results:** The reported compliance during the 4.2 ± 1.4 treatment years was 90.9% ± 17.6%. No patients progressed over 45°, no one was fused, and this remained true at the 2 years follow-up for the 50% that reached it. Worst and average curves progressed in 4%, while 8%, 11% and 6% progressed in thoracic, thoracolumbar, and lumbar curves respectively. We found highly statistically significant reductions of maximal (-7.0°), average (-5.6°), thoracic (-4.2°), and lumbar (-6.7°) curves. Statistically significant improvements were also found for Aesthetics and ATR, but plumbline distances diminished. Clinically, less than 10% of patients worsened for all parameters (exceptions: lumbar ATR and hump), while improvements were very common. According to ISICO criteria, 88% of patients had minimum and 65% optimal results.

**Conclusion:** Respecting SOSORT criteria, the results of conservative treatment was much better than what was previously reported in the literature using the SRS criteria.

**O49 Efficacy of bracing immediately after the end of growth: final results of a retrospective case series**

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Scoliosis 2009, 4(Suppl 2):O49

**Objectives:** The objective of this study was to verify the efficacy of bracing for adolescent idiopathic scoliosis (AIS) after the end of growth (Risser 4 and 5, until 20 years of age).

**Background:** It is widely thought that bracing after skeletal maturity is useless; even though some results we previously published point to a different hypothesis. According to our experience and some old masters proposals (Stagnara, Sibilla), in these cases we propose bracing for aesthetic reasons and in worst cases, for a possible curve reduction.

**Methods:** In this retrospective study, the population included all AIS patients with Risser 4-5 at start that reached the end of treatment since our database started in 2003. We had 23 females and 2 males, average age of 16.5 ± 1.6 years, and an average Cobb angle measurement of 27.4° ± 8.4°. Patients received bracing treatment with Lyon or Sforzescu braces for 18 to 24 hours per day, in addition to specific exercises, respecting SOSORT criteria, with a rapid weaning (2-3 hours every 6 months).

Outcome criteria included the following parameters: SRS (unchanged; worsened over 6°; over 45° at the end of treatment; surgically treated; 2 years follow-up); clinical (ATR, hump, Aesthetic Index, plumbline distances); radiographic (Cobb degrees); and ISICO (optimum; minimum). ANOVA and chi-test were used for data analysis.

**Results:** The reported compliance during the 2.6 ± 0.6 treatment years was 95.1 ± 7.8%, while residual growth was 0.9 ± 1.1 cm. No patients progressed over 45°, no one was fused, and this remained true at the 2 years follow-up for the 25% that reached it. Improvements were found in 48% and 36% of worst and average curves, and in 45%, 58% and 36% of Thoracic, Thoracolumbar and Lumbar curves respectively. We found highly statistically significant reductions of maximal (-4.4°), average (-4.2°), thoracic (-6.0°) and thoracolumbar (-6.6°) curves. Statistically significant improvements were found for Aesthetic Index, but not for ATR or plumbline distances. Clinically, 30% of patients improved over the measurement error for Aesthetic Index. According to ISICO criteria, 50% of patients had minimum and 35% optimal results.

**Conclusion:** Before 20 years of age, even in skeletally mature patients, it is possible to reach radiographic and aesthetic improvements, although not as good as during growth. Correction is based on bone growth, but ligaments and neuromuscular control of posture can also be involved.

**O50 Efficacy of bracing in worst cases (over 45°): end-growth results of a retrospective case series**

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Scoliosis 2009, 4(Suppl 2):O50

**Objectives:** The objective of this study was to verify the efficacy of bracing for adolescent idiopathic scoliosis (AIS) in the worst cases (over 45°) refusing surgery.

**Background:** 45°-50° curves are considered surgical, but not all patients want to face surgery, and a treatment should be warranted to help them avoid fusion. The efficacy of bracing in this degree of curve is generally considered poor, but our experience seems to point to a different conclusion which needs verification.

**Methods:** In this retrospective study, the population included all AIS patients with at least one 45° degree curve at first evaluation that reached the end of treatment since our database started in 2003. We had 14 females and 2 males. 6 had a previous, failed brace treatment. At the start of their treatment, the mean age was 14.1 ± 1.7 years, and the mean Cobb angle measurement was 49.4° ± 4.3° (range 45°-58°). Patients received full time treatment (23 or 24 hours per day) for one year with a Risser cast (11) or a Sforzescu brace (5) respecting SOSORT criteria, in addition to specific exercises. Outcome criteria included the following: SRS (unchanged; worsened over 6°; over 45° at the end of treatment; surgically treated; 2 years follow-up); clinical (ATR, hump, Aesthetic Index, plumbline distances); radiographic (Cobb degrees); and ISICO (optimum; minimum). ANOVA and chi-test were used in data analysis.

**Results:** The reported compliance in the 4.5 ± 1.6 treatment years was 90.5 ± 15.5%. At the end, 5 patients (31%) were still...
measuring over a 45° Cobb angle (range 32°-50°). No one was fused, and this remained true at the 2 years follow-up for the 50% that reached it. Improvements were found in 69% and 56% of worst and average curves, and in 56% and 80% of Thoracic and Lumbar curves respectively. We found highly statistically significant reductions of maximal (-8.6°), average (-4.8°), thoracic (-6.0°) and lumbar (-10.2°) curves. Statistically significant improvements were found for Aesthetic Index and Thoracic ATR, with a decrease of plumbline distances. According to ISICO criteria, 75% of patients had minimum and 63% optimal results.

Conclusion: Curves over 45° represent a challenge for physicians and patients that can be faced with high efficacy braces, good methodology (SOSORT criteria), dedication, and compliance (high motivation that can come from a decision or hope to avoid surgery). In these optimal situations, according to this retrospective study, surgery can be avoided in some cases.

O51
Initial results of SpineCor treatment of Adolescent Idiopathic Scoliosis in Seville, Spain
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Scoliosis 2009, 4(Suppl 2):O51

Objective: The objective of this study was to determine the effectiveness of the SpineCor brace in patients with adolescent idiopathic scoliosis treated in Seville, Spain.

Background: The SpineCor brace is used at St. Justine Children’s Hospital in Montreal. Their results claim that SpineCor is an effective treatment for AIS. We chose to study the effect of this brace on our patients and see if it was similar to the Montreal results.

