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## COMPARISON STUDIES OF 2D Vs. 3d SCOLIOSIS BRACING

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Please find below further evidence and peer reviewed studies comparing 3Dimensional bracing (Cheneau braces) to Boston (2Dimensional) bracing for Adolescent Idiopathic Scoliosis.

“The outcome after treatment of patients with idiopathic scoliosis (IS) with the help of certain bracing concepts support the hypothesis that brace treatment has to be regarded as effective [1–5]. The Boston brace has proven effective in preventing progression [1,4], **but in the international literature there is no evidence that Boston brace treatment can lead to improvements of Cobb angle and cosmesis at the same time. Cosmetic improvements have been documented for Cheneau braces of the latest standard [6] as well as for the Rigo-System Cheneau brace (RSC-brace)**”

1. Rigo M. Intra-observer reliability of a new classification correlating with brace treatment. Pediatric Rehabilitation. 2004;7:63. doi: 10.1080/13638490310001654736. [[Cross Ref](#)]
2. Weiss, H.R, Weiss, G.M. Brace treatment during pubertal growth spurt in girls with idiopathic scoliosis (IS): A prospective trial comparing two different concepts. Pediatric Rehabilitation, July 2005; 8(3): 199–206
3. Weiss HR, Dallmayer R, Gallo D. Sagittal Counter Forces (SCF) in the Treatment of Idiopathic Scoliosis – A Preliminary Report. Pediatric Rehabilitation. 2006;9:24–30. doi: 10.1080/13638490500038126. [[PubMed](#)] [[Cross Ref](#)]

4. Goldberg CJ, Moore DP, Fogarty EE, Dowling FE. Adolescent idiopathic scoliosis: the effect of brace treatment on the incidence of surgery. *Spine*. 2001;26:42–47. doi: 10.1097/00007632-200101010-00009. [[PubMed](#)] [[Cross Ref](#)]
  5. Emans JB, Kaelin A, Bancel P, Hall JE, Miller ME. The Boston bracing system for idiopathic scoliosis: Follow-up results in 295 patients. *Spine*. 1986;11:792–801. doi: 10.1097/00007632-198610000-00009. [[PubMed](#)] [[Cross Ref](#)]
  6. Weiss HR. Standard der Orthesenversorgung in der Skoliosebehandlung. *Med Orth Tech*. 1995;5:323–330.
  7. Landauer F, Wimmer C, Behensky H. Estimating the final outcome of brace treatment for idiopathic thoracic scoliosis at 6-month follow-up. *Pediatr Rehabil*. 2003;6:201–7. [[PubMed](#)]
  8. Hopf C, Heine J. [Long-term results of the conservative treatment of scoliosis.
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A study by Oberthaler et al., (1985) was conducted on 115 patients with idiopathic scoliosis treated with either the TLSO Boston brace or the Chêneau brace. The results found that there was excellent Cobb angle correction of the deformity in both braces. The TLSO Boston brace seems to be better for lumbar and thoracic curves whereas the Chêneau brace lends itself more for thoracic curves or when more than one primary curve is present.

Von Deimling et al., (1995) compared long-term influence of idiopathic scoliosis in 47 patients who wore either the Milwaukee brace or the Chêneau brace with an average follow-up of 7.8 years. **It was reported that Chêneau brace had significantly better results.** There was a Cobb angle correction of 62% and 38% the patients who wore the Chêneau and Milwaukee braces respectively. The initial correction of the Cobb angle was 35% and 47% of the pre-treatment value in the Chêneau and Milwaukee braces

