

#### RESOURCE No. 1:

Abdel-Fattah R. General Protocol in Evaluating Causation of a TMJ Traumatic Injury. Cranio Jan 1996 14(1): 81-86.

#### ABSTRACT:

A medical healthcare expert gives his opinion of the causation for a TMJ traumatic injury based on the data collected. This article is a recommended guideline to assist the clinician; to organize the information collected on a case; and to present it in a systematic, logical manner so that the non-medically oriented person can understand this opinion.

#### METHODOLOGY:

This article is a suggested protocol for analyzing the medical records before and after a traumatic injury.

#### CONCLUSION:

It is important to study many aspects of the case before delivering an opinion on causation of an injury. The opinion on causation of injury should be based on studying the pre-accident condition, accident mechanics and post-accident developments and events.

#### RESOURCE No. 2:

Benoliel R, Eliav E, Elishoov H, Sharav Y. Diagnosis and Treatment of Persistent Pain after Trauma to the Head and Neck. J Oral Maxillofac Surg 52:1138-47, 1994.

#### ABSTRACT:

A retrospective and prospective study on 22 cases of persistent pain after trauma to the head and neck is presented. According to the predominant symptoms and signs, pain patterns could be divided into musculoskeletal, vascular, and neuropathic facilitating treatment decisions. Most cases were musculoskeletal in origin, with

many demonstrating a combination of two or three pain states.

#### METHODOLOGY:

Both senior authors interviewed all patients at some time during their assessment and treatment. Inclusion data consisted of a clear connection between a traumatic event, usually high-velocity impact or a road traffic accident, and persistent pain. Loss of consciousness was not a prerequisite. The patient was seen in a pain clinic and, after a thorough history and clinical examination, further tests or opinions were requested as deemed necessary. Pain diagnosis was divided into three subgroups: musculoskeletal, neuropathic, and vascular, alone or in any combination. Treatment was instituted and using a patient self-assessment “pain diary” assessed results.

#### RESULTS:

Some interesting trends, albeit on a small sample, became apparent. Four patients made a complete recovery; all of these were “pure” musculoskeletal pains and the average referral time was 4 months. Ten patients reported slight or marked pain relief and, in both of these groups, the average referral time was around 12 months. Four patients reported no change and, in this group, the average referral time was 21.5 months. Three of the five cases that reported sleeplessness enjoyed better sleep with Amitriptyline.

#### CONCLUSION:

In true interdisciplinary pain management, drug therapy is only one aspect of pain control. Amitriptyline was the most useful drug in that it provided pain relief in musculoskeletal, vascular, and some neuropathic pain conditions. Multi-drug therapy may be indicated in some recalcitrant cases and drug alternatives are discussed.

#### RESOURCE No. 3:

Braun BL, DiGiovanna A, Schiffman E,  
Bonnema J, and Fricton J. A Cross-sectional  
Study of Temporomandibular Joint Dysfunction  
in Post-Cervical Trauma Patients. *J Cranioman  
Disorders Facial and Oral Pain*, 1992, 6:24-31.

**ABSTRACT:**

The purpose of this cross-sectional study was to  
determine whether temporomandibular joint

(TMJ) dysfunction is associated with cervical hyperextension - hyperflexion injuries.

#### METHODOLOGY:

Twenty-five post-cervical trauma patients referred to a physical therapy clinic for treatment of neck pain and twenty-five asymptomatic age and sex matched volunteers were evaluated using three assessment instruments: a cervical and TMJ symptoms questionnaire, the Cervical Range of Motion (CROM) instrument, and the Craniomandibular Index. The CROM measures cervical mobility in the frontal, sagittal, and coronal planes of movement. The Craniomandibular Index objectively assesses jaw function. Differences between the groups were analyzed using these tests.

#### RESULTS:

The cervical trauma group had significantly less cervical mobility than the control group, suffered more neck muscle tenderness, reported lifestyle changes, and sleep disturbances as a result of pain with jaw function and limited jaw mobility, and displayed more evidence of mild-to-moderate intracapsular TMJ dysfunction. No differences between the groups were noted in signs and symptoms of advanced TMJ dysfunction. The cervical trauma group also exhibited more signs and symptoms of TMJ dysfunction than did the control group. Findings were less severe. Therefore, that group was more likely to exhibit the early signs of TMJ dysfunction than to exhibit the chronic pain symptoms and more advanced TMJ dysfunction.

This study demonstrates a higher incidence of TMJ pain and dysfunction in people who are referred to physical therapy for evaluation and treatment of cervical pain and dysfunction after sustaining a cervical hyperextension-hyperflexion injury compared to an age and sex-matched control group. In addition, these signs

and symptoms of masticatory dysfunction were significantly higher than the signs and symptoms of masticatory dysfunction seen in an age and sex matched control group.

#### CONCLUSION:

Effective clinical management of post - cervical hyperextension-hyperflexion injury patients should include evaluation and possible treatment

of the TMJ and masticatory system to assure maximal resolution of pain and optimal

management of the dysfunction associated with a cervical hyperextension - hyperflexion injury.

#### RESOURCE No. 4:

Brooke RI, Stenn PG, Mothersill KJ. The Diagnosis and Conservative Treatment of Myofascial Pain Dysfunction Syndrome. Oral Surg Oral Med Oral Pathol Oral Radiol Endod, 44:844-52, 1977.

#### ABSTRACT:

A retrospective study was conducted to assess the outcomes of 20 motor vehicle accident/trauma patients in a population of 194 TMD/MPDS patients seen at a University based oral medicine clinic to determine if there is a statistical difference between trauma and non-trauma populations.

#### METHODOLOGY:

This is a retrospective study of 194 of 274 patients referred with TMJ symptoms and diagnosed with MPDS. Twenty of these patients had recent trauma (MVA or similar accident).

The follow-up to these patients involved a 99.5% follow-up rate at 16 to 44 months from initial appearance at the clinic.

#### RESULTS:

60% of the post-injury group had persistent symptoms still requiring treatment at 16 to 44 months post-onset. 10% of the post-injury group had no symptoms. The remaining portion had symptoms that were not seeking further treatment. This compares to 14% of the non-injury group with persistent symptoms and 42% with no symptoms.

#### CONCLUSION:

A statistically significant poorer prognosis in patients with TMD/MPDS who are involved in accidents, as opposed to non-trauma onset was reported.

#### RESOURCE No. 5:

Brooke RI, Stenn PG. Post-Injury Myofascial Pain Dysfunction Syndrome: Its Etiology and Prognosis. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 45: 845-50, 1978.

#### ABSTRACT:

This study is a follow-up to the Brooke, et al study titled, "The Diagnosis and Conservative Treatment of Myofascial Pain Dysfunction Syndrome". The study was conducted to determine the correlation between trauma and non-trauma oriented TMD/MPDS patients.

#### METHODOLOGY:

This was a retrospective study of 37 (of 401) patients seen in a University based oral medicine clinic. The study compared the 37 patients who were post-injury (trauma to the face or neck in MVA's or similar accidents) to 173 non-injury TMD/MPDS patients from the 1977 study. The follow-up percentage rate for the patients was 97.3% and the patients were selected during this process over a 4 year post-onset time period.