Methods: Thirty seven patients were treated using the SpineCor Brace in Seville. Of the 37, 33 patients met criteria of the SpineCororporation international multicenter study treatment protocol. These patients were still under treatment and had not yet achieved a definitive outcome (two years follow-up post brace treatment). The girls were premenarchal or less than 1 year postmenarchal. Effectiveness was looked at using the following parameters: (1) a percentage of patients with an initial Cobb angle reduction of 5 degrees or greater; (2) percentage of patients with an initial Cobb angle increase or decrease of less than 5 degrees; (3) percentage of patients with an initial Cobb increase of 5 degrees or greater; (4) the number of cases progressing to require surgery or undergone surgery.

Results: At the end of the first year, successful treatment (correction > 5 degrees, or stabilization +/- 5 degrees) was achieved in 32 of the 33 patients studied from the time of fitting of the SpineCor Brace to the point at which that last Cobb angle was measured during bracing. This meant an overall correction and stabilization for 97% of the patients in Seville, Spain during their first year of treatment. 1 out of 33 patients (3%) had curve progression of more than 5 degrees and underwent surgery.

Conclusion: The SpineCor Brace is a potentially effective treatment for adolescent idiopathic scoliosis. We need to continue our study over a longer period until patients achieve a definitive result. However, these initial results seem promising and are similar to the initial results originally achieved at St. Justine Children’s Hospital.

O52
The treatment of adult scoliosis utilizing the SpineCor Dynamic Corrective Brace
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Scoliosis 2009, 4(Suppl 2):O52

Introduction: Scoliosis and spinal deformities offer little hope for rehabilitation in the adult population. Pain and visceral somatic dysfunction are frequently encountered, and conventional medical care uses rigid bracing, medication and surgery in the most serious cases. The treatment of adult scoliosis with The SpineCor® Dynamic Corrective Brace deserves more attention. It offers a great variety of combinations to improve spinal alignment and posture, and depending on the curve type, its severity and rigidity. The main therapeutic goal is to reduce pain and the strain on the neuromusculoskeletal system. The brace acts as a dynamic support against compressive loading on the inter-vertebral joints, while creating a corrective movement in the spine which produces neuromuscular integration.

Methods: Seventy three adult scoliosis patients, 63 females and 10 males (ages between 18 and 93 years), with Cobb angles of 15° to 93° and curves of all types and many different etiologies, were fitted with a SpineCor® Brace.

Results: Of the 65 who have actively been wearing the SpineCor® Brace between 10 to 154 hrs/week, 29 have seen complete resolution of their symptoms while in the brace, 14 of which originally had a Numerical Pain Scale (NPS) of 5/10 and over. Although the brace had little effect on the curve itself, especially in older patients, and while there has been 1 reported case of aggravation in leg radiculopathy, we found an overall 60% improvement in the pain status of these patients who have been actively wearing their brace.

Discussion: These results suggest that the SpineCor® Dynamic Corrective Brace is a promising conservative method for the treatment of scoliosis in the adult population, as it improves the pain status and wellbeing of patients.

O53
New results for 495 patients with adolescent idiopathic scoliosis treated with the SpineCor brace
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Scoliosis 2009, 4(Suppl 2):O53

Objective: The purpose of this prospective interventional study was to confirm the effectiveness of SpineCor treatment for patients with adolescent idiopathic scoliosis and to demonstrate the stability of the spine after the end of the brace treatment.

Study design: From 1993 to 2009, 840 AIS patients were treated using the SpineCor brace. 495 fitted patients had a definitive outcome, and 405 patients finished the treatment with the SpineCor brace. 225 patients had a follow-up period of at least 2 years, and 94 patients had 5 years or more of follow-up.
The assessment of brace effectiveness included the following: percentage of patients who had a 5° or less curve progression and the percentage of patients who had 6° or more progression; percentage of patients who have been recommended for or have undergone surgery before skeletal maturity; percentage of patients with curves exceeding 45° at maturity (end of treatment); 2-years follow-up beyond maturity to determine the percentage of patients who subsequently underwent surgery; percentage of patients that corrected or stabilized their Cobb angle 5 years after the weaning point.

**Results**: As demonstrated before, the SpineCor brace does alter the natural history of adolescent idiopathic scoliosis. This study showed that 71.2% of patients (353 out of 495) corrected or stabilized their initial Cobb angle, and only 52 patients (10.5%) had 6° or more progression of their initial Cobb angle without an indication for surgery. 74 immature patients out of 495 (14.9%) required surgical fusion while receiving treatment. Only 16 patients (3.2%) withdrew from the treatment.

**Conclusion**: The SpineCor brace is effective for the treatment of adolescent idiopathic scoliosis. The positive outcomes are maintained even after weaning of the brace. Moreover, one third of the patients still maintained their Cobb angle correction in the five-year period after the end of the treatment.

**O54**

**Effectiveness of the SpineCor brace based on the standardized criteria proposed by the S.R.S. for adolescent idiopathic scoliosis - up to date results**

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Scoliosis 2009, 4(Suppl 2):O54

**Objective**: The objective of this study was to verify the effectiveness of the Dynamic SpineCor brace for adolescent idiopathic scoliosis and to confirm the stability of the results two years after the end of the treatment.

**Study design**: From 1993 to 2009, 840 patients were treated using the SpineCor brace. 413 patients fitted the inclusion criteria recommended by the SRS committee, and 159 patients were still actively being treated. Ultimately, 254 patients had a definitive outcome. The assessment of brace effectiveness included the following: percentage of patients who had a 5° or less curve progression and the percentage of patients who had 6° or more progression; percentage of patients who have been recommended for or have undergone surgery before skeletal maturity; percentage of patients with curves exceeding 45° at maturity (end of treatment); 2-years follow-up beyond maturity to determine the percentage of patients who subsequently underwent surgery.

**Results**: Successful treatment (correction > 5° or stabilization ± 5°) was achieved in 165 patients of the 254 patients (64.9%) from the time of the fitting of the SpineCor brace to the point in which it was discontinued. 46 immature patients (18.1%) required surgical fusion while receiving treatment. Two patients out of 254 (0.7%) had curves exceeding 45° at maturity.

**Conclusion**: The SpineCor brace is effective for the treatment of adolescent idiopathic scoliosis. Positive outcomes are maintained after the weaning of the brace, as 99 patients out of 106 (93.3%) stabilized or corrected their Cobb angle. Moreover, out of the 93.3%, 12.3% of the patients still maintained their Cobb angle correction 2 years after the end of the treatment.

**O55**

**SpineCor treatment for adolescent idiopathic scoliosis - 5 years follow-up after weaning of the brace**

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**Objective**: Knowing that any apparent correction of a scoliosis curve that occurs during rigid brace treatment for adolescent idiopathic scoliosis (AIS) can be expected to be lost over time, the purpose of this prospective interventional study was to evaluate the stability of the spine 5 years after the weaning point of the SpineCor brace.