Rigo (1999c) reported a retrospective study of 105 patients (mean age of 12.5 years) with progressive idiopathic scoliosis who were treated with the Chêneau brace. Of this group, 44 patients had been wearing other braces from other clinics before the start of treatment with the Chêneau brace. **All of these 44 patients presented curve progression even while wearing their previous brace.** The major Cobb and torsion angles had a mean of 37 degrees and 17 degrees respectively at the start of Chêneau brace treatment. The major Cobb and torsion angles had a mean primary correction of 31% and 22% respectively. In the group of patients with end results (n=37) the mean initial major Cobb and torsion angles were 36.4 and 16.9 degrees respectively and at follow-up they were 34.1 and 15.7 degrees. The results show high initial Cobb angles at the start of treatment and a low primary correction. The final Cobb angle at a 2-year follow-up, showed a tendency of a loss of correction, without reaching significance. Rigo (1999c) claimed that **the Chêneau brace could effectively prevent the progression of the Cobb and torsion angles, even in cases of bad prognosis**

Von Deimling, U., Wagner, U.A., Schmitt, O. (1995) Long-term effect of brace treatment on spinal decompensation in idiopathic scoliosis. A comparison of Milwaukee brace—Chêneau corset. *Z Orthop Ihre Grenzgeb*, 133, pp 270-273.

Oberthaler, V.W., Benzer, W., Alfare, N. (1985) Boston brace versus Chêneau brace: a comparative study. *Med othop Tech*, 104, pp 156-161.

Rigo, M. (1996) Influence of physiotherapy and bracing on the deformity of the trunk in patients with idiopathic scoliosis. Proceeding of the 2nd Société Internationale de Recherche et d'Étude sur le Rachis,.S.I.R.E.R. meeting, Barcelona.

Rigo, M. (1997) Reconstrucción tridimensional de la columna vertebral a partir de la imagen topográfica de la superficie de la espalda. Instituto E. Salvá, Barcelona.

Rigo, M. (1999a) 3D correction of trunk deformity in patients with idiopathic scoliosis using a Chêneau brace. In: Stokes (ed.), *Research into Spinal Deformities 2. Studies in Health, Technology and Informatics*. IOS Press. Amsterdam, pp 362-365.

Rigo, M. (1999b) Conservative scoliosis treatment. Does the Chêneau brace change prognosis? Instituto E. Salvá, Barcelona.

Rigo, M. (1999c) El corsé de tipo Chêneau: Resultados preliminares. Société Internationale de Recherche et d'Étude sur le Rachis,.S.I.R.E.R, 8, pp 3-10.

Rigo, M. (2000) 3rd Workshop on the theory and practical aspects of the Chêneau brace. Instituto de Especialidades Ortopédicas, Sevilla.

Rigo, M., Chêneau, J. (1997), 2nd Orthotics Workshop on the Chêneau brace. Barcelona, Instituto E. Salvá.

Rigo, M., Chêneau, J. (2000), 3rd Orthotics Workshop on the Chêneau brace. Instituto E. Salva, Barcelona.

Rigo, M., Quera-Salvá, G., Puigdevall, N., Martínez, M. (2000) Retrospective results in immature idiopathic scoliosis patients treated with a Chêneau brace. Proceedings of the 3rd Meeting of the International Research Society of Spinal Deformities (IRSSD), Clermont-Ferrand.

Rigo, M., Wood, G.I. (2001a) The treatment of scoliosis with a hypercorrection TLSO- The Chêneau brace system, part 1, Barcelona.

<http://www.grantwoodortho.com/research-paper.html>

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**Wood, G. *Brace modifications that can result in improved curve correction in idiopathic scoliosis*. *Scoliosis* 2014, 9:2 doi: 10.1186/1748-7161-9-2**

Background and aim: The purpose of this paper is to share with scoliosis professionals the X-rays of different pad placement levels associated with improved curve correction in a case idiopathic scoliosis (IS). Scoliosis braces of all types and brands utilize common principles of construction that ensure good fit and function. Equally important to the end result is good patient follow-up care and brace quality control by the orthotist. Design and methods this report reviewed the case of an 11-year-old girl diagnosed with IS, focusing on the in and out-of-brace x-rays, as well as the fit and function of the braces. The first brace was a TLSO-type (Boston), the second a Cheneau-type brace using a B1 model following the Rigo classification of scoliosis.

