

Dr Rigo papers

X. (ordinal number). **Title.** **Authors** (surname and first letter of the name without the dot for example Rigo M, Karavidas N). **Journal, vol, issue, pages, date of publication. Abstract.**

1. Retrospective results in mmature idiopathic scoliotic patients treated with a Chêneau brace.

Rigo M, Quera-Salvá G, Puigdevall N, Martínez M.

Stud Health Technol Inform. 2002;88:241-5 Published: 2002

This paper reports a retrospective series which includes 105 idiopathic scoliotic patients treated with a Chêneau brace. With an average age of 12.5 years old and a mean Risser sign of 0.9, the initial major Cobb angle was 36.8 degrees corrected to 25.9 degrees in the brace (31.1% of the primary correction), and the major torsion angle was 16.8 degrees corrected to 12.9 degrees in the brace (22.2% of the primary correction). 37 patients have finished the treatment with a mean follow-up of 16.8 months. For this group, the initial Cobb and torsion angles were not significantly changed (36.4 degrees Cobb to 34.1 degrees Cobb at follow-up, and 16.9 degrees Perdriolle to 15.7 degrees Perdriolle at follow-up). The proportion of patients without progression greater than 5 degrees Cobb (n=20) and with an improved final Cobb angle (n=10) was greater than failures (n=7). However, due to the catastrophic nature of some progressions which generally coincide with a high Cobb angle right from the start, with low primary correction, and with non-compliance, the final Cobb angle showed a slight tendency to decrease but without reaching high significance. These preliminary results demonstrate that the Chêneau brace can effectively prevent the progression of Cobb and torsion angles, even in cases of bad prognosis

2. Effect of conservative management on the prevalence of surgery in patients with adolescent idiopathic scoliosis.

Rigo M, Reiter Ch, Weiss HR.

Pediatr Rehabil. 2003 Jul-Dec;6(3-4):209-14 Published: 2003

Study design: Retrospective analysis of outcome in terms of prevalence of surgery for adolescent idiopathic scoliosis in patients receiving conservative management. **Objectives:** To determine whether a centre with an active policy of conservative management has fewer patients who

eventually undergo surgery for adolescent idiopathic scoliosis than a centre where the practice is non-intervention. **Background data:** The efficacy of orthoses for the treatment of idiopathic scoliosis was called into question in a recent publication. Because the prevalence of surgery in an untreated group of patients (28.1%) was not significantly different from that in a braced group (22.4%), the authors concluded that bracing appears to make no difference. Based on prior experience, this conclusion is questioned. **Methods:** Since 1991, bracing and physical therapy have been recommended for children with adolescent idiopathic scoliosis at a centre in Barcelona, Spain. The scoliosis database was searched for patients with adolescent idiopathic scoliosis who were at least 15 years of age at last review and who had adequate documentation of the Cobb angle. The prevalence of surgery was compared with that of published data from a centre where the practice is non-intervention. **Results:** From a total of 106 braced cases out of which 97 were followed up, six cases (5.6%) ultimately underwent spinal fusion. A worst case analysis, which assumes that all nine cases that were lost to follow-up had operations, brings the uppermost number of cases that could have undergone spinal fusion to 15 (14.1%). Either percentage is significant statistically when compared to the 28.1% reported surgeries from the centre with the policy of non-intervention. **Conclusions:** If conservative management does reduce the proportion of children with adolescent idiopathic scoliosis that require surgery, it can be said to provide a real and meaningful advantage to both the patients and the community. It is contended that conservative methods of treatment should never be ruled out from scoliosis management, because they can and do offer a viable alternative to those patients who cannot or will not opt for surgical treatment.

3. Radiological and cosmetic improvement 2 years after brace weaning--a case report.

Rigo M

Pediatr Rehabil. 2003 Jul-Dec;6(3-4):195-9 Published 2003

In the early international literature, up to now only very few cases are reported with adolescent idiopathic scoliosis (AIS) and a significant improvement of Cobb angle after conservative management. In the recent literature the possibility of an improvement of Cobb angle at skeletal

maturity after brace treatment is mentioned no more. The application of physiotherapy and braces is widely rejected while the standards of conservative measures differ greatly worldwide. So it seems necessary more than ever to present the possibility of successful conservative measures nowadays. More detailed case reports with long-term follow-up using defined protocols are needed to provide appropriate standards for replication by others. The purpose of this presentation is to demonstrate the possibility of significant improvement of curvature angle and cosmesis after the application of long-term physiotherapy and brace treatment in a girl with a curve of more than 50 degrees where spontaneous resolving is not usual. A pre-menarchial girl (although being Risser 2) with a Cobb angle of 53 degrees was treated by exercises and curve-specific bracing for more than 3 years. Two years after the start of the weaning period, the Cobb angle was 36 degrees with a marked and stable cosmetic improvement at the age of 18 years. This case report shows that conservative treatment can improve both cosmesis and curvature in immature patients with AIS. The results of such treatment is appreciated by the patients because of the significant reduction of the truncal deformity as documented by surface topography.

4. Sagittal configuration of the spine in girls with idiopathic scoliosis: progressing rather than initiating factor.

Rigo M, Quera-Salvá G, Villagrasa M.

Stud Health Technol Inform. 2006;123:90-4 Published: 2006

Thoracic hypokyphosis with increasing axial rotational instability is claimed to be a primary factor for the initiation of Idiopathic Scoliosis (IS) according to some authors. The objective of this study was to compare the sagittal configuration of the spine in two groups of girls with and without scoliosis in order to determine whether thoracic hypokyphosis and/or lumbar hypolordosis are initiating factors for AIS or not. A group of 207 consecutive non-treated girls diagnosed with IS (12.7 y +/- 1.8) measured with the Formetric system were compared to a control group of 45 non-scoliotic girls of the same age (12.4 y +/- 2). The Cobb angle for the whole scoliosis sample was 26 degrees +/- 13.6 and the angle of axial rotation 12.4 degrees +/- 7.7 (Perdriolle). The patient group was divided into subgroups by their Cobb angle ie G1 (5 degrees -19 degrees,

n=79), G2 (20 degrees -34 degrees, n=81), G3 (\leq 35 degrees, n=47). The values of the kyphotic angle and lordotic angle were compared. The kyphotic angle was not significantly different in the patients group (48.7 degrees \pm 9.4) compared to the control group (51.5 degrees \pm 10) while the lordotic angle was slightly but significantly lower in the patient group (39.3 degrees \pm 9.4) than in control (42.3 degrees \pm 8.8); however, the lordotic angle in G1 (40.5 degrees \pm 8.3) was not lower than that of the controls. Non-scoliotic girls and those with a mild scoliotic curve had the same angle of thoracic kyphosis and lumbar lordosis. Both angles tended to decrease in progressive curves. Neither thoracic hypokyphosis or lumbar hypolordosis are considered to be initiating factors for scoliosis but are factors in its progression.

5. Members of the Scientific society On Scoliosis Orthopaedic and Rehabilitation Treatment (SOSORT). Why do we treat adolescent idiopathic scoliosis? What we want to obtain and to avoid for our patients. SOSORT 2005 Consensus paper.