#### RESULTS:

86% of the non-injury TMD/MPDS patients were completely symptom-free or required no further treatment, whereas only 36% of the post-injury patients had responded to conservative therapy. Treatment generally consisted of reassurance, ultrasound, occlusal splints, minor tranquilizers, or correction of gross malocclusion.

#### CONCLUSION:

A statistically significant difference in outcome of treatment was noted in the post-injury patients (36% resolution) compared to the non-injury patients (86% resolution).

#### RESOURCE No. 6:

Burgess J. Symptom Characteristics in TMD Patients Reporting Blunt Trauma and/or Whiplash Injury. *J. Craniomandibular Disorders, Facial and Oral Pain*, 1991, Volume 5, No. 4, pp. 251-256.

**ABSTRACT:**

Overt (blunt impact) trauma to the face/head region has been implicated in the etiology of facial pain and temporomandibular disorders (TMD), including TMJ dysfunction. Recent literature also suggests that TMD may result from acceleration/deceleration injury (whiplash syndrome). Trauma type might be expected to affect differences in injury and symptom presentation related to TMD. A recent study by Pullinger and Monteiro comparing orthodontic treatment, molar extraction surgery and the broad category of injury to the face, jaw or neck (including whiplash) seems to support this possibility. However, no study to date has compared TMD patient symptom characteristics, on the basis of injury reported, to have specifically arisen from overt trauma to the face/head region, whiplash alone, and whiplash associated with overt face/head trauma. This article presents descriptive data for 100 consecutive patients reporting these three types of trauma, as well as TMD symptoms.

**METHODOLOGY:**

The 100 patients in this study were divided into three groups based on the type of trauma incurred. Patients in the overt trauma (OT) group reported injury following a nonpenetrating blow or blows to the face, jaw or TMJ. Patients in the whiplash (W) group had been diagnosed by a physician or chiropractor as having cervical injury or whiplash. A third group of patients (WOT) carried a diagnosis of whiplash and noted experiencing concurrent overt trauma to the head/neck or TMJ. Subjects initially completed a questionnaire that included anamnestic data and a 100-mm visual analog scale (VAS) anchored by no pain and worst pain possible, the PRI section of the McGill Pain Questionnaire, and a pain

drawing.

Other measures included an abbreviated version of the Hopkin's Symptom checklist (HSCL - 90), a widely used self-report questionnaire (with established reliability and validity) designed to measure psychological symptom patterns including anxiety, depression and somatization.

Each subject underwent a 30-minute interview, which assessed chief complaints, history of chief complaints, medical history and review of systems, and family/social history. Clinical evaluation consisted of a standardized head and neck examination, including measurement of range of jaw motion (opening, lateral, and

protrusive movement), TMJ noise (audible and stethoscopic evaluation), and palpation of neck and masticatory muscles and the lateral pole of the TMJ using 2 lb. digital pressure. Pressure pain threshold (PRT) was measured by Fisher's algometer for one site of each masseter and the frontalis region. This instrument has established reliability and allows numeric scaling of pain sensitivity for a 1 - cm area of muscle (expressed in kg/cm).

#### RESULTS:

WOT patients had significantly longer pain duration (13.0 months) compared to OT (7.0), and slightly more than W (11.7). Only 25-30% of patients noted onset of pain less than 48 hours after the trauma.

#### CONCLUSION:

The data indicates that patients in these three groups, though sharing common characteristics, are not homogeneous and can significantly differ with respect to certain pain, TMJ, and demographic characteristics based on trauma type. Appreciation for the heterogeneity of trauma patients in the design of future studies should strengthen the construct and external validity of the research. Further investigation of the trauma patients/subsets present in this article in terms of short- and long-term treatment outcome may help to further define additional similarities or differences between groups.

#### RESOURCE No. 7:

Burgess JA, Kolbinson D, Lee, P, Epstein J.  
Motor Vehicle Accidents and TMD's: Assessing the Relationship. JADA 127:1767-72, 1996.

#### ABSTRACT:

TMJ or masticatory muscle injury may be associated with speed, direction of impact, and

the amount of vehicular damage in a motorvehicle accident. A clinical study was conductedto find out how these factors correlate with motor vehicle accidents.

#### METHODOLOGY:

The 219 patients examined in this study (89% female; mean age 30.79) all reported symptoms of

TMD and identified motor vehicle accidents as the cause. An addendum trauma questionnaire detailing impact variables, including estimated speed, principal direction of force, head position and jaw position at impact, type of restraint system used, occupant's position in the vehicle, vehicle type and whether direct trauma occurred to lower jaw, TMJ or head. Initial symptoms were divided into 1 week after the accident; 1-4 weeks after; 1-3 months post motor vehicle accident; and over 3 months post motor vehicle accident.

#### RESULTS:

Symptoms began within one week of the motor vehicle accident in 62% of the patients; within 1-4 weeks in 23% of the patients; and 1-3 months in 10% of the patients, and over 3 months for 5% of the patients. The most commonly reported injures were impact to the face, chin and jaw, 73%. At examination, 47% had TMD pain, 43% had crepitus or clicking/popping of the temporomandibular joints, and 41% had tenderness in 1 or 2 masticatory muscles.

#### CONCLUSION:

The amount of damage in dollars to the vehicle appears to correlate with the maximal jaw opening. Also observed was an association between facial pain and either a front or rear impact or between bruising and frontal impact. At the time of impact, patients who were looking to the side had more pain and tenderness of the masticatory muscles. No difference was seen in patients who had teeth apart or jaws opened at

the time of impact compared to patients whose teeth were clenched. There is a significant correlation between facial pain and front or rear impacts.

RESOURCE No. 8:

Campbell JK. Post-Traumatic Headaches. J Craniomandibular Disorders, Vol. 1, No. 1.

ABSTRACT:

Trauma to the head and cervical spine can lead to a syndrome, which includes headaches, dizziness, lack of concentration and other symptoms. Contrary to earlier beliefs, it is not always a psychogenic disturbance. Current

imaging techniques, including CT and MRI scanning, reveal cryptic changes in the central nervous system in many victims of closed head trauma. Careful evaluation in hospital emergency rooms can minimize the extent of the post-traumatic syndrome.

#### METHODOLOGY:

This paper is a review of references to evaluate the view of post-traumatic headaches being purely psychogenic. In 1961, Miller proposed several tenets. These were: (1) no one suffering from post-traumatic syndrome recovers and returns to work before settlement, (2) that posttraumatic syndrome never occurs in patients when there is no possibility of obtaining compensation, (3) that the syndrome never follows severe head injury, (4) the post-traumatic syndrome never occurs in professional and managerial people, and (5) that such patients always return to work free of symptoms once they have received compensation.

