Cephalic stabilization and idiopathic scoliosis


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Keywords: Idiopathic scoliosis; Cephalic repositioning; Cervical Proprioception

Introduction.— In idiopathic scoliosis (IS), increase of osteopontin tissue expression [1] due to a defect of melanotin signaling could explain the various ocularmotor, vestibular and proprioceptive anomalies. These anomalies can disturb postural control including cephalic stabilization control. Cephalic stabilization is influenced by vestibular, visual, ocularmotor, proprioceptive and cervical information and used as a reference to vertical gravity.

Objective.— To evaluate the cephalic stabilization in IS, with a validated test: Cephalic Repositioning Test (CRT).

Methods and materials.— In this prospective study, we evaluate, in a IS population with an angle Cobb ≥ 15°, cephalic repositioning ability with CRT on a target, eyes closed, after ten right rotation and ten left rotations. Quantitative and qualitative statistical analysis is performed.

Results.— Thirteen IS subjects (age 13.5 ± 2.36) were evaluated. Forty percent have a pathological right and left CRT (≥ 6°), 76.9% have at least one pathological CRT and 61.1% have a pathological left CRT. Higher right lateralization was found significantly after repositioning. Abnormal left CRT is associated with a high angle Cobb lumbar (P < 0.05), and more significant with left convexity lumbar scoliosis (P < 0.05).

Discussion and conclusion.— These preliminary results show a disturbance of CRT and indirectly proprioceptive cervical control in IS. Requires further evaluation with a larger number of IS and matched a control group. In this disease, the test systematization is the detection and guidance to a specific rehabilitation: oculo-cervical reprogramming according to Revel’s [2] protocol.

References

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Laterality and idiopathic scoliosis

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Keywords: Idiopathic scoliosis; Laterality; Melatonin; Posture; Interhemispheric interaction

Introduction.— Several authors found a significant relation between handedness and asymmetry of trunk. The laterality is partially in relation with interhemispheric interaction. It is permitted by interhemispheric commisura, particularly the corpus callosum. Arguments evoke relation between abnormalities of the interhemispheric interaction and scoliosis: 1) the HGPPS, rare human syndrome, associates scoliosis with dysfunction of commissural neurons; 2) significant decrease of the volume of the corpus callosum in the idiopathic scoliosis (IS).

Objective.— Evaluate the interhemispheric interaction in IS, by studying eyes-hand-foot laterality.

Methods and materials.— Prospective case-control study, estimating by eye-hand-foot laterality with specific tests, to SI ≥ 15°. The score allows classifying each laterality in right or left dominance. When the three dominances are isilateral, the laterality is homogeneous; in the opposite, it’s a cross-dominance.

Results.— Two groups were estimated: 38 AIS, and 26 controls. AIS present more cross-dominance than controls: 69% vs 30% (P = 0.003). Cross-dominance eye-hand is most frequent (eye-hand 65.4%; foot-hand 11.5%; mixed dominance 23.1%). These observations show disturbance of the interhemispheric interaction.

Discussion and conclusion.— Results are independent from the scoliotic deformation, because dominance install before seven years. The cross-dominance eye-hand favors direct retino-geniculo-cortical pathway, to save time of interhemispheric transfer during eyes-hand activities. This preferential use of some visual pathways can be secondary of the defect of melanotin signal transduction in ISA. This defect induces increase of osteopontin’s tissular expression. Osteopontin, coupled with the CD44 receptor, which can inhibit, in the optic chiasm, the growth of visual axons in some directions. The sub-use of the crossed retino-tecto-cortical pathway, which contributes to the cervicocephalic visual stabilization, could perturb the postural downward control. The incapacity of proprioceptive compensation, especially cervical, could explain the abnormal muscular adaptation of trunk, and consequently spine deformity. These results can generate new therapeutic orientations.

