Development and Validation of A C0-C7 FE Complex for Biomechanical Study

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Abstract

In this study, the digitized geometrical data of the embalmed skull and vertebrae (C0-C7) of a 68-year old male cadaver were processed to develop a comprehensive, geometrically accurate, nonlinear C0-C7 FE model. The biomechanical response of human neck under physiological static loadings, near vertex drop impact and rear-end impact (whiplash) conditions were investigated and compared with published experimental results. Under static loading conditions, the predicted moment-rotation relationships of each motion segment under moments in mid-sagittal plane and horizontal plane agreed well with experimental data. In addition, the respective predicted head impact force history and the S-shaped kinematics responses of head-neck complex under near-vertex drop impact and rear-end conditions were close to those observed in reported experiments. Although the predicted responses of the head-neck complex under any specific condition cannot perfectly match the experimental observations, the model reasonably reflected the rotation distributions among the motion segments under static moments and basic responses of head and neck under dynamic loadings. The current model may offer potentials to effectively reflect the behavior of human cervical spine suitable for further biomechanics and traumatic studies.

Key words: Finite element, Cervical spine, Dynamic, Impact, Validation, Whiplash