#### RESULTS:

Many studies have disproved Miller's statements. For example, Kelly reported in a prospective study that 84 out of 110 patients returned to work before settlement and were completely recovered; that 24 out of 34 patients injured in a no - claim situation developed posttraumatic syndrome; that 49 out of 62 patients were from the professional or managerial classes, and finally, that 26 out of 56 severely head injured patients developed the syndrome. In an earlier study, Denker reviewed 100 cases of posttraumatic syndrome in which there were no compensation or litigation factors. Thirty percent of these patients, despite apparently minimal head trauma, had an almost identical constellation of symptoms including headache, dizzy spells and personality changes for one year or longer. Almost 20% of these patients still complained three years post - head injury.

Hyperextension-acceleration injuries (whiplash) are more likely to lead to neck and shoulder complaints. In many subjects, the whiplash

injury is associated with a head injury and, in these circumstances, the head pain may be more prominent. Many head injured patients have, in addition to the post-traumatic syndrome, signs and symptoms of local or extensive injury to the nervous system and its coverings. Cranial nerve lesions, such as anosmia diplopia, deafness and loss of vision, are not uncommon. Facial

fractures, basal skull fractures and focal seizures, with or without depressed skull fractures, may be present.

#### CONCLUSION:

With proper diagnosis and treatment, many patients eventually fully recover, while a significant number have long-term discomfort and disability. Several series have shown long-term disability to 15% to 20% of patients who develop the post-traumatic syndrome.

#### RESOURCE No. 9:

Croft AC. Cervical Acceleration/Deceleration Trauma: A Reappraisal of Physical and Biomechanical Events. *J Neuromusculoskeletal System* 1993 1(2):45-51.

#### ABSTRACT:

Early reckonings of the mechanics of whiplash were intuitive and speculative. They provided a fairly simple model that described a rearward excursion of the head/neck complex, followed by some degree of forward movement or flexion. Many misconceptions remain in the literature. This paper attempts to clarify some of the misconceptions and to offer new hypotheses.

#### METHODOLOGY:

Although this paper is not a scientific study, many scientific concepts and theories are thoroughly discussed. Croft feels that the term "cervical acceleration/deceleration" (CAD) should be used instead of the classic whiplash terminology, because CAD more accurately describes the mechanism of this injury. An

excellent historical review of the early scientific studies of whiplash, or CAD, injuries is presented along with appropriate references. In addition, very descriptive figures are described in the text of this paper. These figures, along with the text, quite vividly describe the biomechanics of the acceleration/deceleration injury, as well as the mandibular whiplash injury.

#### RESULTS:

Rear-end collisions are the most injurious of all acceleration/deceleration injuries. In addition, injury to the temporomandibular joint is quite

common and almost universal with these injuries to the cervical spine.

#### CONCLUSION:

Many misconceptions still exist in medicine concerning CAD trauma. There are a number of physical and human variables such as relative sizes of vehicles, vectors of impact, use of restraint systems, and position of occupants, which all effect the extent of CAD trauma. For effective patient treatment, professionals need to be aware of the biomechanical mechanisms of CAD injuries.

Frequently, that same awareness is often necessary as those same professionals find themselves thrust into the medico-legal environment.

#### RESOURCE No. 10:

Croft AC, Steigerwald DP. The Whiplash and TMJ Dysfunction. The Spine Research Institute of San Diego.

#### ABSTRACT:

TM injuries occur during motor vehicle accidents. This paper abstracts several articles to describe the forces involved to the TM joint during rear-end motor vehicle accidents. It also challenges the article by Howard et. al, that used a poorly designed model - without considering other works contrary to their methodology - which oversimplified the working of the cervical spine.

#### METHODOLOGY:

This editorial is a discussion, literature review and case study.

#### RESULTS:

There is good supporting evidence that the

TMJ receives injury during the initial acceleration phase during whiplash injuries. Stretching and tearing of the posterior attachments, as well as the discal attachments of the medial and lateral parts of the condyle, may occur. In the second phase (the deceleration phase), the head and neck are snapped forward into flexion. The exact sequela of events in this phase are yet undetermined. Enough evidence is

presently available to refute Howard's criticism of TM whiplash injuries. Enough evidence also exists to substantiate that major injuries occur to the TM joint apparatus during whiplash related injuries.

#### CONCLUSION:

The TM joint and related structure can receive substantial injuries during cervical whiplash related accidents.

#### RESOURCE No. 11:

Curtis DJ, Weiner L, Crain M. Post Traumatic Swallowing: An Abstract. Association of University Radiologists, George Washington University Medical Center, April 1988.

#### ABSTRACT:

The study attempts to characterize the post traumatic swallow of those individuals, which did not have dysphasia before an auto accident.

#### METHODOLOGY:

Sixty consecutive patients with post-traumatic dysphasia were evaluated in a consistent manner utilizing a double contrast erect swallow, a concerted evaluation for reflux, a minimum of two prone swallows, two 5cc erect liquid bolus swallows and an erect mixed bolus swallow of a tablet and a second erect swallow using bread. A control population of 71 symptomatic gastroesophageal refluxers was compared in an attempt to eliminate alterations in the swallow, which might be reflux rather than trauma related.

## RESULTS:

None of the swallows were normal. Little laryngeal incompetence was noted. Disturbance of primary esophageal peristalsis was common. Oral dysfunction seemed to contribute to solid dysphasia. Some upper esophageal sphincterdysfunction was noted.

## CONCLUSION:

Trauma affects the craniomandibular/cervical relationships in many ways. The oral phase of the swallow seems the most disturbed in these post traumatic patients, with the upper

esophageal sphincter and esophageal body following in frequency of dysfunction. The laryngopharynx, in spite of its dependence upon the craniomandibular/cervical relationship, is less involved. This may be because more adaptability is built into the complex laryngopharyngeal system than is present in the oral, upper esophageal sphincter and esophageal portion of the swallow.

#### RESOURCE No. 12:

Dauvilliers F, Bendjellal F, Weiss M, Lavaste F, Tarrier C. Development of a Finite Element Model of the Neck. Society of Automotive Engineers Technical Series, 942210.

#### ABSTRACT:

A physical model of a minimal number of elements, including bricks and springs, was created to simulate motion of the head and of the vertebrae, discs, and ligaments of the neck. Satisfactory results were obtained in terms of kinematic responses of the head in frontal and lateral directions. Further investigations are needed on modeling the muscles to allow for injury prediction. This paper describes the characteristic of this model, the rationale behind the definition of model elements, and the performance compared to data obtained from human volunteers.

#### METHODOLOGY:

Data from research sled impacts involving human volunteers of average size and weight was gathered from a pre-existing database. The vertebrae and the head were considered as rigid bodies, since their deformation was insignificant compared with deformation of the soft neck tissues. A model containing 150 solid elements, 104 shell elements, 412 damping-spring elements and 2 spherical joints were created. The initial positions and orientations of these elements was taken from a 50th percentile human subject seated in the driving position and from x-rays taken on cadavers. Comparisons were made with models constructed by other researchers. The final

model was tested in frontal and lateral impacts and compared with envelope curves compared against the master database.

#### RESULTS:

The authors believe the model performed well despite variations of angular and linear accelerations and velocities from 23% to 100% lower, to 19% to 30% higher, than in previous human studies. Gross curve shapes correspond to previous studies. Muscular contraction, which becomes dominant after approximately 175 milliseconds, could not be built into the model. Damping remains a problem in model construction.

