A Study of Articulating Facets of the Lumbar L2-L3 Motion Segment

Kim-Kheng Lee, Ee-Chon Teo, Qiu Tian-Xia, Hong-Wan Ng
School of Mechanical & Production Engineering, Nanyang Technological University, Singapore
Corresponding author: Ee-Chon Teo  E-mail: mecteo@ntu.edu.sg

Introduction
Realistic geometric representation for modeling complex vertebra has been accentuated by many investigators as one of the crucial factor for predicting biomechanical responses using finite element method. The predicted biomechanical responses depend on accurate anatomic, physical and material representation of its structural components. The reported modeling of articulating facets in the finite element model of lumbar spine is not able to faithfully represent its role biomechanically due to approximation of the real facet. Accordingly, an anatomically accurate and validated FE model of L2-L3 segment was developed to study the significance of modeling articulating facets under various physiological loadings.

Methods and Materials
In order to extract complex geometry of vertebra with an emphasis of the facets, direct digitizing process was explored to extract the geometrical data of embalmed lumbar spine for the finite element construction in downstream process. It was achieved by using a highly accurate and versatile digitizer, FaroArm, to automatically capture such data in a systematic approach and by employing advanced modeling technique available in the finite element software, ANSYS, to discretize solid domain into finite element mesh.

By subjecting the L2-L3 FE model (Figure 1) to physiological loadings, analysis of the articulating conditions of the facets was done to evaluate its role under these conditions to understand facet joint deficiency and stability studies.

Discussion/Conclusions
An anatomically accurate and comprehensive FE model of L2-L3 motion segment is developed to study the articulating facets in lumbar spine. Employing the direct digitization technique, rather than CT images or literature on anatomy of the lumbar spine, to extract the geometrical data, the complex surface of the articulating facets are anatomically modeled for the analytical biomechanical study.