What You Should Know About Whiplash Trauma

The mechanisms of neck and cervical spine injury in cervical acceleration/deceleration (CAD) or “whiplash” trauma are complex and highly variable owing to the wide range of sitting postures, physical make-ups, and premorbid conditions of real world occupants. Seat back and head restraint designs and adjustments add further variability to the mix, as do the almost infinite variety of collision variables. The purpose of this ALERT is to present an injury model that generally describes the injury mechanism for rear impact collisions.

Crash Speeds and Resultant Injury

Contrary to popular belief, the vast majority of all reported injuries following a motor vehicle crash occur at low speeds. Based on the government figures of tow-away rear impact crashes, 73% occur at speeds between 11 and 20 mph and 12.9% occur at speeds of less than 11 mph. The majority of all impacts occur at relatively low speeds – less than 20 mph – and 81% of injuries associated with rear impacts occur at impact speeds below 30 mph. However, this data is conservatively skewed as a result of the nature of the data collection process. The majority of rear impact crashes (tow-away combined with the more common non-tow-away variety) occur at collision speeds between 1 and 15 mph, and the largest numbers of injuries are reported in the non-tow-away collisions.

In a Swedish study by Olsson, et al, 18% of their whiplash patients were injured in crashes of less than 6.2 mph, 60% between speeds of 6.2 and 12.4 mph, and the remainder at higher speeds. In an Australian study by Ryan et al, 50% of all of their whiplash injuries occurred at speeds between 6.2 and 12 mph.

Paradoxically, injuries from rear impact collisions are slightly more prevalent in lower speed crashes. This is primarily a result of the elastic nature of vehicles at these speeds, and also because of the tendency of seat backs to fail at higher velocity change (delta V) impacts.

A six-month follow up by these same authors noted no statistical correlation between crash severity and outcome, although there was a trend indicating worse outcomes with greater crash severity. These results follow closely with those of States et al, who reported, “Significant neck injury can occur with rear end impacts of 10 mph. The injury producing forces caused by rear end impacts and delivered to the occupant’s seat increase only slightly with impact speeds of between 10 and 30 mph.”

Bailey et al, summarized results of crash testing from their data and that of others, noting the delta V range in which mild transient symptoms had been reported. Most were between 4 and 5 mph, lending further support to the notion that the threshold for cervical straining injuries is about 5 mph.

Whiplash or CAD Syndrome

Symptoms typically associated with CAD or whiplash trauma include:
1. Neck pain
2. Shoulder pain
3. Upper back pain
4. Headaches at the base of the skull or over the eyes
5. Diffuse pain and/or paresthesia in upper extremities
6. Mild sensory abnormalities in the upper and lower extremities
7. Scapular and interscapular pain
8. Development of trigger points in the neck an upper back
9. Low back pain and sciatica

Neck pain following a motor vehicle crash can result from tearing or damage to any soft tissue (including nervous tissue), fracture of bone, or disc herniation/prolapse/protrusion/disruption. Immediate pain often indicates more severe injury, but many disabling injuries have delayed onset of symptoms. Very early onset of severe pain is sometimes an indication of disc or ligament injury. The balance of current evidence implicates paraspinal soft and hard tissue as the chief locus of pain generation. These include the supporting muscles, intervertebral discs, ligaments, joint capsules, endplates, neural tissue, and the vertebrae themselves.
Lesions reported in CAD trauma.

One of the most injurious forces to the neck – one that is rarely seen elsewhere and one that nature probably never intended humans to endure – is horizontal shear force. This force, accompanied by cervical compression, occurs primarily within the first 100-125 milliseconds after a rear end collision and generally prior to the time the head makes contact with the head restraint.

In some cases due to the height of the occupant or a head restraint that’s adjusted in the down position, the head may extend over the head restraint. In most cases, however, injury occurs before this point.

In addition to the shear and compression forces acting on the spine, stretch of the joint capsules and vertebral arteries along with hyperextension of the lower cervical levels can result in long-term pain and biomechanical compromise as a result of ligamentous sub failure, disc disruption, etc.

In addition to the stretching of ligaments, joint capsules, and blood vessels, nerve roots and the brachial plexus can be stretched resulting in brain, brain stem, and spinal cord injuries.

Depending on the occupant’s kinematics and the nature of the crash, forward kinematics can be just as potentially injurious as rearward kinematics. For example, when the occupant’s struck vehicle then collides with the vehicle in front of it – the so called second collision – the injury kinematics may be compounded with those of the rear end collision making the resultant injury much more complex.

Of particular interest and concern are the injuries to the spinal joints (facet joints) and intervertebral discs. Disc separations from the vertebrae (rim lesions), along with small fractures, significant hemarthroses, and synovial injuries to facet joints have been observed at autopsy in persons who survived their injuries, but died later of other causes. In many cases, the lesions were not visible on radiographs, even in retrospect.

Conclusion

Because so many of the symptoms and conditions such as thoracic outlet syndrome, temporomandibular disorders, post-concussion syndrome, and carpal tunnel syndrome develop subsequent to CAD injury – some developing weeks or months later – CAD syndrome should be looked upon as a process rather than a single event. The clinicians at the Back Pain Relief Center are recognized experts at providing specialized care for people suffering from injuries related to a car crash. We welcome your referrals.

For the latest reviews and updates on back and neck pain, please visit us at www.BackPainReliefSecrets.com

References