**Study design**: From 1993 to 2009, 840 patients were treated for AIS using the SpineCor brace. 495 fitted patients had a definitive outcome, and 405 patients finished the treatment with the SpineCor brace. 94 patients had at least 5 years of follow-up. The assessment of brace effectiveness included the following: percentage of patients who had a 5° or less curve progression and the percentage of patients who had 6° or more progression; percentage of patients who have been recommended for or have undergone surgery before skeletal maturity; percentage of patients with curves exceeding 45° at maturity (end of treatment); 2-years follow-up beyond maturity to determine the percentage of patients who subsequently underwent surgery; percentage of patients that corrected or stabilized their Cobb angle 5 years after the weaning point.

**Results**: Looking at the stability of the curves after the end of the treatment, 29% of the patients still continued their correction after the weaning point, 63.5% remained stable, and only 7.5% progressed by more than 5° (4.3% of them had a surgery recommendation after the weaning point).

**Conclusion**: The SpineCor brace is effective for the treatment of adolescent idiopathic scoliosis. Positive outcomes are maintained 5 years after the weaning of the brace. Moreover, one third of the patients still maintained correction of their Cobb angle in the five-year period after the end of the treatment.

**O56**

**The treatment of Hyperkyphosis utilizing the SpineCor® Dynamic Corrective Brace: some preliminary results**

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Scoliosis 2009, 4(Suppl 2):O56

**Introduction**: Hyperkyphosis has long been reported to be associated with many health disorders, both psychological and patho-mechanical. Very few options for the management of this condition are available in medicine, while conservative treatment like chiropractic and physiotherapy can only offer limited
structural rehabilitation. Although originally designed for the treatment of AIS, the SpineCor® Dynamic Brace offers a great variety of options for the treatment of Hyperkyphosis. According to our morphologic classification of hyperkyphotic thoracic curves: Upper Thoracic (UT) (often associated with an anterior thoracic translation relative to pelvis), mid-thoracic (MT) (often associated with hyperlordosis and no significant ribcage translation), and lower thoracic (LT) (often associated with posterior translation of ribcage). Many combinations of brace fittings have been designed for the creation of vectors that create a specific corrective movement for the patient's spine and posture.

Methods: Sixteen adult hyperthoracic kyphotic patients, 12 males and 4 females (aged 19 to 81 years), were fitted with a SpineCor Dynamic Brace according to the morphology of their curves: UT (6 patients), MT (4 patients), and LT (6 patients). Postural comparative evaluation was made with PosturePrint® software which provides a Posture Index, and radiologic measurements were made with a posterior tangent method using segmental angles and then compared to the Harrison Sagittal Spinal Model (HSSM).

Results: The UT group received significant pain relief from 2.4 to 1/10, while their posture index went from 15.3 to 12.2. Pain in the MT group decreased from 3.75 to 2/10, while their posture index was reduced significantly from 17.75 to 12.75. The LT group seemed to benefit the most from the brace, as their overall pain decreased from 5.7 to 2.2/10, although their posture index actually increased slightly from 14.7 to 17.3. Although their overall sagittal balance was better, none of these groups benefited from a significant change in their thoracic lateral curve, as is to be expected in adults.

Discussion: These results suggest that the treatment of adult thoracic hyperkyphosis with the SpineCor® Dynamic brace appears to be promising. It should imperatively be applied to younger patients who have the potential to grow out of their deformity.

O57
Supine fulcrum bending test and in-cast correction of Scheuermann's thoracic kyphosis
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Scoliosis 2009, 4(Suppl 2):O57

Background: Patients with Scheuermann juvenile kyphosis often require conservative management with a series of corrective casts, followed by anti-kyphotic brace. Flexibility of the kyphosis can be assessed during a supine fulcrum bending test.

Objective: The aim of the study was to analyze the radiological flexibility of kyphosis and immediate in-cast correction in a series of patients conservatively treated at our department.

Materials and methods: From 2001 to 2007, eighty-six adolescents were conservatively treated for Scheuermann juvenile kyphosis of thoracic location. Charts of 55 patients, 39 boys and 16 girls, were accessible. The age was from 11 to 18 years, with a mean of 14.6 ± 1.6 years. The location of hyperkyphosis was middle thoracic in most cases, apart from five patients with a thoraco-lumbar location. In 18 patients, a mild non-progressive scoliotic curvature was present; it did not exceed a Cobb angle measurement of 25°. A clinically visible scoliosis concerned 50% of girls and 20% of boys. The scoliosis pattern did not follow any currently used scoliosis classification; the curvature was not harmonious.

On the lateral full cassette standing radiograph, the angle of thoracic kyphosis (T4-T12) and lumbar lordosis (T12-S1) were measured. On the frontal radiograph, the angle of scoliosis was assessed. The flexibility of kyphosis was assessed on a supine fulcrum bending lateral radiograph (Figure 1). The in-cast kyphosis angle was measured on a standing lateral radiograph.

Results: The initial kyphosis angle ranged from 40° to 80° (mean 59.2° ± 9.3°). The lordosis angle ranged from 53° to 96° (mean 76.3° ± 9.3°). The kyphosis angle on supine fulcrum bending test ranged from 13° to 55° (mean 30.4° ± 9.7°). The kyphosis angle in the reclining cast ranged from 22° to 74° (mean 44.3° ± 12.5°). There was no correlation between age and the supine bending correction. There was a correlation between the correction obtained with the supine bending test and the immediate correction in the cast (r = 0.64, p = 0.0012).

Conclusion: The reduction of the kyphosis Cobb angle by supine fulcrum bending was 50% on average, while in the cast in standing position, only half of this correction was maintained.

O58
Lumbar Scheuermann conservative treatment allows a proper vertebral body growth and spinal configuration: a case series
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Scoliosis 2009, 4(Suppl 2):O58

Objectives: The objecting of this study was to verify the efficacy of brace treatment for lumbar Scheuermann disease on radiographic parameters.

Background: Lumbar Scheuermann (LS) is an atypical localization of Scheuermann disease. It has been seldom studied, and little is known about its conservative treatment.
Methods: We retrospectively observed 13 patients with the diagnosis of LS. 7 of them needed bracing because of lumbar kyphosis, while the others were treated only with physical exercises to control pain and prevent deformity. All patients treated with bracing (3 males and 4 females, average age 13.5 years) presented at first observation with back pain, lumbar kyphosis, and a radiographic image of lumbar bone damage typical of Scheuermann disease. 5 of them started treatment with 20 or 23 hours/day of bracing and reached the end of treatment after an average of 2.5 years through a period of progressive brace weaning, and 2 are still in treatment.