Negrini S, Grivas TB, Kotwicki T, Maruyama T, Rigo M, Weiss HR;

Scoliosis. 2006 Apr 10;1:4. doi: 10.1186/1748-7161-1-4 Published: 2006

Background: Medicine is a scientific art: once science is not clear, choices are made according to individual and collective beliefs that should be better understood. This is particularly true in a field like adolescent idiopathic scoliosis, where currently does not exist definitive scientific evidence on the efficacy either of conservative or of surgical treatments. **Aim of the study:** To verify the philosophical choices on the final outcome of a group of people believing and engaged in a conservative treatment of idiopathic scoliosis. **Methods:** We performed a multifaceted study that included a bibliometric analysis, a questionnaire, and a careful Consensus reaching procedure between experts in the conservative treatment of scoliosis (SOSORT members). **Results:** The Consensus reaching procedure has shown to be useful: answers changed in a statistically significant way, and 9 new outcome criteria were included. The most important final outcomes were considered Aesthetics (100%), Quality of life and Disability (more than 90%), while more than 80% of preferences went to Back Pain, Psychological well-being, Progression in adulthood, Breathing function, Scoliosis Cobb degrees (radiographic lateral flexion), Needs of further treatments in adulthood. **Discussion:** In the

literature prevail outcome criteria driven by the contingent treatment needs or the possibility to have measurement systems (even if it seems that usual clinical and radiographic methods are given much more importance than more complex Disability or Quality of Life instruments).

SOSORT members give importance to a wide range of outcome criteria, in which clinical and radiographic issues have the lowest importance.

Conclusion: We treat our patients for what they need for their future (Breathing function, Needs of further treatments in adulthood, Progression in adulthood), and their present too (Aesthetics, Disability, Quality of life). Technical matters, such as rib hump or radiographic lateral alignment and rotation, but not lateral flexion, are secondary outcomes and only instrumental to previously reported primary outcomes. We advocate a multidimensional, comprehensive evaluation of scoliosis patients, to gather all necessary data for a complete therapeutic approach, that goes beyond x-rays to reach the person and the family.

6. **Indications for conservative management of scoliosis (guidelines)**

SOSORT guideline committee, Weiss HR, Negrini S, Rigo M, Kotwicki T, Hawes MC, Grivas TB, Maruyama T, Landauer F
Scoliosis. 2006 May 8;1:5. Published: 2006

7. **Physical exercises in the treatment of idiopathic scoliosis at risk of brace treatment -- SOSORT consensus paper 2005.**

Weiss HR, Negrini S, Hawes MC, Rigo M, Kotwicki T, Grivas TB, Maruyama T; members of the SOSORT
Scoliosis. 2006 May 11;1:6 Published: 2006

Background: Based on a recognized need for research to examine the premise that nonsurgical approaches can be used effectively to treat signs and symptoms of scoliosis, a scientific society on scoliosis orthopaedic and rehabilitation treatment (SOSORT) was established in Barcelona in 2004. SOSORT has a primary goal of implementing multidisciplinary research to develop quantitative, objective data to address the role of conservative therapies in the treatment of scoliosis. This international working group of clinicians and scientists specializing in treatment of

scoliosis met in Milan, Italy in January 2005. **Methods:** As a baseline for developing a consensus for language and goals for proposed multicenter clinical studies, we developed questionnaires to examine current beliefs, before and after the meeting, regarding (1) the aims of physical exercises; (2) standards of treatment; and (3) the impact of such treatment performed by specialists in the field. **Results:** The responses to the questionnaires show that, in principle, specialists in scoliosis physiotherapy do not disagree and that several features can be regarded, currently, as standard features in the rehabilitation of scoliosis patients. These features include autocorrection in 3D, training in ADL, stabilizing the corrected posture, and patient education.

8. **SOSORT consensus paper on brace action: TLSO biomechanics of correction (investigating the rationale for force vector selection).**

Rigo M, Negrini S, Weiss HR, Grivas TB, Maruyama T, Kotwicki T; SOSORT

Scoliosis. 2006 Jul 20;1:11. Published: 2006

Background: The effectiveness of orthotic treatment continues to be controversial in international medical literature due to differences in the reported results and conclusions of various studies. Heterogeneity of the samples has been suggested as a reason for conflicting results. Besides the obvious theoretical differences between the brace concepts, the variability in the technical factors can also explain the contradictory results between same brace types. This paper will investigate the degree of variability among responses of scoliosis specialists from the Brace Study Ground of the International Society on Scoliosis Orthopedic and Rehabilitation Treatment SOSORT. Ultimately, this information could be a foundation for establishing a consensus and framework for future prospective controlled studies. **Methods:** A preliminary questionnaire on the topic of 'brace action' relative to the theory of three-dimensional scoliosis correction and brace treatment was developed and circulated to specialists interested in the conservative treatment of adolescent idiopathic scoliosis. A particular case was presented (main thoracic curve with minor lumbar). Several key points emerged and were used to develop a second questionnaire which was discussed and full filed after the

SOSORT consensus meeting (Milano, Italy, January 2005). **Results:** Twenty-one questionnaires were completed. The Chêneau brace was the most frequently recommended. The importance of the three point system mechanism was stressed. Options about proper pad placement on the thoracic convexity were divided 50% for the pad reaching or involving the apical vertebra and 50% for the pad acting caudal to the apical vertebra. There was agreement about the direction of the vector force, 85% selecting a 'dorso lateral to ventro medial' direction but about the shape of the pad to produce such a force. Principles related to three-dimensional correction achieved high consensus (80%-85%), but suggested methods of correction were quite diverse. **Conclusion:** This study reveals that among participating SOSORT specialists there continues to be a strongly held and conflicting if not a contentious opinion regarding brace design and treatment. If the goal of a 'treatment consensus' is realistic and achievable, significantly more effort will be required to reconcile these differences.

9. **Radiation-free quantitative assessment of scoliosis: a multi center prospective study.**

Ovadia D, Bar-On E, Fragnière B, Rigo M, Dickman D, Leitner J, Wientroub S, Dubousset J

Eur Spine J. 2007 Jan;16(1):97-105 Published: 2007

Accurate quantitative measurements of the spine are essential for deformity diagnosis and assessment of curve progression. There is much concern related to the multiple exposures to ionizing radiation associated with the Cobb method of radiographic measurement, currently the standard procedure for diagnosis and follow-up of the progression of scoliosis. In addition, the Cobb method relies on 2-D analysis of a 3-D deformity. The aim of this prospective study was to investigate the clinical value of Ortelius800 that provides a radiation-free method for scoliosis assessment in three planes (coronal, sagittal, apical), with simultaneous automatic calculation of the Cobb angle in both coronal and sagittal views. Analysis of the clinical value of the device for assessing spinal deformities was performed on patients with adolescent idiopathic scoliosis, deformity angles ranging from 10 degrees to 48 degrees. Correlation between Cobb angles measured manually on standard erect posteroanterior radiographs and those calculated by Ortelius800 showed an absolute difference between the measurements to be significantly less

than +/- 5 degrees for coronal measurements and significantly less than +/- 6 degrees for sagittal measurements indicating good correlation between the two methods. The measurements from four independent sites and six independent examiners were not significantly different. We found the novel clinical tool to be reliable for following mild and moderate idiopathic curves in both coronal and sagittal planes, without exposing the patient to ionizing radiation. Considering the need for further validation of this new method, any change in treatment protocol should still be based on radiographic control

10. SOSORT consensus paper: school screening for scoliosis. Where are we today?

Grivas TB, Wade MH, Negrini S, O'Brien JP, Maruyama T, Hawes MC, Rigo M, Weiss HR, Kotwicki T, Vasiliadis ES, Sulam LN, Neuhous T.

