Nobody really knows when the term “whiplash injury” originated, and U.S. insurance companies, which each year pay out substantial damages to supposed whiplash victims, undoubtedly wish it never had. The sudden backward snap of the head to which whiplash is ascribed generally happens in rear-end automobile collisions; these annually result in thousands of cases of alleged neck injury.

Time Magazine, October 31, 1960

INTRODUCTION

These words written a half-century ago are as valid today as when they were first printed. Simply put, whiplash remains extremely controversial in both medical and legal circles. In fact, the word still evokes strong reactions in great numbers of people.

Counsel for plaintiffs strongly support this injury and point to their many clients whose lives have been changed since the precipitating event. Defense counsel and insurance companies remain skeptical because there is little objective evidence to verify the injury and they believe that many of the claims are the mere creation of greedy trial lawyers and fraudulent claimants.

Cottage industries have even sprouted advocating one position or the other, and these are not limited to doctors and lawyers. For instance, biomechanical engineers offer expert testimony on whether it is possible for the neck to have been injured in a low-impact accident, and there is a specialized journal devoted to whiplash.

Certain undisputed facts, however, have emerged over the years in relation to this problem. Whiplash or whiplash-associated disorders (hereinafter “WAD”) refers to a constellation of symptoms that occur following an injury to the neck, usually as the result of sudden extension and flexion forces, and the malady can inculpate the intervertebral joints, disks, muscles, ligaments, and tendons. Motor vehicle accidents resulting in a flexion/extension movement of the cervical spine are some of the most common causes of neck injuries, with an estimated 1 million claims per year in the United States alone. Part of this number is attributable to the increased stiffness of newer automobile chassis to improve crashworthiness and stiffer seat back designs.

These injuries, frequently dubbed neck sprains and sprains, are the most commonly reported injuries involving insurance claims, accounting for 66 percent of all bodily liability cases as well as 57 percent of those advancing claims for personal injury protection benefits. The cost of these cases is about $8.8 billion and account for roughly 25 percent of the total dollars paid for all crash victims combined. Neck pain is not limited to automobile accidents as its source and can be caused by a host of other problems such as cervical radiculopathy, cervical spondylosis, cervical myelopathy, a
herniated disk, neoplasms, and systemic inflammatory disorders. The pain may develop with no precipitating trauma, the person may have the immediate onset of discomfort, or the pain may happen days after the event. Surprisingly, a person’s gender plays a role in the development of the injury, with women having a 10 percent higher incidence than men.

The National Institute of Neurological Disorders and Strokes reports that neck and head problems associated with whiplash usually clear up within a few days or weeks and most patients recover within 3 months after injury. Nevertheless, some people complain of symptoms for years with no clear demonstrable cause. In fact, the incidence and outcome of whiplash injuries are greatly influenced by pain and suffering damages, injury severity, legal factors, and socio-demographic characteristics. Studies also show that a claimant’s early expectation for recovery is a significant prognostic dynamic in recovery and potentially modifiable. These findings are supported by an unrelated report that determined that a person’s causal beliefs in whiplash may play a major role in the perceived disability and duration of neck complaints following an accident, in that pain catastrophizing is predominantly related to concurrent disability. This finding is consistent with the opinion that an early belief that neck pain is caused by the medico-cultural entity whiplash has a detrimental effect on the duration and outcome of the symptoms.

This chapter will explore the lingering controversy that surrounds these flexion/extension type injuries despite a host of medical advances, the benefit of thousands of court cases, and medical articles on the topic. It will also offer insight into the structures of the neck, the mechanism of injury, the treatment of the problem, and an overview of this dispute in a litigation setting including trial strategies.

MEDICAL CONSIDERATIONS • The concept of a whiplash-type injury was first introduced in 1928 when Crowe presented several cases of a “lash-like effect” injury to the neck following rear-end collisions. The term whiplash, however, was first coined in the medical literature by Davis in a discussion of neck injuries. Over the years, the nature of this injury has remained controversial. In his 1964 book on neck and arm pain, Dr. Rene Cailliet summarizes the then-contemporary understanding of whiplash by stating:

Symptoms attributed to this syndrome are vaguely described, the etiology is dramatically explained, the mechanisms of injury are poorly understood, and the treatment is empirical at best. In this state of total confusion and ignorance the injured have been neglected, mistreated and even accused of deception, while many uninjured complainers have been exorbitantly and unjustifiably rewarded.