Results: The two treatment groups were significantly different at the start. Both treatments produce a fast disappearance of pain. With bracing, a progressive achievement of a proper sagittal outline was achieved, with a good radiographic reconstruction of lumbar vertebral bodies. Distances from plumbline improved, showing a gradual increase of lumbar lordosis. 2 patients are still in treatment, they are now pain free, and clinical and radiographic data suggest an improvement of lumbar kyphosis.

Conclusion: These observations show that bracing can effectively correct LS, allowing proper lumbar vertebral body growth, while exercises can control pain and possible worsening.

O59
Does bracing alter the natural history of Adolescent Idiopathic Scoliosis?
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Scoliosis 2009, 4(Suppl 2):O59

Background: Orthotic treatment of children with AIS is a generally accepted treatment option. Failure of bracing to halt curve progression has been reported in 20% or more of patients, and it is known that some curves in children with AIS will not progress even if untreated. Success and failure rates of brace treatment vary considerably.

Purpose: We reviewed the response to brace treatment in patients who were also analyzed with a DNA-based adolescent idiopathic scoliosis progression test (AIS-PT) and compared this with the natural history of adolescent idiopathic scoliosis without treatment. Our purpose was to document the influence of orthotic care on the outcome at skeletal maturity.

Methods: Medical records and X-rays were reviewed, and DNA was collected with a saliva sample in two cohorts of Caucasian female AIS patients. A risk of progression score was calculated using 53 genetic markers with utility for calculating the risk of AIS curve progression from < 25° to > 40° before skeletal maturity or > 50° at maturity (1-200). Group A (2442 females) had no brace treatment and their outcome at maturity or > 50° at maturity (1-200). Group B (308 females) were brace compliant for more than one year and their curve severity at maturity or surgery was known. Group B (308 females) were brace compliant for more than one year and their curve severity at maturity or surgery was known.

Results: There was little statistical difference in the curves representing risk of progression versus curve severity when the two groups were compared (Figure 1).

Conclusion: In this retrospective study of US Caucasian females, there was no statistically significant difference in the natural history of adolescent idiopathic scoliosis when comparing bracing treatment and no bracing treatment. At best, there was only a modest brace effect. Prospective trials with genotype homogeneity are needed to validate current assumptions about the efficacy of orthotic types and treatment regimens when bracing adolescent idiopathic scoliosis.

O60
Evaluation of a posture tracking system
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Scoliosis 2009, 4(Suppl 2):O60

Objective: The purpose of this study was to examine a portable posture monitoring and training system developed for tracking daily posture information and posture improvement.

Background: Spinal deviations usually refer to abnormal lateral or sagittal curvature that could be the cause or effect of some spinal diseases. The conventional orthotic intervention is to apply passive forces to a patient’s body with an orthosis for supporting and controlling the trunk alignments. However, once the orthosis is removed, such functions cannot be maintained. Therefore, an active posture training approach is proposed for spinal diseases. The conventional orthotic intervention is to apply passive forces to a patient’s body with an orthosis for supporting and controlling the trunk alignments. However, once the orthosis is removed, such functions cannot be maintained. Therefore, an active posture training approach is proposed for suitable clinical cases, as it can keep the trunk in appropriate posture using the patient’s own back muscles, and a long-lasting effect is anticipated.

Materials and methods: A portable posture monitoring system was developed, which consists of 3 inertial sensor modules, a data logging and feedback system, an integrated garment, and software for posture analysis and training. The sensor modules were used for tracking posture change at the thoracic and lumbar regions on the sagittal and coronal planes relative to a neutral position, in terms of curvature alteration measured between adjacent sensor modules. An auto-reset algorithm was designed for minimizing the error due to the
inherent limitations of the inertial sensors. An opto-electronic motion analysis system was used for accuracy comparisons. 

Results: The results showed that inertial sensor modules could provide trunk posture information, and its measurements were found to be comparable to those of the motion analysis system (averaged RMS differences < 4.3° for the sagittal plane and < 3.6° for the coronal plane, correlation coefficient > 0.829 in domain planes of movements during flexion and lateral bending). The system was used to monitor posture changes of 5 healthy human subjects during daily activity over a period of 4 days with different thresholds set for providing an audio-biofeedback signal.

Conclusion: The findings demonstrated the potential of this system in facilitating posture training. It is worthy of further developments, and the ultimate goal is application in occupational health promotion as a prophylactic measure for those jobs with a high risk of back problems as well as a treatment option for the patients with posture deformities or spinal diseases.

O61
In-brace corrections in patients with kyphosis using the kyphologic® brace
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Scoliosis 2009, 4(Suppl 2):O61

Background: Little is known about the in-brace correction effects of braces used for the treatment of kyphosis. While Bradford et al. have found their attempts effective, treating Scheuermann’s kyphosis with Milwaukee braces, they did not report on in-brace corrections. According to White and Panjabi, it seems the appropriate approach is to try to correct a curvature of > 50° with the help of distraction forces; however, patient comfort is largely reduced in the Milwaukee brace. Therefore, in Germany, braces generally prescribed for kyphosis treatment are using transverse correction forces only. Our efforts to reduce brace material have resulted in a special bracing design called Kyphologic® brace.

Aim of this presentation: The objective of this study is to examine possible in-brace corrections which have been achieved with the kyphologic® brace.

Materials and methods: 56 adolescents with the diagnosis of a thoracic Scheuermann’s kyphosis or a thoracic idiopathic kyphosis (22 girls and 34 boys) and an average age of 14 years (12-17 years) were treated with the Kyphologic® brace between 5/07 and 10/08 (Figure 1). The average Stagnara angle was 55.6° (43-80). In-brace correction was recorded and compared to the initial angle with the help of the t-test.

Results: The average Stagnara angle in the brace was 39°. The average in-brace correction was 16.5° (1-40°). The average in-brace correction in percentage of the initial value was 36%. The differences were significant in the t-test (t = 5.31, p < 0.001). There was no correlation between the in-brace correction in percentage and the age of the patient, but there was a high significant correlation between in-brace correction in percentage and the initial Stagnara angle.

Discussion: If we assume that outcome of brace treatment positively correlates with in-brace correction, the treatment should start before the curvature angle exceeds 55°. In scoliosis bracing, an average in-brace correction of > 15° predicts an end result correction. With this Kyphologic® brace, we also achieved > 15° in kyphosis treatment. Therefore, we predict a favorable outcome using this brace type when compliance can be achieved.