#### CONCLUSION:

It is possible to improve models further. Until muscle effects can be factored, injury prediction by means of model research is not practical. Further model test are needed involving more violent front and lateral impacts. Eventually, a model will be created which can be used to study the injury mechanisms and acceptable stress of the cervical spine during impacts.

#### RESOURCE No. 13:

Duckro P, Greenberg M, Schultz K, Burton S, Tait R, Deshields T, Richardson W. Clinical Features of Chronic Post-Traumatic Headache. *Headache Quarterly*, Current Treatment and Research 3(3):295-308, 1992.

#### ABSTRACT:

As many as 40% of patients may experience head pain even one year after a post-traumatic accident. Present study was undertaken as asystematic investigation of the clinical presentation of chronic post-traumatic headache patients.

#### METHODOLOGY:

This is a prospective study of 42 volunteer subjects (25 female, 17 male) who suffer from headache following trauma which had persisted 3 months or more. All subjects were at least 18 years of age (median age 39 years) with no positive medical findings that may explain the continuing headache. Excluded from the study were individuals with cervical disc displacement, unresolved fracture or brain lesions. All subjects underwent physiological assessment of muscular tension, including range of motion, palpation,

surface EMG, and thermography. All subjects also underwent psychological testing, including the anger expression scale, an abbreviated Beck Depression Inventory, a quality of life survey and the Pain Disability Index.

## RESULTS:

1. 45% of subjects were involved in vehicular trauma, while 33% were work-related injuries.
2. Males were significantly more likely to have been injured at work than female.
3. Head trauma was documented in 67% of subjects.
4. Duration of symptoms ranged from 3 to 276 months with a median of 2 months and a mean of 58 months.
5. 68% of subjects suffer from chronic daily headaches (CDH).
6. 90% were on medication with 74% on daily medication.
7. Headaches were classified as mixed/daily in 36%; local pain in 21%, migraine-like in 7%.
8. Subjects exhibit significantly higher levels of total anger and lower anger control than the control group.
9. Mean score on abbreviated Beck Depression Inventory was in the moderate depression category.
10. Average score on life quality measures slightly worse than the midpoint labeled moderately satisfying. Pain disability index average score was slightly worse than the midpoint labeled moderate disability.
11. 62% reported initial insomnia at least 3-4 times per week, while 76% reported disrupted sleep.
12. End of range measures in forward flexion, extension, and rotation were significantly lower than the reported normal controls.
13. The study group as a whole exhibited significant tenderness, especially in the upper back and neck.
14. 70% of the subjects endorsed at least one of the TMD pain/dysfunction responses. The pain/dysfunction cluster positively related to

the average score of 3 headache symptoms associated with TMD pain/dysfunction and parafunction. Both were related to total facial tenderness.

15. 33% of the subjects had a mandibular range of motion less than 40 mm.

16. A relatively large percentage of subjects reported facial pain and facial muscle tenderness to palpation.

17. Thermographic interpretation revealed the masseter as the site with the greatest percentage of asymmetries at 91%. In most cases, the direction of the asymmetry varied within the same subject. There was a small, but significant, positive relationship between the number of facial asymmetries and frequency of headaches.

18. EMG measurements produced results that suggest increasing tension with functional use of the facial muscle.

CONCLUSION:

Chronic post-traumatic headache is far from benign in its effects on people's lives. It is, in fact, a significant and complex clinical syndrome in its origins, nature, and associated symptoms. The most significant factors suggested in the study were analgesic overuse, muscle tension and psychological distress.

RESOURCE No. 14:

Elson LM. The Jolt Syndrome, The Muscle Dysfunction Following Low-Velocity Impact. Pain

Manag, Nov/Dec 1990, 3 (6): pp. 317-326.

ABSTRACT:

Despite involving forces insufficient to cause tissue injury, many low velocity collisions and occupational accidents result in pain and sometimes disability. This paper proposes that the underlying mechanism in this dysfunctional state is an unusual sustained positive feedback loop, flowing from the proprioceptor in the muscle spindle and joint capsules to this neurologic circuit, are an increase in muscle tension and an imbalance in the motor position of the jolted

muscles.

#### METHODOLOGY:

This study used a three pronged approach. The office archives were carefully evaluated for appropriate cases. A review of the literature was conducted. Consultation with a varied group of basic and chemical scientists and back care providers was also included. The premise of this study was that there can be pain without specific injury. Myofascial structures can be made painful without injury when stretched into the supra-physiologic stretch reaction or suddenly reflexly contracted.

## RESULTS:

Muscle spindles are encapsulated muscle fibers connected to or ensheathed in windings of sensory fibers and innervated by small efferents. There are twelve of these in each muscle. The tension of the intrafusal muscle fibers is set by the gamma efferent and it is this tension that determines the sensitivity of the local extrafusal muscle fibers to stretch. Experiments with cats have indicated that gamma efferents may be highly responsive to very small disturbances as rapid stretching of partially contracted muscles occurs. Work with muscles of cats demonstrates a powerful synaptic activity among interneurons associated with ascending tracts, as well as spinal reflex pathways. This indicates that a flurry of afferent discharge from the spindles may reflexly generate exaggerated sensitivity to stretching. Evidently, the more structurally compromised a tissue, the less force necessary to cause systematic disruption.

## CONCLUSION:

Despite involving forces insufficient to cause tissue injury, many low velocity collisions and occupational accidents result in pain and sometimes disability. The mechanism proposed is a positive feedback loop, flowing from the proprioceptors in muscle spindles and joint capsules. The effects of this neurologic circuit are an increase in muscle tension and an imbalance in the motor patterns of the jolted muscles. Treatment should focus on reestablishing dynamically efficient motor patterns via properly selected exercises and posture training.

## RESOURCE No. 15:

Epstein JB. Temporomandibular Disorder, Facial Pain and Headache Following Motor Vehicle Accidents. J Can Dent Assoc, June 1992, 58, 6:pp. 488-495.

## ABSTRACT:

Temporomandibular disorders are known to be a possible sequela of motor vehicle accidents, particularly when flexion/extension injury occurs. This paper recognizes the relationship between cervical injury, dysfunction and headaches. The literature related to motor vehicle accidents, whiplash injury and temporomandibular

dysfunction is reviewed. The etiology, prognosis and management of the trauma associated with head and neck pain and dysfunction are presented.

## METHODOLOGY:

An exhaustive survey of the literature (111 references) was completed. It basically supported the relationship between flexion/extension injury (whiplash), TMD and migraine headaches.

## RESULTS:

Evidence is mounting that the whiplash injury (flexion/extension injury) is a common result of rear-end collision, involving motor vehicle accidents. It is reported that an eight mile perhour impact results in a 2g force of acceleration at the occiput, and head symptoms are often delayed and go unreported for hours, days or longer. Whiplash injuries cause stretching of the muscles and ligaments. It is also noted that trauma associated with migraine headaches occurs in association with whiplash mechanics.

The continuance of symptoms, after more than two months, is a poor prognostic sign. Individuals with chronic pain for more than six months have a greater risk of developing negative personality changes. Persistence of pain is also noted to increase the risk of litigation.