Scoliosis. 2007 Nov 26;2:17. Published: 2007

This report is the SOSORT Consensus Paper on School Screening for Scoliosis discussed at the 4th International Conference on Conservative Management of Spinal Deformities, presented by SOSORT, on May 2007. The objectives were numerous, 1) the inclusion of the existing information on the issue, 2) the analysis and discussion of the responses by the meeting attendees to the twenty six questions of the questionnaire, 3) the impact of screening on frequency of surgical treatment and of its discontinuation, 4) the reasons why these programs must be continued, 5) the evolving aim of School Screening for Scoliosis and 6) recommendations for improvement of the procedure.

11. Indications for conservative management of scoliosis (SOSORT guidelines).

Weiss HR, Negrini S, Rigo M, Kotwicki T, Hawes MC, Grivas TB, Maruyama T, Landauer F.

Stud Health Technol Inform. 2008;135:164-70 Published: 2008

This guideline has been discussed by the SOSORT guideline committee prior to the SOSORT consensus meeting in Milan, January 2005 and published in its first version on the SOSORT homepage: <http://www.sosort.org/meetings.php>. After the meeting it again has been discussed by the members of the SOSORT guideline committee to establish the final 2005 version submitted to *Scoliosis*, the official Journal of the society, in December 2005. This chapter is a republication from the original paper published in "*Scoliosis*" BioMed journal and it is included in this book due to its high importance

12. Scoliosis intensive out-patient rehabilitation based on Schroth method.

Rigo M, Quera-Salvá G, Villagrana M, Ferrer M, Casas A, Corbella C, Urrutia A, Martínez S, Puigdevall N

Stud Health Technol Inform. 2008;135:208-27 Published: 2008

Conservative management of idiopathic scoliosis (IS) and other spinal deformities is a real alternative to surgical treatment. Most of adolescent with IS can be managed conservatively with high safety. Many infantile and juvenile cases show also a good immediate response to conservative care, which can be considered a sign of good prognosis. Only patients showing a continue deterioration even treated conservatively with efficient techniques should be considered candidates to surgical correction and stabilization. Rehabilitation (including specific exercises) and bracing are usually involved in conservative care of IS. In this paper we describe our personal approach in conservative scoliosis care regarding rehabilitation. Bracing has been described in a different paper also published in the present book. Specific exercises can change the signs and symptoms in scoliosis patients. Specialists in physiotherapy for spinal deformities teach the patient how to perform a routine of 'curve pattern' specific exercises with the purpose to facilitate the correction of the asymmetric posture and to teach the patient to maintain the corrected posture in daily activities. Principles of correction are based on those developed by the German physiotherapist K. Schroth.

13. The Chêneau concept of bracing--actual standards.

Weiss HR, Rigo M

Stud Health Technol Inform. 2008;135:291-302 Published: 2008

In-brace correction and compliance are the main predictors of a successful outcome of brace treatment in the management of patients with Idiopathic scoliosis. The latest CAD/CAM or module based bracing concepts, related to a proper classification have lead to a better in-brace correction and have made the braces easier to wear for the patient. Nevertheless, the latest developments on the market do not allow successful treatment in every case. The latest biomechanical models of brace correction therefore may lead to a differential indication for certain concepts described in this paper. Thoracic curves with Cobb angles < 50 degrees may be treated with the best possible success with the latest Chêneau derivates enabling a real 3D-correction including also the sagittal correction of the spine. The application of those braces demands a proper classification of curve patterns. Thoracic curves with Cobb angles > 50 degrees demand to increase the force vector from dorsal with the ventral counteraction of subclavicular pads both sides, although this may be at the cost of sagittal correction. The percentage of in-brace correction is a good indicator for brace action, however in the individual case this is not always the most important factor.

14. The Chêneau concept of bracing--biomechanical aspects.

Rigo M, Weiss HR.

Stud Health Technol Inform. 2008;135:303-19 Published 2008

Current concept of bracing must take in consideration both the three-dimensional (3D) nature of Adolescent Idiopathic Scoliosis (AIS) and its pathomechanism of progression. A modern brace should be able to correct in 3D in order to break the so called 'vicious cycle' model. Generally speaking, it is necessary to create detorsional forces to derotate in the transversal plane, to correct the lateral deviation in the frontal plane and to

normalize the sagittal profile of the spine. Breathing mechanics can be used to fight against the thoracic structural flat back. The original Chêneau brace was introduced at the end of the 70's and its principles were based more in anatomical observations rather than in biomechanics. A further evolution, enunciating new principles, has allowed a higher standard, improving in brace corrections and trunk modelling. This biomechanical principles have been developed under the name of Rigo-Chêneau-System (RSC) and used later in latest brace models like the Chêneau light with reduced material, and similar in brace corrections. Experience is also important to improve the end results. The blueprints to built the brace according to the anatomoradiological pattern are very helpful.

15. Guidelines on "Standards of management of idiopathic scoliosis with corrective braces in everyday clinics and in clinical research": SOSORT Consensus 2008.

Negrini S, Grivas TB, Kotwicki T, Rigo M, Zaina F; international Society on Scoliosis Orthopaedic and Rehabilitation Treatment (SOSORT)

Scoliosis. 2009 Jan 16;4:2. Published 2009

Background: Reported failure rates,(defined based on percentage of cases progressing to surgery) of corrective bracing for idiopathic scoliosis are highly variable. This may be due to the quality of the brace itself, but also of the patient care during treatment. The latter is sometimes neglected, even though it is considered a main determinant of good results among conservative experts of SOSORT. The aim of this paper was to develop and verify the Consensus on management of scoliosis patients treated with braces **Methods:** We followed a Delphi process in four steps, distributing and gradually changing according to the results a set of recommendations: we involved the SOSORT Board twice, then all SOSORT members twice, with a Pre-Meeting Questionnaire (PMQ), and during a Consensus Session at the SOSORT Athens Meeting with a Meeting Questionnaire (MQ). We set a 90% agreement as the minimum to be reached. **Results:** We had a 71% response rate to PMQ, and 66.7% to MQ. Since the PMQ we had a good agreement (no answers below 72% - 70.2% over 90%). With the MQ the agreement consistently increased for all

the answers previously below 90% (no answers below 83%, 75% over 90%). With increasing experience in bracing all numerical criteria tended to become more strict. We finally produced a set of 14 recommendations, grouped in 6 Domains (Experience/competence, Behaviours, Prescription, Construction, Brace Check, Follow-up). **Conclusion:** The Consensus permits establishment of recommendations concerning the standards of management of idiopathic scoliosis with bracing, with the aim to increase efficacy and compliance to treatment. The SOSORT recommends to professionals engaged in patient care to follow the guidelines of this Consensus in their clinical practice. The SOSORT criteria should also be followed in clinical research studies to achieve a minimum quality of care. If the aim is to verify the efficacy of bracing these criteria should be companions of the methodological research criteria for bracing proposed by other societies.

16. Methodology of evaluation of morphology of the spine and the trunk in idiopathic scoliosis and other spinal deformities - 6th SOSORT consensus paper.