Conclusion: An average in-brace correction of > 15° as achieved with the help of the Kyphologic® brace seems to predict a favorable outcome.

O62
The sagittal re-alignment brace in the treatment of chronic low back pain in patients with lumbar kyphosis
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Scoliosis 2009, 4(Suppl 2):O62

Background: For adult scoliosis patients with chronic low back pain, bracing is initially indicated before spinal surgery is considered. Until recently, the effect bracing treatment has on middle to long-term pain reduction has not been reported. Promising results have been documented in the short-term for the application of a sagittal re-alignment brace in patients with spinal deformities and suffering from pain; however mid-term or long-term results are not yet available.

Figure 1 (abstract O61)

Figure 1 (abstract O62)
**Objective:** The objective of this study is to investigate the mid-term effects that sagittal realignment bracing treatment has on pain control.

**Materials and methods:** 65 patients (56 females and 9 males) with chronic low back pain (> 24 months) and the diagnosis of scoliosis or kyphosis were treated with a sagittal realignment brace (physio-logic brace™) between January 2006 and July 2007. All patients had a lumbar kyphosis. The indication for this kind of brace treatment was derived from a positive sagittal re-alignment test (SRT) and the restriction of no successful conservative treatment during the last 24 months (Figure 1). The aim of this intervention was to avoid surgery for chronic low back pain.

**Results:** The average pain intensity on the Roland and Morris VRS (5 steps) before treatment was 3.3 (t1), at the time of brace adjustment 2.7 (t2), and after an average observation time of 18 months 2.0 (t3). The differences were highly significant in the Wilcoxon test.

**Discussion:** Mid-term measurements showed that a significant pain reduction is possible in chronic postural low back pain using a sagittal realignment brace inducing lumbar re-lordosation.

**Conclusion:** The brace action of the sagittal re-alignment brace leads to promising mid-term improvements in patients with chronic low back pain and spinal deformities. Contrary to unspecific orthoses, which after a short period are no longer worn, the sagittal re-alignment brace (physio-logic™ brace) leads to an effective reduction of pain intensity in the mid-term, even in patients who have stopped brace treatment after the initial 6 months of treatment. Therefore, in conservative treatment of chronic low back pain, specific approaches such as the sagittal re-alignment brace should be applied first, before a risky operation is performed.

**O63**

**Compliance and satisfaction of TLI-bracing in kyphotic and scoliotic deformities in relation with intrinsic dynamic aspects**

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Scoliosis 2009, 4(Suppl 2):O63

**Objective:** The objective of this study was to show good compliance and satisfaction in wearing a corrective brace with TLI (Thoracolumbar Lordotic Intervention) technique and highlight the important dynamic parts in this type of treatment.

**Background:** Former rigid non dynamic TLSO braces are known for their troublesome compliance and poor patient satisfaction. Dynamic braces can have good compliance but do not easily reach evident corrections. A solution was found in a short rigid brace with evident dynamic aspects by concentrating forces in a symmetric natural way at the thoracolumbar joint.

**Methods and results:** In a group of 91 adolescents with kyphotic and scoliotic deformities with earlier presented results in radiologic correction, a questionnaire was administered after at least one year (mean 1.6 years) wearing the brace. Bracing alterations were also performed during the times the brace could be adapted towards more corrective lordosis and extension.

**Outcome:** Compliance was estimated by physician and parents and scored poorly in 5.5%, fair in 30.8%, and good in 61% (Unknown 2%). Progressive alterations in shape by adding pads to increase lordosis at the TL joint and bending the sternal support backward were done a mean of 5.1 times by the orthotist. No skin sores were reported. 58.2% and 26.4% were respectively satisfied or very satisfied with the whole treatment course. The ease of brace wearing scored very good in 11%, good in 46.2%, and fair in 25.3%. With respect to overall satisfaction of perceived results, 34.1% were very satisfied, 45.1% were satisfied, 9.9% were neutral, and 6.6% were unsatisfied. Different subgroups were studied and will be presented (Figure 1).

**Conclusion:** TLI braces are accepted very well by children with spinal deformities. Improved radiographic results were not the primary motivation for the compliance, but rather the fact that good compliance was rewarded with gradually improved posture and regained mobility provided by the dynamic philosophy behind the bracing technique.

**O64**

**Bracing different types of adolescent hyperkyphosis: end-growth results of a controlled retrospective study**

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Scoliosis 2009, 4(Suppl 2):O64

**Objectives:** The objective of this study was to verify the efficacy of brace treatment of adolescent hyperkyphosis, idiopathic and due to Scheuermann Disease (SD), using clinical parameters.

**Background:** Adolescent hyperkyphosis, both idiopathic and due to SD, is frequently treated with bracing, but results are scarce, and there are few studies about the use of TLSO.

**Study design:** This retrospective controlled study was conducted on a population of 15 patients diagnosed with hyperkyphosis (10 male and 5 female, average age at diagnosis
Background: Scoliosis is a big problem medically, economically, and socially. The main consequences of osteoporosis are fractures that lead to disability and death in the elderly population. The aim of this prospective study is to evaluate the effectiveness of two models of physiotherapy in a population of in-patients with senile osteoporosis (short-term analysis - 3 weeks).

Materials and methods: Thirty four females with senile osteoporosis, aged 65-84 years, were examined. All patients were divided into two randomized groups. Both groups participated in the same physiotherapy program (antigravity, strengthening, balance, stretching, coordination, circulatory, respiratory, relaxation exercises). The only difference between the two groups was the type of walking training performed on a treadmill; group “F” was instructed to walk forward, and group “B” was instructed to walk backward. Two parameters assessed: the strength of the knee extensor muscles (by tensometry) and correction of thoracic kyphosis (by pluriometer-V).

Results: A statistically significant increase of knee extensor torque was observed. The increase was significantly higher in group B compared to group F, indicating better outcomes with backward walking.

Conclusion: This study supports the use of backward walking in physiotherapy programs for patients with senile osteoporosis, as it leads to greater improvements in knee extensor strength and thoracic kyphosis correction compared to forward walking.
“B” in comparison to group “F”. The correction of thoracic kyphosis was seen in both groups.

**Conclusion:** Using backward walking training in the physiotherapy of female senile osteoporosis patients, a greater increase in the knee extensors torque is appreciated compared with patients who undergo physiotherapy training that employs forward walking. Patients who participated in physiotherapy that included backward walking training experienced significant postural improvements in senile osteoporosis.

