Chiropractic Update

Update 65

KINEMATIC AND ELECTROMYOGRAPHIC RESPONSE TO WHIPLASH

Whiplash injury is a common injury, with a substantial health and economic burden. For five decades, researchers have been striving to discover the mechanisms of whiplash injury to develop methods of prevention through automobile design, and to develop treatment approaches. While earlier experiments with animals, cadavers, and military volunteers have provided some useful insights, it is only in recent years that research has progressed to reveal how neck muscles respond to collisions, particularly how they bear the burden of the forces of collision and how impact direction affects the neck muscle response which may determine the mechanism of injury.

Initially volunteer experiments tended to focus on impact velocities (specifically differences in target and bullet vehicle velocities) and head acceleration, but gradually the focus has shifted to understanding the pattern of spinal segment motion and muscle contraction in response to the perturbation.

Using a new approach which combines sled devices, accelerometry, electromyography, and regression techniques without subject injury, recent research has begun to unravel how neck muscles respond to accelerative loads, bear the burden of low-velocity impacts, and how this load changes according to direction of impact. The approach involves the use of four levels of very-low to low velocity impacts to describe the kinematics of the head and the EMG response of cervical muscles in response to acceleration, but avoids any discernible risk of injury. This allows researchers to determine the cervical muscle response under many different scenarios, including varying direction of impact, awareness of impending impact, and others, without subjecting volunteers to any discernible risk. Some of this work has been published or accepted for publication and some remains in progress. From this growing body of work a summary of kinematic and EMG responses can be made.

As mentioned above, besides subjecting volunteers to eight directions of impact, it is also possible, for any given direction of impact, to study the variable of expectation of impact. Kumar et al. have previously shown that blocking of visual and auditory cues for impact affects the kinematics and the EMG responses to impacts where the subject does not have these cues blocked.

It has been further shown that this effect is not due to a tendency for adaptation by the volunteers to repeated impacts, because the time relationships hold when the impacts are delivered in a random order of directions and acceleration severities, and these trends hold across all directions of impact. It is apparent that head displacement is greater when the impact is unexpected, suggesting that this may affect injury risk.

In conclusion, initial results of impacts from eight directions reveal that the cervical response to whiplash-type impacts is modified by impact awareness, muscles studied, and direction of impact. This will hopefully improve the understanding of the human response to low-velocity whiplash impacts.

Reference:

Kumar S, Ferrari R, Narayan Y. Kinematic and electromyographic response to whiplash loading in low-velocity whiplash impacts - a review. Clinical Biomechanics 2005; 20:343-56.

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