Not only do injuries of this type occur in major accidents, but they can also occur in minor accidents. This injury may result from the

exacerbation of a pre-existing subclinical condition. Generally, stretching and tearing of the ligaments and muscles occur. These injuries are believed to result from the rapid excessive opening of the mouth, due to the fact that the lower jaw does not keep up with the head movement. This injury is reported more commonly in females between the ages 30 and 50.

The results of treatment of post trauma TMD patients are poor, having only positive results in 36% of the cases. This compares to an 86% success rate of non-injury patients. The long-term elimination of clicking is also poor, being resolved in only 25% of the cases. Painful clicking may also be an indication of further progression of the disease. Treatment for these patients includes physical therapy, counseling, mandibular guidance appliances, anti-inflammatory drugs, analgesics and muscle relaxants.

Stress, anxiety and depression may heighten

TMD chronic pain of greater than six months duration, and may require a thorough evaluation and a multi-disciplinary approach to treatment. It is normal for whiplash induced TMD symptoms to be first reported weeks or months after the motor vehicle accident.

Persistence of symptoms of more than two months is a poor prognostic sign. This especially relates to those patients having occipital headaches, referred pain, intercapsular pain, backaches, neurologic signs, radiograph changes and pre-existing osteoarthritis.

#### CONCLUSION:

Minor motor vehicle accidents can cause tissue injury. Often, these people do not report a problem until weeks or months after the accident. The greater the duration of symptoms, the poorer the prognosis for success. Those patients with persistent symptoms of greater than two months have an increased risk for developing a negative personality disorder.

#### RESOURCE No. 16:

Ernest III EA. The Orthopedic Influence of the TMJ Apparatus in Whiplash: Report of a Case. General Dentistry, March-April 1979, pp 62-64.

#### ABSTRACT:

This is a report directing its information to the relationship of head, face and neck muscles, their inter-relationship to each other and the effect observed when the system is placed under stress.

#### METHODOLOGY:

The study was conducted utilizing, as a case report, one patient who was involved in a motor vehicle accident.

#### RESULTS:

One patient was evaluated at a periodic dental exam. Upon examination, a tenderness of head and neck muscles and occlusal discrepancy was noted. The exam revealed the patient was involved in a motor vehicle accident. No history of prior symptoms was present. The patient had a bite plane fabricated and a remission of symptoms occurred after seven days of night wear. The case was later evaluated with study models for orthodontic finalization.

#### CONCLUSION:

The conclusion in this one particular case was that the motor vehicle accident trauma was directly responsible for this patient's symptoms.

#### RESOURCE No. 17:

Ernest EA, et al. Three Disorders that Frequently Cause Temporomandibular Joint (TMJ) Pain: Internal Derangement - The Ernest Syndrome. J Neuro Orthoped Med 1986;7(2):189

192.

#### ABSTRACT:

Diagnosis of chronic unremitting pain of the head, face, jaw and neck has often been a confusing challenge for the most astute of clinicians. Many patients have suffered, only to be treated palliatively at best, until more knowledge was available to assist in establishing an accurate differential diagnosis. This paper describes three disorders that are frequent sources of chronic pain.

#### METHODOLOGY:

The article is written to differentiate between one of these diagnosis, where the main focus of pain is the Temporomandibular Joint (TMJ). The methodology for this differential diagnosis is to utilize specific nerve blocks to anesthetize sensory input fibers. If the pain persists after the block this would suggest that this is not the primary source of the patients pain.

## CONCLUSION:

Careful physical examination and a differential diagnostic exam should be carried out when patients present with TMJ pain. High on the list of differential diagnosis tests should be specific nerve blocks of the temporal tendon, the stylomandibular ligament and the temporomandibular joint capsule itself. It may be necessary to give the injections separately, or in conjunction with each other, to determine the exact etiology of pain.

RESOURCE No. 18: (cervical whiplash). A MRI study was conducted to determine the relationship between cervical whiplash and TMJ injuries.

Garcia R. Air Bag Implicated in Temporo-METHODOLOGY:

mandibular Joint Injury. J Craniomand Disord, Facial and Oral Pain April 1994;12(2).

ABSTRACT:

A patient's impact with an automatic air bag deployed during a vehicular collision causes injury to the Temporomandibular Joints (TMJ's). The injury was confirmed using Magnetic Resonance Imaging (MRI).

METHODOLOGY:

A patient population of eight-seven patients, who had suffered a cervical whiplash injury in a motor vehicle accident, was evaluated for temporomandibular joint injuries. These patients had sustained no direct trauma to the face, head or mandible and had no TMJ complaints prior to the motor vehicle accident. The MRI's were completed and a total of 164 TM joints were evaluated for internal derangement, effusion and inflammation utilizing T1 and T2 weighted MRI images.

The editorial is a discussion, literature review RESULTS: and case study.

CONCLUSION:

Automatic air bags will prevent injuries from impact with hard interior automobile surfaces,

but may contribute to the injuries sustained by the TMJ's in vehicular accidents.

A high percentage of the TMJ patients demonstrated abnormal findings. These findings included 72% disc displacement with reduction, 15% disc displacement without reduction, 69% with joint effusion, and 51% with inflammation or edema. The total number of TMJ abnormalities was 95%.

1. Air bag impact with a closed or nearly CONCLUSION:

closed mandible could cause posterior displacement of the condyles associated with anterior disk displacement and compression of the retrodiscal tissue; or

2. Air bag impact with an extended mandible as might result from the effects of a rear end collision could complicate the mandibular whiplash by further extending the mandible.

Either of these situations would lead to the type of injuries presented by the patients in this study.

RESOURCE No. 19:

Garcia R, Arrington JA. The Relationship between Cervical Whiplash and Temporomandibular Joint Injuries: A MRI Study. *Cranio* 14(3), 233-50, 1996 July.

It was noted that there was a high percentage of TMJ abnormalities in the study. A correlation was made of the significant relationship between cervical whiplash injury and TMJ injuries. A comparison was made between the findings of this particular MRI study and of similar studies with MRI findings and asymptomatic/normal subjects. A large disparity was noted between the total TMJ abnormalities of the two groups. The conclusion from the comparison of these two studies is that joint effusion is extremely common in motor vehicle cervical whiplash patients and extremely rare in asymptomatic/normal subjects. The second finding was that internal derangement is more prevalent in the motor vehicle accident patients, as compared to the normal subjects, and, finally, total joint abnormalities are more frequent in the motor vehicle, cervical whiplash patients than in asymptomatic and normal groups.

ABSTRACT:

Temporomandibular joint symptoms are a common finding following motor vehicle accidents, particularly in patients with hyperextension/hyperflexion injuries of the cervical spine

RESOURCE No. 20:

Garcia R, Arrington JA. TMJ's Evaluated in Patients with Cervical Whiplash Injury. News Journal of the American Academy of Head, Neck and Facial Pain 4 (1), Spring/Summer 1992.

**ABSTRACT:**

Internal derangements of the temporomandibular joints have been suspected by many practitioners to be the focus of an extension-flexion injury. This study attempts to illustrate a direct relationship of this injury to disc displacement, via the imaging by a MRI.