**O67**

**Treating adult scoliosis and back pain with the SpineCor Pain Relief Back Brace**

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**Objective:** The main objective of this study was to explore the issues of treating adult scoliosis and pain by conservative means. We present two case studies of different types of adult scoliosis successfully managed with the SpineCor brace.

**Background:** Management of pain in adult scoliosis represents a significant clinical challenge. Both adolescent scoliosis in the adult (ASA) and degenerative de-novo scoliosis (DDS) can cause significant pain. Over recent years, the SpineCor brace has been used by practitioners in the treatment of painful adult scoliosis. To date, SpineCor has been used clinically in adult treatment in hundreds of cases, and the empirical results seem positive.

**Methods and results:** Patient A, a 26 year old female with painful ASA, had pain prior to SpineCor treatment that averaged 7/10 (10 being the worst). Using the SpineCor brace daily for 8 to 12 hours for 3 months, she had a gradual improvement of her pain to an average of 1-2/10. The initial x-ray showed a 32° right thoracic scoliosis. In the SpineCor brace 1 month after fitting, the x-rays showed an improvement of 8° to 24°. Her pain relief (1-2/10) and spinal correction have been maintained for over 2 years by using the SpineCor brace part-time. Patient B, a 47 year old female with a DDS, had pain prior to treatment that averaged 8/10. In the SpineCor brace, she had an immediate relief of her pain to 3/10. The initial X-ray showed a 40° degenerative lumbar scoliosis curve. In the SpineCor brace, x-rays showed an improvement of 7° to 33° in her curve. Her pain relief (0-3/10) and spinal correction have been maintained for over 2 years by using the SpineCor brace daily. Also of note is the improved lateral shift showing "spinal off loading".

**Outcome:** Both patients achieved significant pain reduction over a 2 year period, demonstrating that in these cases, the SpineCor brace has been an effective treatment for pain related to ASA and DDS.

**Conclusion:** Prospective research in a large population is required to determine the overall effectiveness of the SpineCor brace, but early results seem positive.

**O68**

**Repeatability, reliability and concurrent validity of the SRS-22 and EuroQol in patients with Adolescent Idiopathic Scoliosis**

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Scoliosis 2009, 4(Suppl 2):O68

**Objectives:** The objective of this study was to evaluate the repeatability, reliability, internal consistency, and concurrent validity of an adapted Norwegian version of the Scoliosis Research Society 22 questionnaire (SRS-22) and the generic health-related quality of life instrument EuroQol (EQ-5D and EQ-VAS).

**Background:** SRS-22 is widely used for evaluation of health-related quality of life in AIS. Its repeatability, which is essential for use in follow-up studies, and concurrent validity with EuroQol, which can be used for cost-utility analysis, have not yet been assessed.

**Methods:** The forward-backward translation of the English version of the SRS-22 was performed according the guidelines for cross-cultural adaptation of outcome questionnaires. Fifty-seven patients with AIS of various ages and severity of deformity completed questionnaires including SRS-22, EQ-5D, and EQ-VAS twice with a two-week interval. The study was approved by the Regional Ethics Committee for Medical Research in Norway.

**Results:** There were no floor or ceiling effects on the score distributions. The study demonstrated moderate internal consistency and high reliability of the SRS-22 questionnaire, with Chronbach alpha and ICC ranging from 0.76 to 0.93 for the 5 domains. Repeatability was excellent for all domains of SRS-22, with repeatability coefficients < 1. Concurrent validity with EQ-5D was poor to moderate, with Pearson’s r ranging from 0.01 to 0.58. However, total scores of the two instruments showed satisfactory agreement.

**Conclusion:** The SRS-22 outcome instrument has satisfactory repeatability, but the poor to moderate concurrent validity with EQ-5D suggests that the disease specific and the generic questionnaires measure different parameters.

**O69**

**Quality of life of patients with adolescent idiopathic scoliosis undergoing conservative treatment**

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Scoliosis 2009, 4(Suppl 2):O69

**Background:** One of main purposes of treatment of adolescent idiopathic scoliosis is the improvement of patient’s quality of life with respect to not only biological, but also social and psychological aspects. Pain, limitations of movement, medical recommendations, and methods of rehabilitation affect these aspects.

**Aim:** The aim of the study was to assess the quality of life in group of adolescents with idiopathic scoliosis. We obtained knowledge about their main problems with respect to social, emotional and personal aspects of life with consideration of the scoliosis and the method of conservative treatment.
Materials and methods: 69 adolescents, aged 10 to 18 years, were classified into two groups according to the method of treatment. 39 patients underwent Cheneau bracing and physiotherapy with the DoBoMed program, and 30 were treated with physiotherapy only. All children were asked about their social, emotional and biological problems related to their illness and method of treatment. The group being treated with bracing answered a 24-point questionnaire, and the non-braced group answered a 21-point questionnaire. Each question had answer scale from 1 point (never) to 5 points (always).

Results: The Cheneau brace negatively affected adolescent quality of life in social and biological aspects. Most of the patients declared feeling ashamed in a school environment and experienced an uncomfortable sense of heat and pressure. Patients treated by physiotherapy only did not experience negative consequences of their illness and applied treating methods.

Conclusion: Application of Cheneau brace with physiotherapy negatively affects the quality of life of adolescent patients, while patients treated only with physiotherapy do not experience a negative impact on their quality of life. The main problems among patients treated with bracing are feelings of shame and physical discomforted, as well as other minor factors that decrease quality of life.

O70
Does bracing affect the quality of life of the patients with idiopathic scoliosis? Re-analysis of Cobb angle-matched subjects
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Scoliosis 2009, 4(Suppl 2):O70

Background: At the 2008 SOSORT meeting in Athens, we reported that the quality of life (QOL) of the patients treated with Milwaukee brace (MB) was lower than that of the patients treated with under arm brace (UAB) or exercise. However, in that study, there were significant differences in the Cobb angle measurements among the patients in the treatment groups.

Objectives: The aim of this study is to re-analyze the QOL of the patients with idiopathic scoliosis who underwent conservative treatment by comparing Cobb angle-matched treatment groups.

Methods: Female patients with idiopathic scoliosis who underwent conservative treatment for at least one year, whose age was between 14 and 29 years and whose Cobb angle was between 25 and 50 degrees, were included in the study. The response to the Scoliosis Research Society (SRS-22) questionnaire, Oswestry disability index (ODI), and Roland-Morris disability questionnaire (RDQ) were analyzed according to the treatment they received.

