## Whiplash and Motor Vehicle Trauma: Injuries and Documentation

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otor vehicle accidents (MVAs) are all too common in modern society. According to the Centers for Disease Control, MVAs are one of the leading causes of death and injury in the United States. More than 2.3 million adult drivers and passengers were treated in ERs for MVA injuries in 2009. The lifetime costs of crash related deaths and injuries among drivers and passengers were \$70 Billion in 2005. Rear end motor vehicle accidents (REMVA) are among the most common type of accident. Whiplash is among the most common injuries. Although the medical/ dental professions have recognized this injury since the early 1950's, personal injury litigation in this area rose and fell due to a lack of understanding of these injuries. Judges and juries witness a parade of experts opining on the plaintiff's medical status, while offering a variety of conflicting explanations of the symptoms, damages, and causation. Thus, the judge and jury must render verdicts based on opinions, not necessarily the facts of the case. Both doctors and patients can be confounded when the magnitude of symptomology is totally out of character with the minor damage to the vehicle. The converse is also true and confusing to all parties. There are many cases where automobiles have been totaled and the driver walked away with minor or superficial injuries. The rear end collision is not only the most common vehicular collision; it has the most potential to cause injury to the craniomandibular/ temporomandibular/cervical complex. The rear end collision produces multiple forced hyperextension/forced hyper-flexion injuries, especially involving the cervical and temporomandibular joints. Multiple injuries are the result of repeated movements of the body during the accident. The various injuries caused by this forced acceleration/

deceleration must be thoroughly understood by both the treating clinician to provide effective treatment, and the knowledgeable expert for documentation and analysis of said injuries.

This injury was first termed "whiplash" in 1928 by Crowe and described in detail in 1953 by Gay and Abbott in the Journal of the American Medical Association. The injury has since been described in detail in various medical, dental, chiropractic and physical therapy publications. Interestingly, in the 1800s, rear end railway accidents led to the description of a similar injury termed "railroad spine." The numerous and variable range of "whole body" symptoms have been well documented in the scientific literature, but have only recently been causally linked.

FORCED HYPEREXTENSION: Upon impact, the flexing seat throws the body forward and upward with the head thrown backwards over the headrest until metastatic reflex contraction of the musculature occurs. Inertia keeps the mandible lagging behind the rest of the cranium as the neck hyper-extends. The anterior cervical musculature and all the soft tissues connecting through the hyoid bone and/or into the mandible stretch beyond normal limits resulting in sprains and strains of these tissues. The cranium reaches an endpoint of movement beyond the normal limits of cervical extension with stretching and crushing injuries to the C spine's bony, vascular and neural architecture, and concomitant myofascial damage. The sudden torguing of the condyle in the TM Joint causes its avulsion during the forced hyperextension; muscular strains and sprains occur, and the capsular, discal

collateral and checkrein ligaments tear as the meniscus is ripped from its normal position. The meniscus is ripped forcibly from its position in the joint causing permanent injury and irreversibly compromising joint function. At this point, the metastatic reflex forces the cranium forward forcibly slamming mandible and the maxilla (and the teeth imbedded in them) together. This wrenches the condylar head of the mandible to the back of the TM Joint crushing the neurovascular complex located at the back of the joint, just in front of the ear canal.

FORCED HYPER-FLEXION: The C spine and the head accelerate far faster than the torso during the forward phase of the movement. This forward movement continues until the mandible strikes an object, typically the chest. The cervical spine is forced forward in the extreme with resulting neurovascular, myofascial and bony injuries. The mandible, having been forced into tooth-to-tooth contact, is carried forward along with the cranium until the endpoint again hammers the teeth together and forces the condylar head to the rear of the TM Joint. Since the cartilage disc is no longer interposed between the bones of the joint, the mandible's condylar head acts as a mortar to the cranium's pestle to further crush the neurovascular tissue located at the rear of the joint space. The resulting hemorrhage in the joint initiates changes to the synovial fluids, lining and membranes; alters the synovial fluid content and function, and promotes adhesion formation.

WHOLE BODY LINKAGE: The "whiplash" sequence sketched out above is complicated by angular forces, with a concomitant increase in the magnitude and severity of the injury. This sequence of events normally occurs multiple times (bounce-backs). Since a whole sequence occurs in less than 1/5 of a second, it is common for the victim to be unaware of the movement until the third or fourth cycle. From even this abbreviated version of the whiplash event, it can easily be seen that all of the structural components of the craniomandibular/cervical complex are affected. The effects of the injuries are multiplied and the bio/ physio/mechanics complicated by the omnipresent angular force vectors imparted by the impact. The collision will seldom impart purely linear forces onto the victim. Bodily rotations or the presence of a shoulder harness can further increase the angular component and hence the severity and complexity of the injury. The list of effected tissues includes the muscles and fascia, neural and vascular structures, tendons, ligaments and bone. The entire functional matrix, from skull to shoulder girdle and beyond, is so interrelated, that any unresolved damage to the matrix becomes mutually provocative to the rest of the matrix. Through muscle recruitment and postural

accommodation, it is common for the untreated patient to experience a neuromuscular cascade of increasing dysfunction spreading from the head and neck downward through the spine to the hips and legs. Often, patients will come to our offices months or years after the accident and will have gradually become increasingly compromised to the extent that not only are they physically and posturally debilitated, but have become chronic pain patients, too.

