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Hydration properties of the lumbar intervertebral discs in AIS after surgical correction: five years follow-up and comparison with an age-matched control group

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Summary

We compared disc hydration properties of adolescent idiopathic scoliosis before and 5 years after spinal fusion with an age-matched control group. We conducted a prospective MRI follow-up of 23 patients. Disc and nucleus volumes were reconstructed on T2 weighted sequence. In the scoliotic group, v_d and v_n were lower than control group, hydration ratio (V_n/V_d) was lower. After surgery, subjacent discs rehydrated. AIS induces a loss of IVD hydration. Surgical correction can reverse homeostasis disturbances related to spinal deformity.

Hypothesis

Scoliosis may alter intervertebral disc hydration and induce early degenerative changes.

Design

to compare the disc hydration properties of adolescent idiopathic scoliosis (AIS) before and 5 years after spinal fusion with an age matched control group.

Introduction

Intervertebral discs (IVD) assume the mechanical support and flexibility of the spine. The supportive function is under the influence of disc hydration. Scoliosis induces a chronic asymmetric loading of the IVD that may alter the disc nutrition and may induce early degenerative changes.

Methods

We conducted a prospective MRI follow up of 23 AIS patients (average follow up period 5,5 years). Patients underwent pre and post-operative T2 weighted MRI sequence. Specific software was developed with Matlab® to reconstruct disc and nucleus volumes (v_d , v_n). Hydration content was determined by the ratio v_n/v_d expressed in percentage. A comparative control group of 20 patients was matched by age. Controls were selected in the PACS database and medical charts were reviewed to exclude any deformity or disease affecting the spine. Disc hydration content was measured using the same protocol.

Results

In the control group, volumetric parameters increased during growth spurt and were correlated to age (v_d : $R^2=0.49$, $p<0.001$) ; v_n : $R^2=0.33$, $p=0.02$). Disc hydration content remained constant (mean 28%). In the scoliotic group before surgery, v_d and v_n were lower than normal values, hydration ratio was lower (mean 24%). At latest follow-up, V_d remained constant while v_n increased significantly. Disc hydration content was boosted at a mean value of 32% ($p=0;001$, Mann Whitney Wilcoxon test).

Conclusion

AIS induces a loss of IVD hydration. The correction-fusion induces expansion of the nucleus, but at constant disc volume. Our results suggest that scoliosis surgery performed at the end of growth can reverse the discs constraints related to spinal deformity. However subjacent discs become "hyper hydrated" after surgery. This may be a consequence of homeostasis restoration but also excessive stress induced by spinal fusion on the lumbar spine.