In an attempt to apply science to this controversy, the Quebec Task Force on Whiplash-Associated Disorders was assembled at the request of the automobile insurance industry of Quebec, Canada. The mandate of the Quebec Task Force (QTF) was fivefold: (1) to make recommendations for prevention of whiplash, (2) to understand the natural history of these flexion/extension injuries, (3) to establish a medically sound approach for the diagnosis and treatment of whiplash including an understanding of its
mechanism, (4) to develop a teaching strategy regarding this type of trauma for medical and paramedical professionals, and (5) to assist in the rehabilitation of whiplash-injured patients. The findings of the QTF were published in 1995.\textsuperscript{20} The QTF sifted through 10,000 articles but concluded that only 346 reports were of adequate scientific merit to be considered.\textsuperscript{21} Following the QTF report, a subsequent publication by Rodrigez (and several coauthors) updated the QTF approach to the year 2004.\textsuperscript{22}

This section of the chapter will reference these two important works as well as additional publications on the subject in order to consider (1) the anatomy of the neck, (2) the definition of a whiplash injury with a description of symptoms, (3) the mechanism of the injury, (4) identifying the source of whiplash injury, and (5) the prognosis and treatment of this disorder.

**Anatomy of the Cervical Spine**

The mechanism of whiplash can be better understood when one considers the anatomy of the neck, especially because a number of structures in this anatomic region of the spine can be injured, resulting in neck pain.\textsuperscript{23} Starting with the skeletal components, the neck is supported by a series of seven vertebrae placed on top of each other, positioned in a gentle “C” shape curve, concave to the back of the neck. Interestingly, a giraffe has as many vertebrae in the neck as a human – their bones are just bigger.\textsuperscript{24} The skull sits on top of this cervical region of the spine; this bony structure then continues down to the midback, an area known as the thoracic spine. Each cervical vertebra is assigned a number – C1 to C7 – with the C1 vertebra at the top end just underneath the head and the C7 vertebra at the lowest end of the cervical region contiguous with the top region of the thoracic spine. The C1 vertebra is alternatively called the atlas, because it supports the skull. The next vertebra, C2, is labeled the axis, for it serves as a pivoting point for the head turning left and right in a “no” motion. Projecting from the back of each vertebra is a bony protrusion, the spinous process. The C7 spinous process is the hard lump that one can feel at the base of the middle of the neck. These vertebrae are not the source of neck pain; rather, the discomfort from a fracture or injury to bone is due to the periosteum, the richly innervated membrane covering all bony structures.

Placed between each vertebra is an intervertebral disk or cushion that provides a degree of mobility and allows the neck to bend. As for its appearance, an intervertebral disk resembles a hockey puck. It is a two-layered structure with an inner gelatinous core, termed the nucleus pulposus, and an outer fibrous shell, known as the annulus fibrosis. When a disk herniates, the inner core extrudes through the outer fibrous layers. Disks are usually numbered by the vertebrae above and below. Thus, the C6-C7 disk is located between the sixth and seventh cervical vertebrae.

Each vertebra is interconnected above and below with the adjacent vertebrae by two sets of joints, the facets (also termed zygoapophyseal joints). The facets are quite pain-sensitive, supplied by small sensory branches of each spinal nerve called the medial branches. The vertebrae are stabilized and kept in line by two long ligaments (the anterior and posterior longitudinal ligaments) that extend up and down the front and
back of the spine, as well as by shorter ligaments located in the hole in the vertebrae reserved for the spinal cord (the ligamentum flavum), that interconnect each vertebrae. The muscles of the neck also help to maintain the cervical spine in an upright position and provide movement to the head and neck. There are several layered muscles in the neck, which are of various sizes and shapes.

The spinal cord runs through the opening of the vertebrae called the spinal (or vertebral) canal. This canal is formed much like the tunnel that results when napkin rings are placed on top of each other. At one time, the spinal cord and the brain were considered separate structures. The more modern view is that the spinal cord is a downward continuation of the brain and is a major controlling relay from the brain to direct all voluntary movements of the body and to send sensations up to the brain. The tragic accident involving Christopher Reeve that damaged the spinal cord in his neck, resulting in paralysis of both arms and legs, reminds us of the importance of this neuronal structure.