## Results

**The first TLSO-type brace presented an in-brace X-ray that showed a curve increase. The Cheneau-type scoliosis brace reduced the Cobb angles over 50%.**

## Conclusions

The biomechanical changes consequent to modifications in brace design and pad placements appeared to have improved the scoliosis and reduced the Cobb angles in this case. An orthotist must provide optimal fit and function of the brace which was prescribed by the referring physician. Adherence to certain basic design principles, and close follow up by the orthotist-especially during growth spurts - are critical to its effectiveness. Specifically, a skilled orthotist must be experienced with the particular brace-type, apply these principles, and maintain a good working relationship with both physician and patient to ensure timely brace adjustments essential to continued brace comfort and efficacy.

<http://www.scoliosisjournal.com/content/9/1/2/abstract>

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**Pham V.M, Herbaux B, Schill A, Thevenon A. *Evaluation of the Chêneau brace in adolescent idiopathic scoliosis*. Ann Readapt Med Phys. 2007 Apr; 50(3):125-33**

### **OBJECTIVE:**

We aimed to evaluate the Chêneau brace in the orthopaedic treatment of adolescent idiopathic scoliosis to better determine the indications under which it could be prescribed.

### **MATERIALS AND METHODS:**

This was a retrospective study including 63 patients treated by Chêneau brace for adolescent idiopathic scoliosis between 1997 and 2006. The Cobb angles of the curves in the frontal and sagittal planes as well as rotations and rib hump were measured at the beginning of treatment, with the brace, at the end of treatment and 2 years after discontinuing the brace. A variation of +/-10 degrees in angle was selected to judge the results.

### **RESULTS:**

At the end of the treatment, 25.4% of the curves were improved and 60.3% stabilized, with 14.3% aggravated; 5 patients (7.9%) required surgery. At 2 years, the reduction in angle was 1.8 degrees, on average. The best results were obtained for the lumbar and dorsolumbar curves. A significant improvement was noted for the dorsal curves; the major double curves are not as accessible to the treatment. For curves whose initial angle was less than 30 degrees, an initial reduction of higher than 50% with the brace presented the best improvement at the end of the follow-up. We note a significant reduction of the rib hump but not accompanied by a reduction of rotation. Finally, we note a deleterious effect in the sagittal curves, with a slight flatness of the spinal profile.

#### **CONCLUSION:**

**The continuous wearing of the Chêneau brace can stabilize the evolution of adolescent idiopathic scoliosis.** The loss of the correction after discontinuing the brace is minor. **We emphasize, therefore, the necessity to monitor the sagittal aspect of the spine as well as the possibility of early treatment,** strict surveillance and prolonged follow-up. (Boston brace cannot address sagittal alignment)

<http://www.ncbi.nlm.nih.gov/pubmed/17174434>

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**Fiore N<sup>1</sup>, Onimus M, Ferre B, Laurain JM. *Treatment of lumbar and dorso-lumbar scoliosis using the Boston orthosis and the 3-valve orthosis. Comparative study of the results in the frontal and horizontal planes.* Rev Chir Orthop Reparatrice Appar Mot. 1988; 74(6):569-75.**

A study was made of 30 patients presenting with lumbar and thoracolumbar scoliosis; 15 patients had been treated with a 3-valve orthosis and 15 with a Boston brace. The mean age at the commencement of treatment was 14 years for the 3-valve orthosis (Cheneau type) and 14 years 4 months for the Boston brace. The total duration of treatment was 11.1 months for the 3-valve orthosis and 11.8 months for the Boston brace. The patients with the 3-valve orthoses presented with an initial mean curve of 30 degrees and with the Boston braces a curve of 24 degrees. The mean follow-up after removal of the brace was 17 months for the 3-valve orthosis and 12 months for the Boston braces. The efficacy of the two orthoses was studied in the frontal and horizontal planes, taking into account the overall rotation of the curve and the segmental rotation of each vertebra in the curve. The Boston brace and the 3-valve orthosis were identical in the correction of the curve. The overall derotation was better with the 3-valve orthosis. **Segmentally, the 3-valve orthosis was more effective at the apex of the curve whilst the Boston brace was more effective at the extremities of the curve.** The ilio-lumbar angle and the trunk instability were corrected better by the Boston brace. **The specific indication for the 3-valve orthosis seems, therefore, to be scolioses in which there is a predominance of rotation at the apex of the curve.** The Boston brace has its main indication in cases where rotation is considerably close to or at the ends of the curve.