Kotwicki T, Negrini S, Grivas TB, Rigo M, Maruyama T, Durmala J, Zaina F

Scoliosis. 2009 Nov 26;4:26 Published 2009

Background: Comprehensive evaluation of the morphology of the spine and of the whole body is essential in order to correctly manage patients suffering from progressive idiopathic scoliosis. Although methodology of clinical and radiological examination is well described in manuals of orthopaedics, there is deficit of data which clinical and radiological parameters are considered in everyday practise. Recently, an increasing tendency to extend scoliosis examination beyond the measure of the Cobb angle can be observed, reflecting a more patient-oriented approach. Such evaluation often involves surface parameters, aesthetics, function and quality of life. **Aim of the study:** To investigate current recommendations of experts on methodology of evaluation of the patient with spinal deformity, essentially idiopathic scoliosis. **Methods:** Structured Delphi procedure for collecting and processing knowledge from a group of experts with a series of questionnaires and controlled opinion feedback was performed. Experience and opinions of the professionals - physicians and physiotherapists managing scoliosis patients -

were studied. According to Delphi method a Meeting Questionnaire (MQ) has been developed, resulting from a preliminary Pre-Meeting Questionnaire (PMQ) which had been previously discussed and approved on line. The MQ was circulated among the SOSORT experts during Consensus Session on "Measurements" which took place at the Annual Meeting of the Society, totally 23 panellists being engaged. Clinical, radiological and surface topography parameters were checked for agreement. **Results:** 90% agreement or more was reached in 35 items and superior than 75% agreement was reached in further 25 items. An evaluation form was proposed to be used by clinicians and researchers. **Conclusion:** The consensus was reached on evaluation of the morphology of the patient with idiopathic scoliosis, comprising clinical, radiological and, to less extend, surface topography assessment. Considering the variety of parameters indicated by the panellists, the Cobb angle, yet the gold standard, can be seen neither as the unique nor the only decisive parameter in the management of patients with idiopathic scoliosis.

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

Rigo MD, Villagrasa M, Gallo D.

Scoliosis. 2010 Jan 27;5(1):1. Published 2010

Background: Spinal classification systems for scoliosis which were developed to correlate with surgical treatment historically have been used in brace treatment as well. Previously, there had not been a scoliosis classification system developed specifically to correlate with brace design and treatment. The purpose of this study is to show the intra- and inter- observer reliability of a new scoliosis classification system correlating with brace treatment. **Methods:** An original classification system ("Rigo Classification") was developed in order to define specific principles of correction required for efficacious brace design and fabrication. The classification includes radiological as well as clinical criteria. The radiological criteria are utilized to differentiate five basic types of curvatures including: (I) imbalanced thoracic (or three curves pattern), (II) true double (or four curve pattern), (III) balanced thoracic and false double (non 3 non 4), (IV) single lumbar and (V) single thoracolumbar. In

addition to the radiological criteria, the Rigo Classification incorporates the curve pattern according to SRS terminology, the balance/imbalance at the transitional point, and L4-5 counter-tilting. To test the intra-and inter-observer reliability of the Rigo Classification, three observers (1 MD, 1 PT and 1 CPO) measured (and one of them, the MD, re-measured) 51 AP radiographs including all curvature types. **Results:** The intra-observer Kappa value was 0.87 (acceptance >0.70). The inter-observer Kappa values fluctuated from 0.61 to 0.81 with an average of 0.71 (acceptance > 0.70). **Conclusions:** A specific scoliosis classification which correlates with brace treatment has been proposed with an acceptable intra-and inter-observer reliability.

18. Spanish validation of Bad Sobernheim Stress Questionnaire (BSSQ (brace).es) for adolescents with braces.

D'Agata E, Testor CP, Rigo M.

Scoliosis. 2010 Jul 15;5:15. Published 2010

Background: As a result of scientific and medical professionals gaining interest in Stress and Health Related Quality of Life (HRQL), the aim of our research is, thus, to validate into Spanish the German questionnaire Bad Sobernheim Stress Questionnaire (BSSQ) (mit Korsett), for adolescents wearing braces. **Methods:** The methodology used adheres to literature on trans-cultural adaptation by doing a translation and a back translation; it involved 35 adolescents, ages ranging between 10 and 16, with Adolescent Idiopathic Scoliosis (AIS) and wearing the same kind of brace (Rigo System Chêneau Brace). The materials used were a socio-demographics data questionnaire, the SRS-22 and the Spanish version of BSSQ(brace).es. The statistical analysis calculated the reliability (test-retest reliability and internal consistency) and the validity (convergent and construct validity) of the BSSQ (brace).es. **Results:** BSSQ(brace).es is reliable because of its satisfactory internal consistency (Cronbach's alpha coefficient was 0.809, $p < 0.001$) and temporal stability (test-retest method with a Pearson correlation coefficient of 0.902 ($p < 0.01$)). It demonstrated convergent validity with SRS-22 since the Pearson correlation coefficient was 0.656 ($p < 0.01$). By undertaking an Exploratory

Principal Components Analysis, a latent structure was found based on two Components which explicate the variance at 60.8%. **Conclusions:** BSSQ (brace).es is reliable and valid and can be used with Spanish adolescents to assess the stress level caused by the brace.

19. **Terminology - glossary including acronyms and quotations in use for the conservative spinal deformities treatment: 8th SOSORT consensus paper.**

Grivas TB, de Mauroy JC, Négrini S, Kotwicki T, Zaina F, Wynne JH, Stokes IA, Knott P, Pizzetti P, Rigo M, Villagrasa M, Weiss HR, Maruyama T; SOSORT members.

Scoliosis. 2010 Nov 2;5:23 Published 2010

Background: This report is the SOSORT Consensus Paper on Terminology for use in the treatment of conservative spinal deformities. Figures are provided and relevant literature is cited where appropriate. **Methods:** The Delphi method was used to reach a preliminary consensus before the meeting, where the terms that still needed further clarification were discussed. **Results:** A final agreement was found for all the terms, which now constitute the base of this glossary. New terms will be added after being discussed and accepted. **Discussion:** When only one set of terms is used for communication in a place or among a group of people, then everyone can clearly and efficiently communicate. This principle applies for any professional group. Until now, no common set of terms was available in the field of the conservative treatment of scoliosis and spinal deformities. This glossary gives a common base language to draw from to discuss data, findings and treatment.

20. **"Rehabilitation schools for scoliosis" thematic series: describing the methods and results.**

Rigo MD, Grivas TB.

Scoliosis. 2010 Dec 24;5:27. Published 2010

The Scoliosis Rehabilitation model begins with the correct diagnosis and evaluation of the patient, to make treatment decisions oriented to the patient. The treatment is based on observation, education, scoliosis specific exercises, and bracing. The state of research in the field of conservative treatment is insufficient. There is some evidence supporting scoliosis specific exercises as a part of the rehabilitation treatment, however, the evidence is poor and the different methods are not known by most of the scientific community. The only way to improve the knowledge and understanding of the different physiotherapy methodologies (specific exercises), integrated into the whole rehabilitation program, is to establish a single and comprehensive source of information about it. This is what the SCOLIOSIS Journal is going to do through the "Rehabilitation Schools for Scoliosis" Thematic Series, where technical papers coming from the different schools will be published.

21. Patient evaluation in idiopathic scoliosis: Radiographic assessment, trunk deformity and back asymmetry.

Rigo M.

Physiother Theory Pract. 2011 Jan;27(1):7-25. Published 2011

Progressive adolescent idiopathic scoliosis (AIS) produces specific signs and symptoms, including trunk and spinal deformity and imbalance, impairment of breathing function, pain, progression during adult life, and psychological problems, as a whole resulting in an alteration of the health-related quality of life. A scoliosis-specific rehabilitation program attempts to prevent, improve, or minimize these signs and symptoms by using exercises and braces as the main tools in the rehabilitation treatment. Patient evaluation is an essential point in the decision-making process and determines the selection of the specific exercises and the specifications of the brace design. However, this article is not addressed to scoliosis management. In this present article, a complete definition and discussion of radiological aspects, such as the Cobb angle, axial rotation, curve pattern classifications, and sagittal configuration, follow a short description of the three-dimensional nature of AIS. The relationship between AIS and growth is also discussed. There is also a section dedicated to the assessment of trunk deformity and back asymmetry. Other important clinical

aspects, such as pain and disability, changes in other regions of the body, muscular balance, breathing function, and health-related quality of life, are not discussed in this present article.