Results: Of the 84 included in the analysis, 19 were treated with MB, 37 were treated with Boston type UAB, and 28 were treated with exercise only. Most of the patients wore their brace part-time. The average age of three groups was 17.9, 18.3, and 21.5 years, and the average Cobb angle was 38.8, 37.8, and 36.0 degrees respectively. The average score for the domains of SRS-22 in pain, function, self image, mental health, and satisfaction was respectively 4.5, 4.0, 3.5, 3.9, and 3.4 in the MB group, 4.7, 4.2, 3.5, 4.1, and 3.4 in the UAB group, and 4.6, 4.4, 3.2, 3.8, and 3.6 in exercise group. The score for function domain was significantly lower in the MB group than in the other two groups. There was no difference among the three groups regarding other domains of the SRS-22, ODI and RDQ score.

Conclusion: Brace type was one of the factors that affected the QOL of patients with idiopathic scoliosis.

O71
Surgical treatment for Scheuermann’s juvenile kyphosis: presentation of four cases
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Scoliosis 2009, 4(Suppl 2):O71

Background: Surgical treatment is reported to be rarely necessary for Scheuermann juvenile kyphosis. Significant deformity, thoraco-lumbar location, and back pain are considered indications for surgery.

Objective: The aim of the study is to present the patients surgically treated for Scheuermann juvenile kyphosis during ten years of our department activity.

Methods and materials: Since 1999, 110 patients were admitted for conservative treatment of Scheuermann juvenile kyphosis. The number of out-patient treatments were not accessible. Four patients (4% of hospitalized patients) underwent surgical treatment. The age of surgery was 16, 16, 17, and 18 years respectively. The sagittal thoracic T4-T12 Cobb angle was 80°, 85°, 80°, and 100° respectively. The level was middle thoracic. The reasons for surgery were the following: back pain not alleviated with conservative therapy, and deformity unacceptable for the patient.

The surgery consisted of posterior correction with Cotrel-Dubousset instrumentation and spinal fusion using autologous iliac bone graft. The sagittal Cobb angle was measured before and at surgical follow-up on a standing long cassette lateral spinal radiograph.

Results: The postoperative sagittal Cobb angle was 36°, 42°, 38°, and 70° respectively; the values equivalent to the pre-operative supine fulcrum bending test. There was no loss of correction (5° or more) in the follow-up period in three patients. One patient (patient 2) presented with implant dislodgement at 24 months after surgery, accompanied by deep infection around the instrumentation, requiring removal of implants. In this patient, the correction was lost from 42° to 80° at 5 years follow-up. The clinical result was satisfactory in the three patients but insufficient in one. No patient revealed back pain at follow-up.

Conclusion: During the past 10 years in this department, surgical correction of Scheuermann juvenile kyphosis was performed in 4% of patients; those who presented an unacceptable and painful deformity. Operation resulted in important angular correction equal to a pre-operative supine
bending test. Late postoperative complications caused loss of correction in one patient.

POSTER PRESENTATIONS

P1
New lumbar Lordosing orthosis for degenerative lumbar conditions: clinical and experimental tests
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Scoliosis 2009, 4(Suppl 2):P1

Background: The need to limit discovertebral constraints without restricting the patient's everyday activities during episodes of lumbar pain has led to the production of a standard model brace. The brace's design and functions target sagittal balance through trunk reposition, spinal flexion reduction, and lordosis maintenance without putting pressure on the posterior joints. The 4 clinical and experimental studies presented below confirm the importance of this orthosis.

Clinical test 1 objective: The first objective is to evaluate the effects of wearing a LORDACTIV orthosis during pain experienced by patients suffering from degenerative lumbar conditions.

Methods: 113 patients suffering from lumbar pain were fitted with a corset (56 women and 57 men) with an average age of 42 years, presenting on average with 8 months of persistent lumbar pain or radiculitis (intensity 7.3/10 on the Visual Analog Scale). Simple X-rays and an MRI allowed the following to be distinguished: discopathy (black appearance in T2 for discs L4L5 and/or L5S1), 44 cases, average age 38 years; inflammatory disc degeneration (MODIC 1) 21 cases, average age 50 years; disc hernia, 33 cases, average age 42.8 years; spondylolisthesis, 15 cases, average age 44 years. The corset was worn 8 hours per day for 4 weeks, and no sick leave was given. Pain evaluation was assessed with the Visual Analog Scale.

Results: The VAS average result after 4 weeks was 1.5/10, representing a pain reduction of 80%. The patients judged this result 'good' or 'very good' in 78% of cases. Regarding the different conditions studied, the greatest VAS reduction was for spondylolisthesis (7.3), followed by discopathy (6.5), MODIC discopathy (5.2) and finally disc hernias (5).

Conclusion: This study demonstrates the effectiveness of the LORDACTIV orthosis for pain reduction in cases of degenerative lumbar conditions.

Clinical test 2 objective: The second objective is to compare spinal extension and flexion in patients wearing LORDACTIV, a conventional lumbar support belt, and no orthosis.

Methods: Chromatic tests were performed on 39 patients suffering from lumbar pain divided equally between disc herniation (DH), spondylolisthesis by isthmic lysis (SPD), discopathy (DISCO), degenerative discopathy (MODIC 1), and mechanical sacroiliac conditions (SI). Patients wore either the LORDACTIV orthosis or a traditional orthosis. In the experimental procedure, 6 patients suffering from lumbar pain with discopathy (normal or inflammatory) had to stand on a force platform with their eyes closed (hands by their sides) minimizing their movements, with or without an orthosis.

Results: The results show that restriction in spinal column flexion is only significant with lordosis (63% for degenerative lumbar conditions) compared to traditional boned belts, which even facilitate flexion in the case of spondylolisthesis. For patients standing on the platform, the reduction of movement of the center of gravity demonstrates a reduction in body movements in patients wearing the LORDACTIV brace. The correction initiation time is shorter with LORDACTIV (the time lapse from the moment the subject moves away from the reference position before correcting their posture) compared with the flexible belt. This means that patients in the LORDACTIV brace correct disruptions in balance more quickly.

Conclusion: These results show the importance of the LORDACTIV® orthosis in stabilizing the posture of patients suffering from lumbar pain compared to a traditional support belt. The patient’s balance strategy is improved, which could be at the origin of spinal stabilization, passive structure relief (intervertebral discs, ligaments, joints), therefore having an analgesic effect.