CHRONIC PAIN OVERLAY: Chronic pain is generally defined as pain continuing beyond a few weeks. Chronic pain is more properly called "complicated pain." Chronic pain differs from acute pain in how patients deal with it psychologically. Acute pain generally provokes anxiety and fear; however, the time that the patient suffers is generally of short duration and is caused by a known problem. Because the source of the pain is known and has an anticipated end- point, major emotional disturbances rarely surface. Chronic pain is much more devastating to the patient. Pilling termed chronic pain "the ultimate stress." The complications of chronic pain are due to the patient's response to this prolonged stress. The patient's negative responses to the lingering pain increase in number and intensity the longer that the pain persists. A self-feeding cycle of reduced pain tolerance, increased pain awareness and increased stress from pain develops in these patients. Physiologically, the neural pathways moderating the perception and response to pain become more ingrained to the sensory input from the injured tissues. As more of the body's structural components are recruited to support and compensate for the injured and dysfunctional tissues, the existing stress-spawned neural pathways and the lowered pain thresholds facilitate increased pain perception in the recruited tissues. Additionally, the compensatory postural and functional movements quickly fatigue the muscular components forced to work in an asynchronous, dysfunctional manner. The emotional toll of the continued dysfunctional activity can be devastating on the patient. Hans Selve stated that all creatures reach the point of exhaustion if stress continues long enough. The stress response affects the entire body. The digestive tract is affected reducing the body's ability to provide nourishment just when the demand is greatly increased. The spastic, fatigued muscles function anaerobically thus utilizing the diminished nourishment inefficiently. The basis for the patient's complaints is physical, but the response becomes emotional. The psyche and the soma are inseparable.

Life's two major stressors are "change" and "loss." For the whiplash victim, there is the change from health to illness, from no pain to constant pain, from ability to disability. The losses mount: time away from work, family, friends; financial loss from the accident, treatment costs, and possible litigation costs. The patients will "ping-pong" from one emotional state to another. Without intervention, they will endure an unending cycle of depression, anger, denial, guilt, and fear. Patients gradually withdraw from family and friends, from activities that sap their dwindling energy reserves. Often these patients will be attending the workplace solely for a paycheck to support their family. It is all too common for these victims to lose jobs and/or families as the victims withdraw inside themselves, husbanding their limited energy and coping unsuccessfully with their pain. The presence of chronic pain adds emotional and psychological stresses that not only strain the doctor-patient relationship, but also interferes with evaluating and treating these patients in an objective manner. Doctors treating these demanding and unpleasant patients often overlook the devastating affects of chronic pain on the patient and his/her relationship with family, friends and co-workers.

**OBJECTIVE DOCUMENTATION:** The major problem in most personal injury litigation is the subjective nature of medical opinions. Both plaintiff and defense produce a parade of medical experts, each one opining on the issues; typically causality, prior and current medical condition, and future physical impairment and treatment needs. These subjective opinions are normally at odds with one another, leaving the judge or jury weighing the theatrical skills of the experts and attorneys, rather than the science and facts of the case. Computerized diagnostic instrumentation is used to measure the function and dysfunction of the victim, and to do so in a scientifically valid and repeatable manner. Diagnostic, treatment and documentary predictability requires that the underlying pathogenesis must be assessed and determined. Craniomandibular disorders are initially classified as intrinsic (arthrogenous) or extrinsic

(myogenous) in nature. Research has shown that over 90% of symptomatic patients have myogenous dysfunctions. These muscle-driven dysfunctions are usually precursors to intrinsic joint disorders. Objective documentation requires the ability to accurately record and reproduce data concerning the status of the craniomandibular complex. Fortunately, the instrumentation to perform such accurate measurements exists. The instrumentation consists of computerized Sonography, Electromyography, Electrognathography, TENS and Cone Beam Computed Tomography (CBCT).

CLINICAL AND FORENSIC APPLICATIONS: Practicing clinicians can routinely integrate various radiographic techniques ("plain" cervical films, computed tomography and MRI) with the computerized diagnostics, an extensive "hands-on" clinical exam, the patient's history and subjective complaints, and functional testing to determine the proper differential diagnosis and to develop an effective treatment plan.

**CONCLUSION:** The marriage of clinical, radiographic and computerized electrodiagnostic examinations provides the clinician with a comprehensive diagnostic view of the patient's physical injuries and dysfunctions, thus allowing appropriate and efficacious treatment regimens to be initiated. Attorneys are provided with objective and accurate documentation of permanent injuries, limits of treatment, and ramifications of the injury. Computerized diagnostic equipment married to forensic techniques can be used to both provide evidence of or to dispel claims of trauma related injury. Efficacious treatment and solid proof is provided the true victim, and no malingerer can fake Sonographic, EMG, or EGN data. This methodology allows judge and jury to function as "triers-of-fact," not "triers- of-opinion." Subjective medical opinion is supplanted by objective medical science!

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