Author's response to reviews

Title: The new Lyon brace: ARTbrace. New concepts based on scoliosis detorsion. Prospective study of the first 225 early radiological results of in-brace correction

Authors:

Jean Claude JC de Mauroy (demauroy@aol.com)
Cyril C Lecante (cyril.lecante@lecante.com)
Frédéric F Barral (frederic.barral@lecante.com)
Sophie S Pourret (sophie.pourret@lecante.com)

Version: 3 Date: 1 September 2014

Author's response to reviews: see over
MSW The five innovative concepts of ARTbrace seem not new and some tended to be repeated.

MSW The first, third and fourth concepts are very close and repetitive explanations of de-rotational effect for correction of scoliotic spine via lumbar and thoracic segments. The authors may consider streamlining and combining into one concept.

For the mathematical model of the twisted column and its use in bracing, no publication in the literature was found. This concept is the support of a new smoothing shape tool for ORTEN which is under development.

For the third concept, the innovation is focused on the thoracolumbar fixed point with unscrewing between this fixed point and the pelvis for lumbar curvature and the shoulder girdle for thoracic curvature. For thoraco-lumbar curves, the fixed points are at the cranial and caudal parts of the spine and unscrewing is done at thoracolumbar level. No biomechanics of this type has been described in the literature.

The fourth concept is a little different. Untwisting the spine is done maintaining the curvatures in the sagittal plane. Indeed, the screw is not right, but curved. However, curving the screwdriver is useless. The new solution is the moulding in frontal bending which respects lordosis and kyphosis and allows untwisting whilst retaining the curvatures in the sagittal plane. The sagittal plane is fixed and as physiological as possible. Only the frontal and horizontal planes are mobile.

MSW For the second concept, squeezing action via spreading over the entire cylinder surface may not work in the actual situation. In the correction of 3D deformities of the scoliotic spine, rooms should be provided for migration of
lateral curvature, rotated vertebrae and breathing exercise. In this design, actually various 3-point pressure systems are provided to correct the lateral curvature and vertebral rotation from different anatomical planes.

The shape of the brace is not a straight spine like the Sforzesco or the old Lyon brace, but an overcorrected spine with reverse scoliosis (concept 1). This is possible thanks to the superposition of two corrective bending mouldings. It is obvious that only vertebral bodies without excessive deformation may be inverted. This inversion of the curvature automatically creates an expansion in the concavity that allows the 4th dynamical dimension, ie contact during movement and breathing.

MSW The fifth concept is an explanation of de-coupling effect between lateral curvature and vertebral rotation which has been discussed and emphasized in the literature.

Yes, but with a lot of uncertainty about the direction of rotation which may differ depending on the position of the spine in the sagittal plane. When there is a flat back, the initial scoliotic rotation may be increased by the correction in the frontal plane. Restitution of physiological curves in the sagittal plane seems to go in the direction to decrease the scoliosis rotation (Harrison Fryette’s laws)


**Principle I**: When the spine is in neutral, sidebending to one side will be accompanied by horizontal rotation to the opposite side.

**Principle II**: When the spine is in a flexed or extended position (non-neutral), sidebending to one side will be accompanied by rotation to the same side.

With EOS we hope to better study the effect of the brace on rotation.

MSW The 4D global correction of ARTbrace should further be explained as it has been generally accepted that balancing among the three anatomical planes are very important for harmonic growth and functioning of the spine.

(see above concept 2) I agree

MSW The proposed concept should be verified with mathematical model and advanced imaging technique (referred to the changes of bony geometry).
We are currently working with the mathematician Marc Ginoux and François Lavaste (ENSAM) who are very interested in the concept of ARTbrace. Future publications are in preparation (IRSSD)…

MSW In the procedure of CAD/CAM scanning, it would be useful to quantify and document the amount of axial elongation, lumbar and thoracic shift, de-rotation and lateral tilting; and how close would be in comparison between the corrected posture captured by CAD/CAM and the final in-orthosis situation.

Thank you for suggesting this research. For axial elongation the immediate increase in height may be useful. For lumbar and thoracic shift all data are stored in ORTEN and constitute a database useful for further research. For derotation and lateral tilting EOS provides us with quantifiable results but for the moment we do not always have EOS before bracing. Some results are very interesting like this girl Leslie K T10-L3 42° and 2° in brace, as the EOS results show before bracing and “in brace”.

LS A stronger, more thorough background and introduction section in the abstract and main paper is essential to help readers understand the authors historical perspective with EDF plaster casting and the Lyon brace. Highlight previous studies supporting the positive results with casting and Lyon brace but also explain the challenges and complications that prompted a need for improvements that ultimately resulted in the development of this new design.
While the ART brace could be defined as a modified or "new" Lyon brace, I suggest you emphasize that this completely replaces the casting and old Lyon brace process; it really deserves to be recognized as its unique design that has surpassed its predecessor and former protocol.

The Methods section of the abstract would benefit from editing and polishing and should focus strictly on the process and statistical comparisons. Easier if the concepts are presented in an introduction.

The results section needs more detailed description on the rows, specifying "Cobb angle" or Curve magnitude in degrees. See Table 1.

Discretionary Revisions

The current clinical outcomes of ARTbrace look quite promising but are limited to short-term (3 days follow-up). Long-term results are expected.

A second paper is in preparation with the results after 1 year and will be submitted shortly. We considered all the patients from 2012 and January-may 2013 treated with the old Lyon brace, which allows a matched pair control. If the initial in-brace reduction is 40% higher than the old Lyon brace, this percentage increases at 6 months and 1 year, which would suggest that the greater the initial in-brace reduction is, the better the final result is. The efficiency of the ARTbrace seems to continue beyond the initial reduction.

The suggested seating posture for the patients using ARTbrace may lead to early tiredness of the back and lower limbs because no back rest is provided to the patients who may need to sit a prolonged period of time for reading and writing.
In the ARTbrace, the fixed point is the lower part of the thorax at the thoracolumbar junction. The dynamic movement of the posterior part of the spine is better in this posture. It is the fourth dimension of the brace. The child will relax in the listening posture on the back of the chair. Alternating these two extreme postures seems to be more dynamic.

MSW The patients’ compliance of ARTbrace should also be studied.

Compliance will be discussed in the second paper. But even with the plaster cast, compliance was not 100% and some children took the plaster cast off, most of them before surgery…

LS The content has great potential ...and with some grammatical corrections and revisions from a professional editor will be cleaner, clearer and easier to read!

Thank you