Further reading

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Intradiscal pressure change induced by a lumbar orthosis

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Keywords: Lumbar orthosis; Intradiscal pressure; Finite element; Low back pain

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**Introduction.**—To correct the spine sagittal imbalance, lumbar orthoses are commonly prescribed as conservative treatment of low back pain. These devices could affect the distribution of loads among passive and active lumbar sub-systems. However, with only one study in this field proposed by Nachemson et al. (1983), their biomechanical action such as the reduction of the intradiscal pressure (IDP) remains unknown and controversial. The goal of this study was to investigate the IDP change induced by a rigid lumbar orthosis from a new non-invasive measurement method.

**Method.**—From the comparison of two radiographs EOS™ (Biospace, Paris) with and without a lumbar orthosis, the displacements and rotations of each vertebra were calculated and implemented in a patient-specific finite element modelling. The IDP measurements along each lumbar disc were extracted with a precision of $\pm 2.5\text{ Pa}$. Twenty patients were tested in standing or sitting posture with a semi-rigid lumbar orthosis Lordactiv™ (Ormihl-Danet, Villeurbanne) in two conditions: with or without a curved rigid lumbar part.

**Results.**—A curved rigid lumbar part was necessary to obtain significant IDP distribution change along the anteroposterior direction. Interestingly, an IDP decrease appeared in some patients until $-50$ to $+8$ Pa. However, the IDP change appeared only could be explained by a decrease muscle activity. Especially, the intradiscal elasticity (age-dependent) and the lumbar back adipose tissue thickness are the main variables correlated with the interindividual differences.

**Discussion.**—An IDP distribution change reveals a different load sharing between posterior elements and intervertebral discs whereas decompression could affect the distribution of loads among passive and active lumbar sub-systems. However, only one study in this field proposed by Nachemson et al. (1983), their biomechanical action such as the reduction of the intradiscal pressure (IDP) remains unknown and controversial. The goal of this study was to develop a new non-invasive and patient-specific method allowing lumbar intradiscal pressure change measurement induced by conservative or surgical treatments.

**Conclusion.**—These results demonstrated that wearing a rigid lumbar orthosis can significantly influence the stress-strain values in diseased discs, provided that the patient is kept an sufficient elasticity.

**Further reading**


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**New non-invasive and patient-specific method allowing intradiscal pressure change measurement induced by lumbar conservative or surgical treatments**

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**Keywords:** Intervertebral disc; Pressure; Load; Finite element; Low back pain

**Introduction.**—Mechanical loads on the spine appear to play a major role in the etiology of low back pain. Unfortunately, little is known about the intradiscal pressure change associated with conservative or surgical treatments. Direct and indirect measurements are mainly limited respectively by the invasiveness and by the patient-specific calibration of the finite element modelling. The goal of this study was to develop a new non-invasive and patient-specific method allowing lumbar intradiscal pressure change measurement induced by conservative or surgical treatments.

**Method.**—According to an adaptation of the Catmull-Rom Splines method validated by McCane et al. (2006), the displacements and rotations of each vertebra were measured from the comparison of two radiographs EOS™ (Biospace, Paris) before and after treatment. The elastic modulus of each disc was calibrated from the comparison of two radiographs non-loaded and loaded with 4 kg on each shoulder of the patient. A finite element model was created from the radiograph without treatment. Finally, the kinematic of each vertebra and the elastic modulus of each disc were implemented in this model, from which the pressure measurements along each lumbar disc were extracted. To determine the precision of this method, the accuracy of $\pm 0.7\text{°}$ and $\pm 0.285 \text{ mm}$ reported by McCane et al. (2006) for the kinematic measurement was simulated in the model created from a clinical case.

**Results.**—The mean intradiscal pressure precision measured along the disc was $\pm 2.5\text{ Pa}$. The precision appeared sufficient to measure a clinically relevant change of pressure in the lumbar disc after treatment. The main advantages of this method are the inclusion of the differences of geometry and elasticity between each level of the lumbar disc and for each patient. Thus, the effectiveness of the treatment can be interpreted in light of the remaining level of discal elasticity.

**Conclusion.**—This method could help to measure effective intradiscal pressure to better understand and improve conservative or surgical treatments of low back pain.

**Further reading**


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