Neck posture and muscle activation: a human volunteer study comparing the effect of upright and inverted postures

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ABSTRACT

Rollover accidents are highly dynamic and complex events in which occupants frequently contact the interior of the vehicle, such as the roof. Injuries to the head, spine and spinal cord, due to head-first impact, are common in occupants involved in rollover accidents. Cadaveric drop tests at the University of British Columbia have shown that the type of injury sustained in a head-first impact depends on compressive neck muscle forces and the alignment of the cervical vertebrae. However, there is little understanding of how the neck posture changes when someone is upside down or how muscle control can alter this posture. Therefore, the aim of this study is to explore how people react to a head-first impact scenario, such as a rollover, by altering their neck muscle activation and their neck alignment. The first step to advancing our understanding is to quantify which neck muscles are active and what the spinal posture is in an upside-down configuration. Human subjects are placed in seated upright and inverted configurations using a custom built chair apparatus. For both configurations, neck muscle activity is recorded using indwelling electrode electromyography and vertebral alignment is measured using fluoroscopy. Preliminary results (n=2) indicate that there are changes in the posture of the neck as well as altered muscle recruitment strategies in the inverted configuration. In a relaxed inverted configuration, the cervical vertebra (C1-to-C6) rotated by an average of 11.3 degrees in extension, with the largest rotation at C4 (16.9 degrees). The neck muscle activity also increased, most notably for the neck flexor muscles (sternohyoid and sternocleidomastoid). This study will provide a unique in vivo data set of vertebral and muscular response to inverted configurations, which can be used to develop, improve and validate headfirst injury models. Ultimately, application of this data has the potential to advance injury prevention strategies through vehicle design and improved sporting equipment.