22. Expert-driven Chêneau applications: Description and in- brace correction.

Weiss HR, Rigo M.

Physiother Theory Pract. 2011 Jan;27(1):61-7 Published 2011

In-brace correction and compliance are the main predictors of a successful outcome of brace treatment in the management of patients with idiopathic scoliosis. The latest CAD/CAM- or module-based bracing concepts related to a proper classification have led to better in-brace corrections and have made the braces easier to wear for the patient. However, even the latest developments on the market do not ensure successful treatment in every case. Thoracic curves with Cobb angles less than 50° may be treated with the best likelihood of success utilizing the latest Chêneau derivatives, enabling a real 3D correction that includes sagittal correction of the spine, when patient compliance can be achieved. The successful application of the braces demands a proper classification of curve patterns. The percentage of in-brace correction of the Cobb angle correlates with the end result and consequently is a good indicator for brace quality. However, other factors, such as 3D correction or the absolute reduction of the Cobb angle (i.e., in rigid curves over 50°), might also be important indicators.

23. 2011 SOSORT guidelines: Orthopaedic and Rehabilitation treatment of idiopathic scoliosis during growth.

Negrini S, Aulisa AG, Aulisa L, Circo AB, de Mauroy JC, Durmala J, Grivas TB, Knott P, Kotwicki T, Maruyama T, Minozzi S, O'Brien JP, Papadopoulos D, Rigo M, Rivard CH, Romano M, Wynne JH, Villagrasa M, Weiss HR, Zaina F.

Scoliosis. 2012 Jan 20;7(1):3. Published 2012

Background: The International Scientific Society on Scoliosis Orthopaedic and Rehabilitation Treatment (SOSORT), that produced its first Guidelines in 2005, felt the need to revise them and increase their scientific quality. The aim is to offer to all professionals and their patients an evidence-based updated review of the actual evidence on conservative treatment of idiopathic scoliosis (CTIS). **Methods:** All types of professionals (specialty physicians, and allied health professionals) engaged in CTIS have been involved together with a methodologist and a patient representative. A review of all the relevant literature and of the existing Guidelines have been performed. Documents, recommendations, and practical approach flow charts have been developed according to a Delphi procedure. A methodological and practical review has been made, and a final Consensus Session was held during the 2011 Barcelona SOSORT Meeting. **Results:** The contents of the document are: methodology; generalities on idiopathic scoliosis; approach to CTIS in different patients, with practical flow-charts; literature review and recommendations on assessment, bracing, physiotherapy, Physiotherapeutic Specific Exercises (PSE) and other CTIS. Sixty-five recommendations have been given, divided in the following topics: Bracing (20 recommendations), PSE to prevent scoliosis progression during growth (8), PSE during brace treatment and surgical therapy (5), Other conservative treatments (3), Respiratory function and exercises (3), Sports activities (6), Assessment (20). No recommendations reached a Strength of Evidence level I; 2 were level II; 7 level III; and 20 level IV; through the Consensus procedure 26 reached level V and 10 level VI. The Strength of Recommendations was Grade A for 13, B for 49 and C for 3; none had grade D. **Conclusion:** These Guidelines have been a big effort of SOSORT to paint the actual situation of CTIS, starting from the evidence, and filling all the gray areas using a scientific method. According to results, it is possible to understand the lack of research in general on CTIS. SOSORT invites researchers to join, and clinicians to develop good research strategies to allow in the future to support or refute these recommendations according to new and stronger evidence.

24. **Comparison between subjective perception of trunk deformity (TAPS) and objective assessment of back asymmetry (surface topography).** M Rigo M, D'Agata E
Scoliosis 2013, 8(Suppl 1):O9

From 9th International Conference on Conservative Management of Spinal Deformities - SOSORT 2012 Annual Meeting
Milan, Italy. 10-12 May 2012

25. Conservative treatment of juvenile with Chiari I malformation, syringomyelia and scoliosis. Two case reports

Rigo M, Janssen B, Campo R, Tremonti L

Scoliosis 2013, 8(Suppl 1):O52. From 9th International Conference on Conservative Management of Spinal Deformities - SOSORT 2012 Annual Meeting Milan, Italy. 10-12 May 2012

26. Trunk appearance perception scale (TAPS) discrepancy between adolescents with idiopathic scoliosis and their parents influences HRQL.

Rigo M, D'Agata E, Jelacic M

Scoliosis 2013, 8(Suppl 1):O55. From 9th International Conference on Conservative Management of Spinal Deformities - SOSORT 2012 Annual Meeting Milan, Italy. 10-12 May 2012

27. What is the role of self-esteem in adolescents with idiopathic scoliosis under a conservative treatment?

D'Agata E, Pérez-Testor C, Negrini S, Rigo M

Scoliosis 2013, 8(Suppl 1):O60. From 9th International Conference on Conservative Management of Spinal Deformities - SOSORT 2012 Annual Meeting Milan, Italy. 10-12 May 2012

28. Actual evidence in the medical approach to adolescents with idiopathic scoliosis.

Negrini S, De Mauroy JC, Grivas TB, Knott P, Kotwicki T, Maruyama T, O'Brien JP, Rigo M, Zaina F.

Eur J Phys Rehabil Med. 2014 Feb;50(1):87-92. Published 2014

Idiopathic scoliosis (IS) is a three-dimensional deformity of the spine and trunk. The most common form involve adolescents. The prevalence is 2-3% of the population, with 1 out of 6 patients requiring treatment of which 25% progress to surgery. Physical and rehabilitation medicine (PRM) plays a primary role in the so-called conservative treatment of adolescents with IS, since all the therapeutic tools used (exercises and braces) fall into the PRM domain. According to a Cochrane systematic review there is evidence in favor of bracing, even if it is of low quality. Recently, a controlled prospective trial including a randomised arm gave more strength to this conclusion. Another Cochrane review shows that there is evidence in favor of exercises as an adjunctive treatment, but of low quality. Three meta-analysis have been published on bracing: one shows that bracing does not reduce surgery rates, but studies with bracing plus exercises were not included and had the highest effectiveness; another shows that full time is better than part-time bracing; the last focuses on observational studies following the Scoliosis Research Society (SRS) criteria and shows that not all full time rigid bracing are the same: some have the highest effectiveness, others have less than elastic and nighttime bracing. Two very important RCTs failed in recruitment, showing that in the field of bracing for scoliosis RCTs are not accepted by the patients. Consensuses by the international Society on Scoliosis Orthopedic and Rehabilitation Treatment (SOSORT) show that there is no agreement among experts either on the best braces or on their biomechanical action, and that compliance is a matter of clinical more than patients' behavior (there is strong agreement on the management criteria to achieve best results with bracing). A systematic review of all the existing studies shows effectiveness of exercises, and that auto-correction is their main goal. A systematic review shows that there are no studies on manual treatment. The SOSORT Guidelines offer the actual standard of conservative care.

29. Bracing for scoliosis in 2014: state of the art.

Zaina F, De Mauroy JC, Grivas T, Hresko MT, Kotwicki T, Maruyama T, Price N, Rigo M, Stikeleather L, Wynne J, Negrini S.

