15th International Symposium on Computer Methods in Biomechanics and Biomedical Engineering
and
3rd Conference on Imaging and Visualization
CMBBE 2018
P. R. Fernandes and J. M. Tavares (Editors)

Abstract ID-12

SHEAR WAVE ELASTOGRAPHY TO CHARACTERIZE SCOLIOTIC INTERVERTEBRAL DISC

Claudio Vergari[(1)], Tristan Langlais[(2)], Raphaël Pietton[(2)], Jean Dubousset[(1)], Wafa Skalli[(1)], Raphaël Vialle[(2)]

[(1)]Institut de Biomécanique Humaine Georges Charpak, France
claudio.vergari@ensam.eu

[(2)]DHU MAMUTH - Department of Pediatric Orthopaedic, Armand Trousseau Hospital, France

Keywords: scoliosis, imaging, mechanical properties

Summary: Adolescent idiopathic scoliosis (AIS) is a 3D deformity of the spine that can rapidly progress during adolescent's growth spurt; an unchecked progression can lead to respiratory or locomotion impairment that can only be corrected by spinal surgery. Nevertheless, if progressive cases are detected early, they can be efficiently treated by bracing. Intervertebral disc (IVD) is a main component of spine mechanics, and could play a biomechanical role in the vicious cycle leading to curve progression. Moreover, personalization of its mechanical properties in numerical models would improve their realism. Shearwave ultrasound elastography was recently applied to measure shear wave speed (SWS) in IVD in vitro, in animal model, and in vivo in healthy subjects. SWS measurement proved reliable, and it correlated to disc mechanical properties. In the present work, elastography was applied to compare SWS in scoliotic and healthy lumbar IVDs.
Thirty healthy adolescents (13.0 ± 2 years old) and thirty scoliotic patients (13 ± 2 years old, Cobb angles 28.8° ± 10.5°, range 13-50°) were included. Of the latter, twenty were progressive (Cobb > 25°) and 10 were stable scoliosis (i.e., Cobb angle < 25° and Risser sign > 2). SWS was measured in L3-L4, L4-L5 and L5-S1 discs with the patient lying in supine position.
SWS was 3.0 ± 0.3 m/s in healthy discs and 3.5 ± 0.3 m/s in scoliotic discs; the difference was significant ($p < 0.001$). The difference was also significant at each disc level independently ($p < 0.05$). Results suggest that a junctional disc with a high SWS is associated with a risk of progression accrued by 4.6 times.
Measurement was feasible and did not present particular difficulties. Moreover, SWS in the control group was similar to those previously measured in healthy children (2.9 ± 0.5 m/s). These results should be confirmed on a larger cohort; in particular, the effect of scoliosis topology, which was not controlled in the present work, should be investigated. Nevertheless, this study confirmed the potential interest of IVD elastography as a biomarker of scoliosis, but also of its use in the personalization of numerical biomechanical models.