PATIENT-SPECIFIC SOFT TISSUE PROPERTIES FOR AIS PATIENTS: A FINITE ELEMENT STUDY

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There is a need for improved understanding of the biomechanics of scoliosis surgery due to high complication rates and suboptimal outcomes. Patient-specific finite element (FE) models are becoming increasingly utilized in orthopaedic biomechanics. While patient specific osseoligamentous geometry can be readily obtained from patient image datasets (eg. MRI,CT), material properties for spinal soft tissues are more complicated to derive for an individual patient. This paper will describe the use of Fulcrum bending radiographs to determine patient specific soft tissue properties for use in computational studies of scoliosis. Osseo-ligamentous geometry for five adolescent idiopathic scoliosis (AIS) patients was derived from low-dose pre-operative CT datasets. Anatomical landmarks on the thoracolumbar spinal column and ribcage were used to derive patient specific FE models. A cylindrical bolster was simulated for each patient to reproduce the Fulcrum bending technique described by Cheung and Luk (1997). Loading conditions simulated the distributed gravitational load of the torso when laid over the bolster. Fulcrum bending involves minimal muscle activation, thus this diagnostic technique lends itself to inverse determination of passive spinal soft tissue properties (ie. intervertebral discs, ligaments). Ligament and disc stiffnesses were initially based on data reported in the literature. Following FE analysis these properties were changed depending on the agreement between the clinically measured bending Cobb angle and the computationally predicted Cobb. Using soft tissue stiffnesses from the literature, there was limited agreement between computational and clinically measured major Cobb angle. Iterative variation of ligament stiffnesses allowed the predicted Cobb angle to be brought into agreement with the clinical value in each case, thus defining a set of patient specific soft tissue properties for use in further biomechanical studies.

Cheung, K. M. and Luk, K. D., 1997, *J bone Joint Surg Am*., **79**, p1144-50.