Extending out from the spinal cord at regular intervals is a series of spinal nerves. These nerves exit the spinal cord through an opening created by the vertebrae above and below, termed the intervertebral foramen. In turn, each spinal nerve is named according to the spinal cord segment; thus, the C7 nerve root originates from the C7 level of the spinal cord. The cervical spinal nerves join and rejoin to form all of the nerves that control and provide sensation to the arms and hands.

The term “soft tissue injury” generally refers to all of the above structures of the neck, except the bony vertebrae.

**Definition and Symptoms of Whiplash**

The QTF adopted the following definition of a whiplash injury²⁵:

Whiplash is an acceleration-deceleration mechanism of energy transfer to the neck which may result from rear-end or side impact, predominantly in motor vehicle collisions, but also from diving accidents, and from other mishaps. The energy transfer may result in bony or soft tissue injuries (whiplash injury), which in turn may lead to a wide variety of clinical manifestations (whiplash-associated disorders).

This definition, stating that injury to the neck results from a sudden acceleration-deceleration, has become the standard since the QTF report was issued.²⁶ Inherent in the description is that although most cases of whiplash occur as a result of motor vehicle accidents, other causes, such as sports-related injuries, may produce similar problems. The other component of this definition is that a whiplash injury can produce a host of different symptoms, collectively termed whiplash-associated disorders (WAD).

WAD include a number of symptoms, some of which are understandable as to how they relate to the injury; some are less apparent. Neck pain is almost always present in patients with whiplash, occurring in 62 percent of victims seen immediately in the
emergency room after a motor vehicle accident. The development of neck pain, however, may be delayed. For instance, 65 percent of the time, neck pain occurs within the first 6 hours of the accident. However, neck pain may take up to a day to develop in 28 percent of patients, and 3 days in 7 percent of other people. Headaches are also commonly seen, up to 82 percent of the time according to one study. This high incidence of headaches is expected because it has been long recognized that head and neck injuries are associated with headaches. In fact, neck pain and headaches are the two most characteristic symptoms, with neck pain occurring in 88 to 100 percent of patients and headache in 55 to 66 percent of the cases.

Dizziness is also reported by whiplash-injured patients, with one study finding a 50 percent correlation. Tingling or other sensory symptoms in the arms, not related to a nerve compression, occur in 33 percent of victims immediately following a whiplash injury. A sense of arm weakness is also a common complaint. With those who experience more long-term residual problems, additionally reported WAD symptoms include visual disturbance (38 percent), cognitive difficulties (50 percent), irritability/nervousness (67 percent), fatigue (40 percent), and depression (37 percent).

The speed of the vehicles at the time of impact would seem to be a main factor in the development of WAD, but studies of accidents at slower speeds of 8 km/h (13 mph) demonstrated that 38 percent of volunteer subjects experienced WAD symptoms. A velocity change of 9.38 mph or less was determined to be the “limit of harmlessness” in a study of volunteers subjected to rear-end impacts. These type of findings have lead to the conclusion that generally the greater the velocity at impact, the greater the chance of injury to the vehicle’s occupants. However, this is not always a reliable assumption. In low-speed collisions, the amount of property damage is not always a reliable predictor of injury. The relevant factors related to injury are the respective size, weight, and speed of the vehicles; the type and position of the seat and head restraint; and the ability of the vehicles to absorb or transmit energy. In addition, “human factors” such as the physical characteristics of the vehicle’s occupants, direction they are facing at the moment of impact, and if they are aware of the impending accident play a role.

The QTF further classified whiplash by grades of severity:

| Grade 0 | No neck pain, no physical signs |
| Grade 1 | Neck pain, stiffness, tenderness; no physical signs |
| Grade 2 | Neck pain with musculoskeletal signs (restricted range of motion, localized tenderness) |
| Grade 3 | Neck pain with neurologic signs/symptoms (weakness, tingling, reflex changes) |
| Grade 4 | Neck pain with vertebral fracture or dislocation |

In addition, grading was assigned based on the elapsed time since the injury: Grade 1 (less than 4 days after injury); Grade 2 (4-21 days after injury); Grade 3 (22-45 days after injury); and Grade 4 (46-180 days after injury).