**METHODOLOGY:**

Forty - three patients were utilized for this study. The median age was thirty-five. All patients were involved in extension flexion injuries and evaluated for TMJ injury. MRI images were completed with T1 weighted image of 12 TMJ's and 74 patients received T1, T2 images. The evaluation was to:

- a. display disc position - normal or displaced
- b. display effusions - in T2 images
- c. evaluate for disc reduction in open mouthposition

**RESULTS:**

5 normal disc positions  
66 reduced discs  
15 non-reducing discs  
52 TMJ with effusions

5 Normal TMJ's

**CONCLUSION:**

A hyperextension, flexion injury of the cervical spine can cause damage to the TMJ. The attempt to support this with the MRI studies, illustrating data that indicated 94.1% of those scanned, show an anterior displacement, and 97.7% reveal an anterior displacement or joint effusions.

**RESOURCE No. 21:**

Goldberg MB, Mock D, Ichise M, et al.  
Neuropsychologic Deficits and Clinical Features  
of Post-traumatic Temporomandibular Disorders.  
J Orofacial Pain 10(2):126-139, 1996.

#### ABSTRACT:

Greater cognitive deficits, slower reaction times and more severe musculoligamentous signs may be found in post-traumatic TMD than in idiopathic TMD's. There may be possible underlying central nervous system changes in a subset of post-traumatic TMD patients.

#### METHODOLOGY:

Of 27 female participants, 13 had TMD resulting from a motor vehicle accident related to an acceleration/deceleration injury (post-traumatic TMD) and 14 had TMD which arose idiopathically (idiopathic TMD). This patient population came from a no-fault insurance system where litigation was not an issue.

#### RESULTS:

Slower reaction times (35-45%) for simple and complex multiple-choice reaction-time testing indicated that post-traumatic TMD patients fatigue more readily. In the California Verbal Learning Test (CVLT), used to test a subject's immediate recall, the idiopathic TMD group fared significantly better than the post-traumatic TMD group.

When researchers used a revised form of the Symptom Checklist-90 Revised (SCL-90R) test, created for determining the prevalence of clinically significant depression in head-injured persons, they found a significantly higher somatic response in the post-traumatic TMD group versus the idiopathic TMD group.

The post-traumatic TMD group had more pronounced underlying musculoligamentous signs. More post-traumatic TMD patients had a positive reaction to palpation of the external masseter, temporalis, and sternocleidomastoid muscles than did idiopathic TMD patients.

Patients with post-traumatic TMD also had increased prevalence of cervical muscle involvement.

**CONCLUSION:**

More signs/symptoms may be found in posttraumatic TMD than idiopathic TMD, including greater cognitive deficits, slow reaction times, more severe musculoligamentous signs & possible underlying central nervous system changes.

RESOURCE No. 22:

Grady D. In One Country, Chronic Whiplash is Uncompensated and Unknown. Medical Science  
NY Times, 1996 May.

#### ABSTRACT:

Newspaper reports on a medical study published in Lancet claiming examination of drivers in Lithuania who were involved in automobile accidents reported no incidence of whiplash symptoms; i.e. headache, neck pains, etc. Comments by two American doctors dispute the findings.

#### METHODOLOGY:

Dr. Harold Schrader, a neurologist from University Hospital in Trondheim, Norway, gave health questionnaires to 202 drivers whose cars had been struck from behind within the preceding 1 to 3 years. The accidents varied in severity from mild to moderate, and severe in 11 cases. They were asked about their symptoms and compared to a "control" group of similar aged residents in the same town who had no history of a car accident.

#### RESULTS:

35% of the accident cases reported neck pain; 33% of the controls reported same. 53% of accident victims reported headaches; 50% of the controls reported same. No one in the victim group had disabling or persistent symptoms. This is in sharp contrast to Dr. Schrader's homecountry where chronic whiplash cases have been prolific; i.e. One out of 60 residents are in an organization for chronic disability due to whiplash injuries.

#### CONCLUSION:

The American insurance industry claims that 16% of all auto injury claims paid is for soft tissue injuries. Because there is no personal injury insurance for drivers in Lithuania, the

implication is that complaints elsewhere of whiplash-like symptoms is related to financial gain.

The findings are refuted in part by Dr. Paul McCormick, neurosurgery at Columbia University College of Physicians and Surgeons. He cites the small number of subjects questioned as a biased group. Dr. Barry August, dentist at the

NY University Medical Center, questions the past history of the control group subjects as other traumatic factors, besides automobile accidents, can cause the symptoms questioned in the survey.

RESOURCE No. 23:

Guccione S, Weiss M. The Reliability of Human Head/Neck Force and Torque Estimation. Society of Automotive Engineers Technical Series 1995, 952720.

ABSTRACT:

The purpose of this letter is to determine if a reliable model can be developed to assess the risk of head/neck injuries from indirect impact.

METHODOLOGY:

Three anthropometrically dissimilar human volunteers were used for 67 frontal impact tests at paired g-levels of 8g and 15g to determine the sensitivity of the distribution of force and torque. The aim is provide a method of evaluating the effect of acceleration input and

mechanical parameters are uncertain and must

initial head

head/neck.

position parameters on the

RESULTS:

Estimates of head/neck geometrics and

be treated as random variables.

## CONCLUSION:

More research must be done before a realistic head/neck dynamic model can be developed. The following is a proposed methodology for achieving these goals. The first need is more accurate head/neck geometric and mass distribution data on live subjects; second, coordination with cadaver studies; third, more information is needed on the classification of head/neck and body types; fourth, more accurate kinematic measurements on humans and cadavers; and fifth, more accurate kinematic measurements for predicting from external measurements. Until such information is available, the validity and applicability of any head/neck dynamic model is highly suspect.

## RESOURCE No. 24:

Harby K. The Quebec Task Force on Whiplash-Associated Disorders. The Spine Letter 2(9), 1995 Sept.

### ABSTRACT:

A group led by Walter O. Spitzer, M.D., M.P.H., with 16 task force members reviewed the published literature and as much unpublished information as they could locate regarding whiplash – 10,382 studies and abstracts. Of these, 1,204 studies met their preliminary criteria for review, (which are not given). Ultimately, the task force concluded that only 62 published articles were relevant and scientifically admissible. The group made a number of conclusions.

### METHODOLOGY:

This was a literature review. The criteria used for selecting published studies for in-depth review was not given. Ninety-five percent of all published studies were dismissed as not relevant or not scientifically admissible.

### RESULTS:

The key conclusions of the Task Force on Whiplash-Associated Disorders are listed:

- Whiplash-associated disorders are medically benign and usually resolve spontaneously or with very conservative, short-term treatment. Disability, if any, generally lasts only a few days.
- Except in severe cases, which are uncommon, health care providers should manage whiplash by strongly encouraging the patient to return to activities of daily living as quickly as possible. Such management can help prevent whiplash from becoming a chronic condition. The persistence of serious symptoms 45 days after the accident was found to be a warning signal about the threat of

chronicity.