Eur J Phys Rehabil Med. 2014 Feb;50(1):93-110. Published 2014

Bracing is currently the primary method for treating moderate idiopathic scoliosis (IS) during the developmental phase of growth. Following a lengthy debate, during which researchers and authors questioned the role of bracing in the treatment of IS due to inconsistent evidence, the Bracing in Adolescent Idiopathic Scoliosis Trial study have provided a high level of evidence to the value of bracing and may have convinced most of those who were skeptic. However, although some guidelines have been published, there remains no standard for constructing scoliosis orthoses and no standard treatment protocol. The Scoliosis Research Society criteria were established to provide a framework by which to research bracing and adolescent idiopathic scoliosis, and the Society on Scoliosis Orthopedic and Rehabilitation Treatment criteria were published to guarantee a minimum level of expertise for MDs and CPOs involved in the brace treatment. However, very few contemporary papers follow both sets of criteria, and the extensive variety of braces makes it difficult to determine if one is superior to another. The aim of this paper is to provide an overview of state-of-the-art brace treatment, highlighting commonly used braces and their history, biomechanical concept, and results, as reported in published literature. Specific focus is placed on European (i.e., Chêneau and derivatives, Dynamic Derotating, Lyon, PASB, Sforzesco, TLI, TriaC) and North American (i.e. Boston, Charleston, Milwaukee, Providence, Rosenberger, SpineCor, Wilmington) designs. Details about different building techniques are also reported, along with recently developed tools that are designed to monitor compliance.

30. SOSORT 2012 consensus paper: reducing x-ray exposure in pediatric patients with scoliosis.

Knott P, Pappo E, Cameron M, Demauroy J, Rivard C, Kotwicki T, Zaina F, Wynne J, Stikeleather L, Bettany-Saltikov J, Grivas

TB, Durmala J, Maruyama T, Negrini S, O'Brien JP, Rigo M.

Scoliosis. 2014 Apr 25;9:4 Published 2014

This 2012 Consensus paper reviews the literature on side effects of x-ray exposure in the pediatric population as it relates to scoliosis evaluation and treatment. Alternative methods of spinal assessment and imaging are reviewed, and strategies for reducing the number of radiographs are developed. Using the Delphi technique, SOSORT members developed consensus statements that describe how often radiographs should be taken in each of the pediatric and adolescent sub-populations.

31. Emotional indicators in young patients with Idiopathic Scoliosis: a study through the drawing of Human Figure.

D'Agata E, Rigo M, Pérez-Testor C, Puigví NC, Castellano-Tejedor C

Scoliosis. 2014 Dec 12;9(1):24 Published 2014

Background: Investigating Health Related Quality of Life (HRQL) is considered determinant in patients with Adolescent Idiopathic Scoliosis (AIS) in clinical as in research field. The aim of the present study is to explore the most relevant aspects of personality of the patients with AIS and its relationship with HRQL. **Method:** 50 patients (mean age = 16 years) were given a socio-demographic data questionnaire, the Human Figure Drawing (HFD) and SRS (Scoliosis Research Society) -22. **Results:** In Subtotal SRS-22, patients presented a mean value of 3.9. In HFD, half of these patients presented physical and/or emotional tensions with reference to the shoulders and almost all of them did not show any expression of aggressiveness. No relationship between personality and HRQL was confirmed. The older the patients were, the more body tension was discovered as well as the more concerns about their bodies they showed to have. There was also a correlation between growing old and a decreasing in Mental Health. Previous conservative treatment did not show any impact on personality or on HRQL. **Conclusions:** Patients with

AIS suffer stress and general concern more frequently with the increase of age. We suggest an appropriate supportive treatment for this type of patient

32. Research quality in scoliosis conservative treatment: state of the art.

Zaina F, Romano M, Knott P, de Mauroy JC, Grivas TB, Kotwicki T, Maruyama T, O'Brien J, Rigo M, Negrini S.

Scoliosis. 2015 Jul 11;10:21 Published 2015

The publication of research in the field of conservative treatment of scoliosis is increasing after a long period of progressive decline. In 2014, three high quality and scientifically sound papers gave new strength to the conservative scoliosis approach. The efficacy of treatment over observation was demonstrated by two RCTs for bracing, and one for scoliosis-specific exercises provided by a physical therapist. It is difficult to design strong studies in this field due to the long time needed for follow up and the challenge of recruiting patients and families willing to be involved in the decision process. Nevertheless, the main methodological errors are not related to the study design but rather on the way it is performed, which very frequently affects the reliability of results. The most common errors are: selection bias, with many studies including functional rather than a true structural scoliosis; inappropriate outcome measures, utilizing parameters not related to scoliosis progression or quality of life; inappropriate follow up, reporting only immediate results and not addressing end of growth results; an incorrect interpretation of findings, with an overestimation of results; and missing the evaluation of skeletal maturity, without which results cannot be considered stable. Being aware of these errors is extremely important both for authors and for readers in order to avoid questionable practices based on inconclusive studies that could harm patients.

33. Physiotherapy scoliosis-specific exercises - a comprehensive review of seven major schools.

Berdishevsky H, Lebel VA, Bettany-Saltikov J, Rigo M, Lebel A, Hennes A, Romano M, Bialek M, M'hango A, Betts T, de

Mauroy JC, Durmala J

Scoliosis Spinal Disord. 2016 Aug 4;11:20 Published 2016

In recent decades, there has been a call for change among all stakeholders involved in scoliosis management. Parents of children with scoliosis have complained about the so-called "wait and see" approach that far too many doctors use when evaluating children's scoliosis curves between 10° and 25°. Observation, Physiotherapy Scoliosis Specific Exercises (PSSE) and bracing for idiopathic scoliosis during growth are all therapeutic interventions accepted by the 2011 International Society on Scoliosis Orthopaedic and Rehabilitation Treatment (SOSORT). The standard features of these interventions are: 1) 3-dimension self-correction; 2) Training activities of daily living (ADL); and 3) Stabilization of the corrected posture. PSSE is part of a scoliosis care model that includes scoliosis specific education, scoliosis specific physical therapy exercises, observation or surveillance, psychological support and intervention, bracing and surgery. The model is oriented to the patient. Diagnosis and patient evaluation is essential in this model looking at a patient-oriented decision according to clinical experience, scientific evidence and patient's preference. Thus, specific exercises are not considered as an alternative to bracing or surgery but as a therapeutic intervention, which can be used alone or in combination with bracing or surgery according to individual indication. In the PSSE model it is recommended that the physical therapist work as part of a multidisciplinary team including the orthopaedic doctor, the orthotist, and the mental health care provider - all are according to the SOSORT guidelines and Scoliosis Research Society (SRS) philosophy. From clinical experiences, PSSE can temporarily stabilize progressive scoliosis curves during the secondary period of progression, more than a year after passing the peak of growth. In non-progressive scoliosis, the regular practice of PSSE could produce a temporary and significant reduction of the Cobb angle. PSSE can also produce benefits in subjects with scoliosis other than reducing the Cobb angle, like improving back asymmetry, based on 3D self-correction and stabilization of a stable 3D corrected posture, as well as the secondary muscle imbalance and related pain. In more severe cases of thoracic scoliosis, it can also improve breathing function. This paper will discuss in detail seven major scoliosis schools and their approaches to PSSE, including their bracing techniques and scientific evidence. The aim of this paper is to understand and learn about the different international

treatment methods so that physical therapists can incorporate the best from each into their own practices, and in that way attempt to improve the conservative management of patients with idiopathic scoliosis. These schools are presented in the historical order in which they were developed. They include the Lyon approach from France, the Katharina Schroth Asklepios approach from Germany, the Scientific Exercise Approach to Scoliosis (SEAS) from Italy, the Barcelona Scoliosis Physical Therapy School approach (BSPTS) from Spain, the Dobomed approach from Poland, the Side Shift approach from the United Kingdom, and the Functional Individual Therapy of Scoliosis approach (FITS) from Poland.

