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Influence of Neck Muscle Tone on Brain Tissue Strain during Pedestrian Impacts

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Unprotected pedestrians are an exposed group in rural traffic were the most vulnerable human body region is the head and the source of many fatal injuries. Brain tissue strain has been shown to correlate well with brain injuries in a detailed FE model [1]. This study was performed to gain a better understanding of the influence that the neck muscle tone has on brain tissue strain during pedestrian head impacts. The study was carried out using a detailed whole body FE model with a detailed neck [2], [3] and brain model [4]. To determine the influence of the muscle tone, a series of simulations were performed where the vehicle speed, pedestrian posture and muscle tone were varied. A generalized hood was also used to get the same impact surface in the different simulations and isolate the influence on strain due changed head kinematics. The influence of increased muscle stiffness was also isolated by adding the increased stiffnes momentaraly before head impact. Hence, the head kinematics did not have time to change and a change in strain was asumed to only be due to the changed neck stiffness. It has previously been shown that the neck muscle tone has a relatively small influence on head kinematics compared to posture, and hence head impact orientation [5]. The influence on brain tissue strain levels was however highly sensitive to impact point on a detailed vehicle due to the complex impact surface. When impacting a generalized surface the diffrences in strain between all simulations were significantly reduced and the influence due to muscle tone was in the same level as due to posture. The isolated influence of increased neck stiffness due to muscle tone was lower than the influence due to slightly changed head impact orientation. The increased neck stiffnes was therefore considered relatively un-significant when considering brain injuries due to first impact on a vehicle structure in pedestrain accidents.

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