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Patient specific finite element models for the spine and ribcage to investigate scoliosis correction devices

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Scoliosis is three dimensional deformity characterized by deviation in the structure of the thoraco-lumbar spine in coronal, sagittal and transverse planes. Finite Element (FE) models of the spine and ribcage have been widely developed for investigating surgical and non-surgical treatment options to correct the deformity. Variations in the pattern of deformity in every scoliosis patient necessitate the development of patient-specific FE models of the thoraco-lumbar spine and ribcage. Currently available patient specific FE models for such investigations are limited to a single patient specific geometry. However, developing FE models for each patient without compromising the anatomical features is time intensive. Hence there is a need for techniques that can rapidly generate patient-specific FE models of the spine and ribcage and also optimally accommodate patient specific variations, which is not addressed by the current available FE models. The main goal of this work is to develop baseline FE model of the normative thoracic spine and ribcage that will serve as the basis for generating scoliosis patient specific FE models. The baseline model was developed using the multi-block meshing technique available in ANSYS ICEM-CFD 14.5 (ANSYS, Canonsburg, PA). The baseline FE model was also validated against the data pertaining to the flexibility of the spine (with and without ribcage) reported in the literature. The validated baseline FE model was morphed to a scoliosis patient-specific spinal geometry based on the FE morphing algorithm that was developed in house. Such methods to rapidly develop patient-specific FE models will be useful to plan surgical or bracing treatments for individual patients.

Biography

Prasannaah Hadagali completed his Bachelors in Biomedical Engineering from Anna University, Chennai, India in 2010 and obtained a Masters from Drexel University, Philadelphia in 2014. His research work during graduate studies was specialized in spinal biomechanics and scoliosis. He served as a Research Assistant in the Orthopedic Biomechanics Laboratory from 2012-2014 under the guidance of his Mentor Dr. Sriram Balasubramanian. He was instrumental in developing protocols to aid generation and validation of patient-specific FE models of the spine and ribcage. He is looking forward to start his career as a Research Engineer at the Medical College of Wisconsin from November 2014.

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