CERVICAL INTERVERTEBRAL KINEMATICS AND MUSCLE REPONSES DURING SIMULATED VEHICLE ROLLOVERS

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INTRODUCTION

Rollovers account for 3% of motor vehicle crashes [1] but cause one third of all crash-related fatalities [2]. Despite advanced cervical spine injury models, a discrepancy exists between clinically reported injuries and cadaver-test pathologies [3]. In cadaveric tests, the intervertebral posture and simulated muscle tone typically mimic an upright and relaxed condition that may not exist during a rollover. The cervical spine posture and muscle activity of an occupant immediately before a headfirst impact is unknown. In previous tests in our lab, we observed that cervical spine posture and muscle activity changed due to inversion alone [4] and when adopting a static protective posture [5]. Our goal here is to extend these prior static experiments by capturing the *in vivo* dynamic cervical spine re-alignment and muscle activity during a dynamic event that more closely simulates an impending head-first impact.

METHODS

A custom device was built to expose human subjects to an inverted free-fall that simulates a short phase of a rollover crash (Figure 1). Subjects are seated in an upright posture and then inverted and elevated by a linear motor. Subjects are exposed to a 312ms inverted free-fall, which is sufficient to capture a postural response [6], before being brought to rest (peak deceleration of 1.34g). An on-board fluoroscopic C-Arm captures image of the cervical spine during the drop at 400 Hz. Indwelling wire electrodes are anchored in 8 neck muscles to record electromyographic (EMG) activity at 4 kHz. This study is approved by the University of British Columbia's Clinical Research Ethics Board.

RESULTS AND DISCUSSION

Results will be available for the symposium. Image analysis will yield the intervertebral angles and eccentricities, C7 angle, and Frankfort Plane angle. EMG data analysis will yield the neck muscle activation pattern. Findings will be compared to prior human subject data [4,5].

CONCLUSIONS

A custom inversion device was built to simulate impending headfirst impacts and to capture cervical spine posture and muscle activity. An *in vivo* data set of vertebral and muscular responses, in the context of pre-impact in a rollover environment, could be used to improve and validate current injury models and to advance injury prevention strategies.

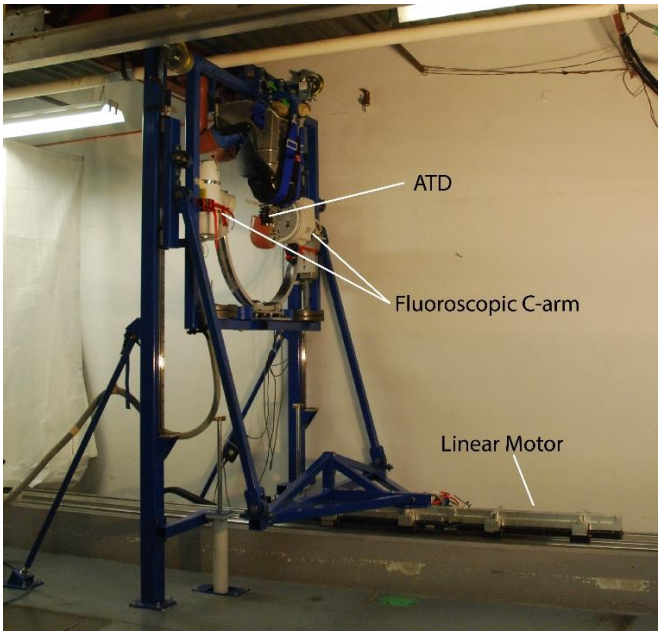

Figure 1 - Oblique view of the inversion device in which an ATD is inverted and raised to the fixed drop height.

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