<http://www.ncbi.nlm.nih.gov/pubmed/3070653>

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**Gignac D, Aubin CE, Dansereau J, Poulin F, Labelle H. *A biomechanical study of new orthotic treatment approaches for the 3D correction of scoliosis.* Ann Chir. 1998; 52(8):795-800**

Scoliosis is a complex deformity of the spine and rib cage often treated by the Boston brace. The goal of this research is to study the simulation of two new treatment approaches and to compare their results to the Boston brace. A personalized biomechanical model has been used to simulate the treatment on 20 scoliotic teenagers with double curvature. On the first treatment, different forces were applied at the thoracic apex level and the posterior displacement of the rib hump was locked. For the second treatment, an oblique force oriented 45 degrees with respect to the frontal plane was added at the lumbar apex. Following each simulation, geometrical and clinical measurements were calculated and compared to the initial geometry and the Boston brace treatment. Overall, the two new treatment modalities correct the thoracic Cobb angle in the frontal plane while maintaining the normal physiological curvatures in the sagittal plane, move the thoracic plane of maximum deformity towards the sagittal plane and reduce axial rotation and rib hump. In comparison, the Boston brace reduces the Cobb angles in the frontal as well as in the sagittal planes, moves the planes of maximum deformities towards the coronal plane and has no effect on axial rotation and rib hump. **This biomechanical study shows force patterns that correct scoliosis more efficiently than the Boston brace. These new treatment approaches must be personalized for each patient and still require clinical evaluation.**

<http://www.ncbi.nlm.nih.gov/pubmed/9846431>

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Labelle H, Dansereau J, Bellefleur C, Poitras B. *Three-dimensional effect of the Boston brace on the thoracic spine and rib cage*. Spine (Phila Pa 1976). 1996 Jan 1;21(1):59-64. Spine 1996 Apr 1;21(7):890.

### Abstract

#### STUDY DESIGN:

Three-dimensional reconstructions of the spine and rib cage were done and compared just before and 1 month after initiation of treatment with a Boston brace in a group of adolescents with idiopathic scoliosis.

#### OBJECTIVES:

To document the immediate changes in shape of the thoracic spine and rib cage induced by the original Boston brace design.

#### SUMMARY OF BACKGROUND DATA:

The effect of the Boston brace has been well documented in the frontal plane but is poorly understood in the other planes of deformity.

#### METHODS:

Three-dimensional reconstructions were obtained with and without the brace using a stereoradiographic technique in a group of 40 adolescents with idiopathic scoliosis. Several geometric indices of the spine and rib cage were compared using Student t tests.

#### RESULTS:

The brace produced significant curve correction of the spinal deformity in the frontal plane **at the expense of a significant reduction of thoracic kyphosis in the sagittal plane, as well as in the plane of minimum deformity. No significant effect on rotation of the thoracic apical vertebra, on the rib hump, or on frontal balance could be documented, (with the Boston)** but changes were noted in the sagittal orientation of the rib cage and in the sagittal balance of the spine.

#### CONCLUSIONS:

**The original Boston brace does not completely correct the three-dimensional deformities associated with thoracic idiopathic scoliosis,** although it reduces Cobb angles in the frontal plane.

<http://www.ncbi.nlm.nih.gov/pubmed/9122764>

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Trusting that this further evidence regarding the effectiveness of 3D bracing as opposed to 2D bracing answers the queries you have raised.

You are more than welcome to contact me should you have further questions in this regard.

Sincerely,

A handwritten signature in black ink, appearing to read 'Rowan Berkowitz', with a stylized flourish at the end.

**Rowan Berkowitz**  
C.P.O. (S.A)  
*BerkowitzShnier Inc*