34. **Brace technology thematic series: the 3D Rigo Chêneau-type brace.**

Rigo M, Jelačić M.

Scoliosis Spinal Disord. 2017 Mar 16;12:10 Published 2017

Background: Chêneau and Matthias introduced in 1979 a brace concept inspired in casting. The brace was initially named "CTM" from Chêneau-Toulouse-Münster. The name "CTM" is still popular in France but "Chêneau-type brace" is its common name in the rest of the world. Principles to construct this brace were originally based on anatomical descriptions rather than biomechanics, and its standard is poor. **Methods:** This paper follows the format of the "Brace technology thematic series." The Chêneau-type brace has been versioned by many authors. The contribution of the present authors is about to the description of the principles based on biomechanics and a specific classification created to help to standardize the brace design and construction. The classification also correlates with specific exercises (PSSE) according to the Barcelona School, using Schroth principles (BSPTS). This current authors' version has been named "3D Rigo Chêneau-type brace." The 3D principles are related to a detorsional mechanism created by forces and counterforces to bring the trunk into the best possible correction: (1) three-point system; (2) regional derotation; (3) sagittal alignment and balance. A custom-made TLS brace (thoracolumbosacral) is built in order to provide highly defined contact areas, which are located, shaped, and oriented in the space to generate the necessary vectors of force to correct in 3D. Expansion areas are also essential for tissue migration, growth, and breathing movements, although body reactions depend basically on how well designed

are the contact areas. The brace is open in front and can be considered rigid and dynamic at the same time. **Results:** Blueprints for construction of the brace according to the revisited Rigo classification are fully described in this paper. **Conclusions:** Different independent teams have published comparable outcomes by using Chêneau-type braces and versions in combination with specific exercises and following a similar scoliosis comprehensive care model. This present version is also supported by scientific results from several independent teams. **Keywords:** Bracing; Idiopathic scoliosis; Non-operative treatment; Rigo-Chêneau brace; Scoliosis classification.

35. **2016 SOSORT guidelines: orthopaedic and rehabilitation treatment of idiopathic scoliosis during growth.**

Negrini S, Donzelli S, Aulisa AG, Czaprowski D, Schreiber S, de Mauroy JC, Diers H, Grivas TB, Knott P, Kotwicki T, Lebel A, Marti C, Maruyama T, O'Brien J, Price N, Parent E, Rigo M, Romano M, Stikeleather L, Wynne J, Zaina F.

Scoliosis Spinal Disord. 2018 Jan 10;13:3 Published 2018

Background: The International Scientific Society on Scoliosis Orthopaedic and Rehabilitation Treatment (SOSORT) produced its first guidelines in 2005 and renewed them in 2011. Recently published high-quality clinical trials on the effect of conservative treatment approaches (braces and exercises) for idiopathic scoliosis prompted us to update the last guidelines' version. The objective was to align the guidelines with the new scientific evidence to assure faster knowledge transfer into clinical practice of conservative treatment for idiopathic scoliosis (CTIS). **Methods:** Physicians, researchers and allied health practitioners working in the area of CTIS were involved in the development of the 2016 guidelines. Multiple literature reviews reviewing the evidence on CTIS (assessment, bracing, physiotherapy, physiotherapeutic scoliosis-specific exercises (PSSE) and other CTIS) were conducted. Documents, recommendations and practical approach flow charts were developed using a Delphi procedure. The process was completed with the Consensus Session held during the first combined SOSORT/IRSSD Meeting held in Banff, Canada, in May 2016. **Results:** The contents of the new 2016 guidelines include the following: background on idiopathic scoliosis, description of CTIS approaches for various populations with flow-charts for clinical practice, as well as literature reviews and recommendations

on assessment, bracing, PSSE and other CTIS. The present guidelines include a total of 68 recommendations divided into following topics: bracing ($n = 25$), PSSE to prevent scoliosis progression during growth ($n = 12$), PSSE during brace treatment and surgical therapy ($n = 6$), other conservative treatments ($n = 2$), respiratory function and exercises ($n = 3$), general sport activities ($n = 6$); and assessment ($n = 14$). According to the agreed strength and level of evidence rating scale, there were 2 recommendations on bracing and 1 recommendation on PSSE that reached level of recommendation "I" and level of evidence "II". Three recommendations reached strength of recommendation A based on the level of evidence I (2 for bracing and one for assessment); 39 recommendations reached strength of recommendation B (20 for bracing, 13 for PSSE, and 6 for assessment). The number of paper for each level of evidence for each treatment is shown in Table 8. **Conclusion:** The 2016 SOSORT guidelines were developed based on the current evidence on CTIS. Over the last 5 years, high-quality evidence has started to emerge, particularly in the areas of efficacy of bracing (one large multicentre trial) and PSSE (three single-centre randomized controlled trials). Several grade A recommendations were presented. Despite the growing high-quality evidence, the heterogeneity of the study protocols limits generalizability of the recommendations. There is a need for standardization of research methods of conservative treatment effectiveness, as recognized by SOSORT and the Scoliosis Research Society (SRS) non-operative management Committee. **Keywords:** Guidelines; Idiopathic scoliosis; Treatment.

36. Establishing consensus on the best practice guidelines for the use of bracing in adolescent idiopathic scoliosis.

Roye BD, Simhon ME, Matsumoto H, Bakarania P, Berdishevsky H, Dolan LA, Grimes K, Grivas TB, Hresko MT, Karol LA, Lonner BS, Mendelow M, Negrini S, Newton PO, Parent EC, Rigo M, Strikeleather L, Tunney J, Weinstein SL, Wood G, Vitale MG.

Spine Deform. 2020 Aug;8(4):597-604 Published 2020

Study design: Survey. **Objectives:** Bracing is the mainstay of conservative treatment in Adolescent Idiopathic Scoliosis (AIS). The purpose of this study was to establish best practice guidelines (BPG) among a multidisciplinary group of international bracing experts including surgeons, physiatrists, physical therapists, and orthotists utilizing formal consensus building techniques. Currently, there is significant variability in the practice of brace treatment for AIS and, therefore, there is a strong need to develop BPG for bracing in AIS. **Methods:** We utilized the Delphi process and the nominal group technique to establish consensus among a multidisciplinary group of bracing experts. Our previous work identified areas of variability in brace treatment that we targeted for consensus. Following a review of the literature, three iterative surveys were administered. Topics included bracing goals, indications for starting and discontinuing bracing, brace types, brace prescription, radiographs, physical activities, and physiotherapeutic scoliosis-specific exercises. A face-to-face meeting was then conducted that allowed participants to vote for or against inclusion of each item. Agreement of 80% throughout the surveys and face-to-face meeting was considered consensus. Items that did not reach consensus were discussed and revised and repeat voting for consensus was performed. **Results:** Of the 38 experts invited to participate, we received responses from 32, 35, and 34 for each survey, respectively. 11 surgeons, 4 physiatrists, 8 physical therapists, 3 orthotists, and 1 research scientist participated in the final face-to-face meeting. Experts reached consensus on 67 items across 10 domains of bracing which were consolidated into the final best practice recommendations. **Conclusions:** We believe that adherence to these BPG will lead to fewer sub-optimal outcomes in patients with AIS by reducing the variability in AIS bracing practices, and provide a framework future research. **Level of evidence:** Level IV. **Keywords:** Adolescent idiopathic scoliosis; Best practice guideline; Bracing.