P2
Elastic resistance exercises for prevention of trunk deformities - a case study
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Scoliosis 2009, 4(Suppl 2):P2

Background: Some previous studies supported the clinical effectiveness of the Brügger-concept in the treatment of idiopathic scoliosis and showed that treatment can reduce magnitudes of thoracolumbar and lumbar curves. The Brügger-Concept emphasizes self exercises, and it uses alternating concentric and eccentric contraction against elastic resistance.

Objectives: The purpose of this case study was to analyze EMG activity during “Agistic-Eccentric-Contraction-Exercises” with elastic resistance according the Brügger-Concept, with a primary focus on the trunk.

Subjects and methods: The present pilot study is a case report on a single proband. Surface EMG (Noraxon) was recorded on one healthy subject during 3 resistive exercises using Thera-Band (blue color). EMG activity during the agistic-excentric-exercises was analyzed on m. obliquus abdominis int., m. rectus abdominis, m. latissimus dorsi, m. ector spinae TH-L on the right and left side. The EMG activity was analyzed and compared with MVC. Results were examined by exercise for improvement of the function of trunk lateroflexion, rotation, and frontal shift of thorax, and this was documented with EMG-activity in m. latissimus dorsi 4% MVC - 24% MVC, in m. obliquus abs. int. 6% MVC - 73% MVC, in m. ector spinae TH-L 1% MVC - 52% MVC and in m. rectus abdominis 2% MVC - 3% MVC. During the exercises, increases and decreases in EMG activity were seen in analyzed muscles. Detailed results will be described in the presentation.

Conclusion: This pilot study indicates the effectiveness of elastic resistance Brugger-Exercising, which was developed empirically and under support of neurophysiological regulations. Fluent, harmonic motion, provided throughout the whole range of motion, resisted by elastic bands that alternate concentric and
eccentric muscle contractions with decreasing muscle activation, effects agistic-eccentric-contraction-exercises with elastic resistance in accordance with the Brügger theory. The % of MVC that we analyzed are in conformity with general functional training requirements. The exercise that was evaluated with respect to the trunk can therefore be seen as one possibility of how to prevent trunk deformities.

**Acknowledgements**

The study was supported by grant from Czech Ministry of Education, Youth and Physical Education MSM 0021620864.

**P3**

**Spanish validation of Bad Sobernheim Scoliosis Questionnaire for adolescents wearing braces**

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_Scoliosis_ 2009, 4(Suppl 2):P3

**Objectives:** Because of the present interest in health-related quality of life in the scientific community, the aim of our research is to demonstrate the cross-cultural reliability of the German Bad Sobernheim Scoliosis Questionnaire (BSSQ) applied to a Spanish population of adolescents with scoliosis undergoing bracing treatment.

**Background:** Adolescence is considered a critical phase, and adolescent idiopathic scoliosis (AIS) can have a considerably negative impact on a patient's quality of life (Payne, Ogilvie, Resnick, Kane, Transfeldt, Blum, 1997). AIS can also produce psychosocial problems through potentially detrimental effects on body image, and bracing can exacerbate this problem. There are currently two questionnaires designed to measure quality of life in adolescents with scoliosis who are undergoing bracing treatment: the German Bad Sobernheim Stress Questionnaire (BSSQ), and the Greek Brace Questionnaire (BrQ).

**Methods and results:** The method followed the trans-cultural adaptation of the questionnaire through a translation and back-translation, according to the use in the international literature. The translated questionnaire was administered to a Spanish sample consisting of 35 adolescents, aged between 10 and 16 years, with scoliosis being treated with the same bracing treatment (Rigo System Chêneau Brace). The SRS-22 and a socio-demographics data questionnaire were also used. For the statistical analysis, reliability and validity were calculated on SPSS 16.0:

- reliability: - test-retest method with a Pearson correlation coefficient of 0.902 (p < 0.01); - internal consistency, with a Cronbach’s alpha of 0.809.
- validity: -criterion validity, using SRS-22 as criterion, Pearson correlation coefficient of 0.656 (p < 0.01); -construct validity, in an exploratory Factorial Analysis: two Main Components are found to explicate the variance at 60.8%.

**Conclusion:** The BSSQ is reliable with a satisfactory internal consistency and temporal stability. It has sufficient criterion validity and a latent structure of two components according to the main components analysis. The questionnaire can be reliably used to assess quality of life among Spanish adolescents receiving bracing treatment for scoliosis. The good statistical features in the Spanish population are similar to those of the German population. In a future research, a hope is to increase the sample size, incorporate different types of braces, and clarify the structure of the questionnaire.

**P4**

The pelvis: “Strange attractor” of the postural system. A study based on a group of 332 children between 2 and 12 years old

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_Scoliosis_ 2009, 4(Suppl 2):P4

**Objectives:** The aim of this work is to show that the pelvis represents the focal point of the postural system, or rather, the link between muscular and skeletal systems. The pelvis is the seat of insertion of lower extremity and trunk musculature, and these muscles are controlled by the postural system. The afferent postural information relayed by this musculature conditions the spatial order of the musculoskeletal system, so that correct afferent conditioning leads to proper musculoskeletal-orientation aligned with the center of gravity.

**Background:** Theories about postural systems were born during the 1970’s, and they are mainly represented by the Fine Postural System by P. M. Gagey and the Tonic Postural System by B. Bricot. Moreover, in 2005 J. C. de Mauroy hypothesized the existence of a “strange attractor” that provides a foundation for the vertebral curvature of a child's spine. Ontogenesis has shown that the pelvis takes on the role of body stabilizer in the space as the human body becomes vertically oriented.

**Materials and methods:** During 5 years, 332 children were observed, ages 2 to 12 years old. In this population, 210 children started receptorial therapy for a period of 24 months. 182 patients showed at the first visit an AP and lateral full-spine X-ray. During the first visit and at three months intervals, children were imaged in the frontal (anterior, posterior) and sagittal planes, in standard position with plantar support with an angle of 30 degrees.

**Outcome:** Clinical evidence shows that in 12 months, the pelvis realigns, with a subsequent re-established balance of the legs. In 33 patients with scoliosis and dorsolumbar deviation (Cobb angle between 10 and 18 degrees), a significant improvement was shown at 12 months (p = 0.0005; r = 0.708). In 29 patients with a Risser score of zero and dorsolumbar deviation (Cobb angle between 10 and 30 degrees and vertebral rotation between 5 and 15 degrees), a significant improvement of curves was shown at 24 months.

**Conclusion:** The pelvis is the focal point, the “strange attractor,” of the musculoskeletal system, it is managed by the automatic postural system, and an automatic postural component exists even in idiopathic scoliosis.