- Most interventions have not been evaluated in scientifically rigorous trials, and those that have seem to be ineffective. In particular, soft collars are not recommended, as immobilization of the neck may actually be harmful to the patient.

- In the Quebec cohort study, more than 46% of the costs associated with whiplash were found to be caused by 12.5% of the patients. In these cases, the reported disability lasts more than 6 months, which the task force defined as “chronicity”.

- Correctly adjusted vehicle headrests help reduce the likelihood of injury.

- Most reports on whiplash in the medical literature do not meet the standards of scientific evidence. Future research needs to be more scientifically rigorous and multidisciplinary in approach.

CONCLUSION:

One conclusion not listed as key in this article was that soft collars may be harmful. Also, Dr. Spitzer advises that (1) patients return to normal activity as soon as possible; (2) patients must not assume that the occurrence of a whiplash-associated disorder is a terrible event of serious prognosis; (3) patients should not be allowed to drift into chronicity.

RESOURCE No. 25:

Harkins SJ. Extrinsic Trauma and Temporomandibular Dysfunction. *Cranio* Jan 1986, Vol 4, No. 1.

ABSTRACT:

The incidence of temporomandibular dysfunction, due to extrinsic trauma, has been under reported as a significant precipitating etiology.

METHODOLOGY:

The editorial is a discussion with pertinent literature review.

CONCLUSION:

1. Precipitating factors can be delineated with a careful medical and social history.
2. The clinician must rely upon subjective data collected from the patient post facto.

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3. Acute extrinsic trauma to the head and neck constitute a definite precipitating etiologic event in the onset and development of craniomandibular disorders.

RESOURCE No. 26:

Harkins SJ, Martiney JL. Extrinsic Trauma: A Significant Factor in Temporomandibular Dysfunctions. J Prosthetic Dent, Vol. 54, No. 2, August 1985, pp. 271-272.

#### ABSTRACT:

This study sought to evaluate the role of extrinsic trauma as a precipitating factor in temporomandibular joint (TMJ) dysfunction in a large heterogeneous, symptomatic population.

#### METHODOLOGY:

This study was conducted utilizing:

1. 727 symptomatic patients of TMJ, who actually sought treatment for this disorder within a specific period of time.
2. Data utilized
  - a. History interview
  - b. Clinical exam
  - c. Self administered questionnaire
  - d. When suspected, utilized psychosomatic tests
  - e. Radiographs
    - i. Submental Vertex
    - ii. TMJ Tomograms
    - iii. AP TMJ Tomograms
    - iv. Lateral Head
    - v. Frontal
    - vi. Casts, slides, photos

#### RESULTS:

1. 9% no objective signs or symptoms
2. Range 17 to 70 years of age
3. 86% female, 14% male
4. 45% total group had acute extrinsic trauma to head or neck, 83% female, 12% male

5. 43% of total reported extrinsic trauma as ppt in onset of dysfunction symptoms.
6. 2% no correlation between trauma and TMJ dysfunction
7. 26% of head and neck trauma as result of motor vehicle accident
8. 21% reported cervical sprain as their head and neck trauma
9. 19% reported whiplash as ppt of TMJ dysfunction
10. 22% a single blow from a motor vehicle accident, fall, fight or sports injury to the head or neck as the cause of TMJ dysfunction.
11. 1% from oral surgery
12. >1% oral litigation involving liability after head and neck trauma. 83% of this were in a motor accident and 12% in other miscellaneous accidents.
13. 22% litigation involving liability after head and neck trauma. 83% of these were in a motor vehicle accident and 12% in other miscellaneous accidents.

#### CONCLUSION:

Acute extrinsic trauma may be a factor in the development in TMJ dysfunction or disorder.

#### RESOURCE No. 27:

Havsy SL. Whiplash Injuries of the CervicalSpine and their Clinical Sequelae: Part I.  
Amer  
Journal of Pain Management 1994; 4:23-31.

#### ABSTRACT:

Whiplash injury is a significant medical problem receiving ever increasing attention by contemporary pain management practitioners. This paper describes the mechanism of whiplash injuries to the cervical spine and surrounding areas. Hyperflexion, hyperextension, and rotatory injuries and their associated clinical sequelae are discussed.

#### METHODOLOGY:

A brief historical review of whiplash injuries is given. The anatomy of the cervical spine with its muscular attachments, structures of joints, ligaments, cervical nerves, motion and areas usually injured in a whiplash injury are discussed. All muscles of the neck are listed, describing their origins, intersections, innervation and actions. Further, nervous systems trauma is discussed, along with an in-depth discussion of the mechanics of a whiplash

injury.

#### RESULTS:

This paper, being basically a review of literature and discussion by the author, does not list specific results of experimentation. However, the author does a great service by reviewing the biomechanical mechanism of whiplash injury, including the sequence of events of such an injury, as well as variables that affect the extent of injury.

#### CONCLUSION:

The author concludes that, not only are whiplash injuries real and serious to all, but especially so to older people. With increasing age, the elasticity of soft tissue and range of motion of the cervical spine decreases. Therefore, the potential for injury to the cervical spine from a whiplash injury is increased as the tissues are less resilient with age.

#### RESOURCE No. 28:

Heise AP. Epidemiology & Etiology Whiplash. J Oral Max Surg, Vol. 50, No. 8, pp. 825-828, 1992.

#### ABSTRACT:

This study was performed over a one-year period to determine if damage to the TMJ's is a common occurrence in whiplash patients.

#### METHODOLOGY:

One hundred fifty-five emergency room patients medically diagnosed with cervical flexion-extension injuries from motor vehicle accidents were divided into two groups; those with (Group 1) and those without (Group 2) radiological evidence of fracture. All patients were asked about current neck pain, TMJ pain, TMJ sounds,

facial pain, decreased opening, abnormal bite and headache. The patients were questioned 3 times: at the emergency room; one month later; and one year later.

#### RESULTS:

In Group 1: at the emergency room, 63 patients were examined, 8 patients with TMJ/muscle pain, and 0 patients with TMJ clicking were examined.

In Group 2: at the emergency room, 92 patients were examined, 14 patients with TMJ/musclepain, and 1 patient with TMJ clicking were examined.

One month later:

In Group 1: 51 (81%) were questioned, 2 patients with new symptoms.

In Group 2: 78 (85%) were questioned, 0 patients with new symptoms.

One year later:

In Group 1: 44 (70%) were questioned, 0 patients with new symptoms.

In Group 2: 60 (65%) were questioned, 0 patients with new symptoms.

#### CONCLUSION:

This study concludes that the incidence of TMJ symptoms in whiplash patients is extremely low, both initially and up to 1 year following the injury. The method of assessment is totally unscientific both in the initial examination and the follow-up. Results and conclusions have no clinical basis.

RESOURCE No. 29:

Helkimo E, Westling L. History, Clinical Findings, and Outcome of Treatment of Patients Anterior Disk Displacement. J Craniomandibular Practice July 1987, 5 (3): pp. 270-276.

## ABSTRACT:

The purpose of this study is to present the history and symptomology of patients with clinically diagnosed anterior TMJ disc displacement and to show in what respects successfully treated patients differ from those whose treatments fail.