37. Evolution of Early Onset Scoliosis under Treatment with a 3D-Brace Concept.

Sauvagnac R, Rigo M.

J Clin Med. 2022 Feb 23;11(5):1186 Published: Feb 2022

The objective of this study is to examine the evolution of all the braced patients diagnosed with early onset scoliosis in a private scoliosis center. All patients diagnosed with EOS and braced before the age of ten were retrospectively reviewed. The results have been defined in accordance with the Scoliosis Research Society (SRS) for bracing criteria, and with a minimum follow-up of one year. Improvement and stabilization were considered successful treatments, while failure was considered to be an unsuccessful treatment. Successful results were observed in 80% of patients (63% worst case). In the success group, the Cobb angle was reduced from 36.3° (21-68) to 25° (10-43), with 36% of patients being initially treated only with night-time bracing. Twenty percent of the patients failed, seven had more than 45° at the last control and five had undergone surgery. This study suggests that bracing, using a modern 3D-brace concept, could be an effective treatment option for early onset scoliosis and advocates exploring its effectiveness as an alternative to casting throughout studies of higher levels of evidence. **Keywords:** bracing; early onset scoliosis; non-operative treatment.

38. The classification of scoliosis braces developed by SOSORT with SRS, ISPO, and POSNA and approved by ESPRM.

Negrini S, Aulisa AG, Cerny P, de Mauroy JC, McAviney J, Mills A, Donzelli S, Grivas TB, Hresko MT, Kotwicki T, Labelle H, Marcotte L, Matthews M, O'Brien J, Parent EC, Price N, Manuel R, Stikeleather L, Vitale MG, Wong MS, Wood G, Wynne J, Zaina F, Bruno MB, Würsching SB, Yilgor C, Cahill P, Dema E, Knott P, Lebel A, Lein G, Newton PO, Smith BG.

Eur Spine J. 2022 Apr;31(4):980-989. Published 2022

Purpose: Studies have shown that bracing is an effective treatment for patients with idiopathic scoliosis. According to the current classification, almost all braces fall in the thoracolumbosacral orthosis (TLSO) category. Consequently, the generalization of scientific results is either impossible or misleading. This study aims to produce a classification of the brace types. **Methods:** Four scientific societies (SOSORT, SRS, ISPO, and POSNA) invited all their members to be part of the study. Six level 1 experts developed the initial classifications. At a consensus meeting with 26 other experts and societies' officials, thematic analysis and general discussion allowed to define the classification (minimum

80% agreement). The classification was applied to the braces published in the literature and officially approved by the 4 scientific societies and by ESPRM. **Results:** The classification is based on the following classificatory items: anatomy (CTLSO, TLSO, LSO), rigidity (very rigid, rigid, elastic), primary corrective plane (frontal, sagittal, transverse, frontal & sagittal, frontal & transverse, sagittal & transverse, three-dimensional), construction-valves (monocot, bivalve, multisegmented), construction-closure (dorsal, lateral, ventral), and primary action (bending, detorsion, elongation, movement, push-up, three points). The experts developed a definition for each item and were able to classify the 15 published braces into nine groups. **Conclusion:** The classification is based on the best current expertise (the lowest level of evidence). Experts recognize that this is the first edition and will change with future understanding and research. The broad application of this classification could have value for brace research, education, clinical practice, and growth in this field. **Keywords:** Brace; Classification; Idiopathic scoliosis.

39. Nonoperative management of adolescent idiopathic scoliosis (AIS) using braces.

Grivas TB, Negrini S, Aubin CE, Aulisa AG, De Mauroy JC, Donzelli S, Hresko MT, Kotwicki T, Lou E, Maruyama T, Parent EC, Rigo M, Thometz JG, Wong MS, Zaina F.

Prosthet Orthot Int. 2022 Aug 1;46(4):383-391 Published: Aug 2022

This review presents the state of the art according to the current evidence on nonoperative treatment for adolescent idiopathic scoliosis, focusing on bracing. The definition of braces for the treatment of adolescent idiopathic scoliosis and a short history are provided. The analysis includes biomechanics, types, existing classifications, indications for treatment, time of brace wear and weaning, adherence, three-dimensional modeling, use of ultrasound imaging for bracing, management of treatment, issue of immediate in-brace correction, and documentation of the outcomes usually assessed for brace treatment, including the quality-of-life issues. According to the current evidence, there are two randomized control trials in favor of bracing. There are insufficient data on the superiority of one brace over another, although it is possible to classify and grade braces for efficacy from nonrigid to rigid and very rigid. Nevertheless, there is consensus on patients' management on the need for teamwork focusing on adherence to treatment, acceptability, and family and patient involvement.

40. Biomechanical Effects of Thoracolumbosacral Orthosis Design Features on 3D Correction in Adolescent Idiopathic Scoliosis: A Comprehensive Multicenter Study.

Guy A, Coulombe M, Labelle H, Rigo M, Wong MS, Beygi BH, Wynne J, Hresko MT, Ebermeyer E, Vedreine P, Liu XC,

Thometz JG, Bissonnette B, Sapaly C, Barchi S, Aubin CÉ.
Spine (Phila Pa 1976). 2022 Aug 1;47(15):1103-1110 Published 2022

Study design: Multicenter numerical study. **Objective:** To biomechanically analyze and compare various passive correction features of braces, designed by several centers with diverse practices, for three-dimensional (3D) correction of adolescent idiopathic scoliosis. **Summary of background data:** A wide variety of brace designs exist, but their biomechanical effectiveness is not clearly understood. Many studies have reported brace treatment correction potential with various degrees of control, making the objective comparison of correction mechanisms difficult. A Finite Element Model simulating the immediate in-brace corrective effects has been developed and allows to comprehensively assess the biomechanics of different brace designs. **Methods:** Expert clinical teams (one orthotist and one orthopedist) from six centers in five countries participated in the study. For six scoliosis cases with different curve types respecting SRS criteria, the teams designed two braces according to their treatment protocol. Finite Element Model simulations were performed to compute immediate in-brace 3D correction and skin-to-brace pressures. All braces were randomized and labeled according to 21 design features derived from Society on Scoliosis Orthopaedic and Rehabilitation Treatment proposed descriptors, including positioning of pressure points, orientation of push vectors, and sagittal design. Simulated in brace 3D corrections were compared for each design feature class using ANOVAs and linear regressions (significance $P \leq 0.05$). **Results:** Seventy-two braces were tested, with significant variety in the design approaches. Pressure points at the apical vertebra level corrected the main thoracic curve better than more caudal locations. Braces with ventral support flattened the lumbar lordosis. Lateral and ventral skin-to-brace pressures were correlated with changes in thoracolumbar/lumbar Cobb and lumbar lordosis ($r = -0.53$, $r = -0.54$). Upper straps positioned above T10 corrected the main thoracic Cobb better than those placed lower. **Conclusions:** The corrective features of various scoliosis braces were objectively compared in a systematic approach with minimal biases and variability in test parameters, providing a better biomechanical understanding of individual passive mechanisms' contribution to 3D correction.

