

Effects of Active Muscle Contraction in a Car Occupant in Whiplash Injury

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Abstract : Whiplash Injuries are usually associated with car accidents. The sudden forward or backward jerk to head causes neck strain, which is the result of damage to the muscle or tendons. Neck pain and headaches are the two most common symptoms of whiplash. Symptoms of whiplash are commonly reported in studies but the Injury mechanism is poorly understood. Neck muscles are the most important factor to study the neck Injury. This study focuses on the development of finite element (FE) model of human neck muscle to study the whiplash injury mechanism and effect of active muscle contraction on occupant kinematics. A detailed study of Injury mechanism will promote development and evaluation of new safety systems in cars, hence reducing the occurrence of severe injuries to the occupant. In present study, an active human finite element (FE) model with 3D neck muscle model is developed. Neck muscle was modeled with a combination of solid tetrahedral elements and 1D beam elements. Muscle active properties were represented by beam elements whereas, passive properties by solid tetrahedral elements. To generate muscular force according to inputted activation levels, Hill-type muscle model was applied to beam elements. To simulate non-linear passive properties of muscle, solid elements were modeled with rubber/foam material model. Material properties were assigned from published experimental tests. Some important muscles were then inserted into THUMS (Total Human Model for Safety) 50th percentile male pedestrian model. To reduce the simulation time required, THUMS lower body parts were not included. Posterior to muscle insertion, THUMS was given a boundary conditions similar to experimental tests. The model was exposed to 4g and 7g rear impacts as these load impacts are close to low speed impacts causing whiplash. The effect of muscle activation level on occupant kinematics during whiplash was analyzed.

Keywords : finite element model, muscle activation, neck muscle, whiplash injury prevention

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