Abstract

A detailed three-dimensional head-neck (C0-C7) finite element (FE) model developed and validated previously based on the actual geometry of a cadaveric specimen was used to evaluate the effect of cranial acceleration on the response of cervical spine during low speed rear-end impact. Analyses were carried out to compare the predicted overall and segmental rotations, peak disc stresses and capsular ligament strains of each motion segment during whiplash with or without cranial acceleration applied on C7 inferior surface. The results show that in the first 150ms, the variation curves of predicted segmental rotational angles, disc stresses and capsular strains for each motion segments overlapped well under the two conditions. However, after 150ms, the capsular strains of C2 to C6 without cranial acceleration applied on C7 were all obviously lower than those with cranial acceleration applied, but the segmental rotational angles and disc stresses remain unaffected. It was implied that although without cranial acceleration applied on C7, the relatively simple head-neck model could be used to effectively reflect the biomechanical response of the cervical spine during initial stage (i.e. 150ms) under low speed rear-end impact as well as the whole human body dummy model.

Key words: Finite element, Rear-end impact, Cervical spine, Cranial acceleration, segmental rotation, capsular strain