## METHODOLOGY:

In 1984, 55 patients, including 43 women and 12 men with the clinical diagnosis of anterior disk displacement, were selected. The diagnosis was based upon history and physical examination. All patients had almost complete dentition with minimal dental disease. They were examined and treated according to routine procedures.

Approximately, one year after the first visit, the 55 patients were reexamined and evaluated by the two authors.

#### RESULTS:

Patients with displacement had more severe symptoms at the first visit than the average craniomandibular dysfunction patients. TMJ sounds were described as the most common sign in patients with TMJ pain and dysfunction. In a four year period follow-up of the 55 displacement patients, 35 (64%) still had clicking and eight (15%) had locking. 53% of the patients considered themselves symptom free, although they still had clicking, leading the authors to conclude that there is a progression of symptoms in three stages as presented by Rasmussen (Initial, Intermediate, Terminal -crepitation, constriction often followed by symptom resolution). They conclude each patient's treatment must be individually based and no special treatment can be universally recommended.

#### CONCLUSION:

There is no doubt that severe trauma is directly destructive to the TMJ's. Of the 55 patients studied, they showed no difference between the successfully treated and the deteriorated patients in the history of trauma.

#### RESOURCE No. 30:

Hertling D, Kessler RM. Management of Common Musculoskeletal Disorders. Physical Therapy Principles and Methods, Second edition,

J.B. Lippincott, 1990, pp. 428-433.

#### ABSTRACT:

Functionally, the temporomandibular joint, the cervical spine, and the articulations between the teeth are intimately related. The neuromuscular influence of the cervical and masticatory region actively participate in the function of mandibular movement and cervical positioning.

## METHODOLOGY:

This editorial is a discussion, literature review and case study.

## CONCLUSION:

While there are several etiologies of TMD, one of the most frequent causes of TMD is a direct or indirect blow to the joint or supporting structures. Whiplash injuries, in particular, are responsible for many TMD's. A whiplash, deceleration effect can occur either directly or indirectly by muscular or neurological involvement.

Treatment may consist of conservative physical therapy, intraoral appliances, surgery or a combination of the above.

Treatment and management of such injuries will depend upon the structures involved, the extent of disc displacement (if any), the effect on function and the degree of pain.

## RESOURCE No. 31:

Howard, RP, et al. Whiplash-TMD Theory Refuted. American Academy of Head, Neck and Facial Pain News Journal 1992; 4(1): 2,3,11.

## ABSTRACT:

A review and rebuttal by the College of Trauma, American Academy of Head, Neck, and Facial Pain.

## METHODOLOGY:

This editorial is a discussion, literature review and case study.

## CONCLUSION:

This paper is a review and rebuttal of the article by Richard Howard, Assessing Neck Extension/ Flexion as a Basis for Temporomandibular Joint Dysfunction. The

Howard article stands alone against other previous research and published documentation, because the authors developed illogical and inaccurate conclusions from previous literature and their own study. The Academy addressed this paper noting its deficiencies and reviewing the documentation that accurately supports the relationship between extension-flexion trauma and TMJ injury.

## RESOURCE No. 32:

Howard R, Hatsell C, Guzman H. Temporomandibular Joint Injury Potential Imposed by the Low-Velocity Extension-Flexion Maneuver. J Oral Maxillo Surg 53;256-62, 1995.

### ABSTRACT:

The purpose of this study was to measure the forces generated on the TM joint by a rear-end collision. The collision resulted in a velocity change of 4 to 8 kph (5 mph).

### METHODOLOGY:

Accelerometer sensor and high speed cinematographic data were obtained from the kinematic responses of live human test subjects positioned as occupants in motor vehicles that underwent staged low-velocity rear-end collisions. Four live human subjects participated in a series of 10 vehicle-to-vehicle low-velocity impact tests to provide data to describe the dynamic forces generated at the TMJ's as a result of vehicle impact-related extension-flexion neck motion.

### RESULTS:

The maximum linear forces generated at the TMJ in a rear-end collision resulting in a velocity change of the test subject of 8 km/h (5 mph) were in the 7 to 10 N (1.6 to 2.2 lb) range. Moment forces at the joint peaked briefly at 0.55 Nm (4.87lb-in).

### CONCLUSION:

It is the conclusion of this study that injuries to the TMJ attributed to low-velocity "whiplash" cannot be accounted for by the joint forces produced by this maneuver. Forces calculated in this study were for a relatively narrow range of impact-produced velocity changes of 4 to 8 kph. It is not clear from these studies whether reflex contraction forces of the temporalis and masseter groups attributable to opening muscle stretch

would contribute to the closing force of the mandible within the short duration in which opening displacement motion occurs.

RESOURCE No. 33:

Huelke DF. An Overview of Air Bag Deployments and Related Injuries. Case Studies and a Review of the Literature. Society of Automotive Engineers Technical Paper Series, 950866.

ABSTRACT:

This study is an overview of air bag injuries includes a review of the literature with descriptions of air bag related injuries to various areas of the body. A review of some unusual injuries from the author's files and the Special Studies Division of NHTSA are presented.

METHODOLOGY:

This study of airbag injuries on body areas was conducted using a review of the literature and case histories of drivers and 2 right side passengers:

1. Head and face
2. Eye
3. TMJ (1)
4. Neck and spine
5. Thorax
6. Abdomen
7. Back
8. Upper extremity
9. Eight unusual air bag accidents
10. Two cases of passenger injury

RESULTS:

This paper is a review of the literature and case histories and does not list specific results of experimentation.

CONCLUSION:

The author concludes that air bags can be

related to injuries that are minor in nature. This article should be reviewed by every dentist to see what injuries air bags can cause and what other areas of the face that were not evaluated.

RESOURCE No. 34:

Kaplan AS, Assael LA. Temporomandibular Disorders - Diagnosis and Treatment. W.A. Saunders Co., 1991. pp. 202-205, 215.

ABSTRACT:

Whiplash (extension-flexion) injuries lead to cervical soft tissues reflex postural changes. These, in turn, lead to mandibular alterations and TMJ derangements. Psychological factors of the trauma must be included in the diagnosis and treatment.

METHODOLOGY:

This is a discussion, literature review and case study format.

CONCLUSION:

Numerous quoted studies relate the mechanism and results of such injuries on the temporomandibular joints and other structures of the masticatory system. Craniomandibular and cervicomandibular pain syndromes are the result. Limited mouth opening, clicking, numbness, myalgia, synovitis, discitis, effusion, hemarthrosis, capsulitis, muscle splinting, reflex postural alterations, occlusal alterations, as well as other related symptoms, are all a possible result of this trauma. The psychological aspects of the TMJ trauma can not be overstated. The worst problems occur in the patient whose pain remains undiagnosed. Chronicity leads to anxiety and depression.

RESOURCE No. 35:

Kaye LB, Moran JH, Fritz ME. Statistical Analysis of an Urban Population of 236 Patients with Head and Neck Pain, Part I. J Periodontology, February, 1979, pp. 55-58.

ABSTRACT:

This study is a report on the clinical findings of 236 patients. All patients had a complaint of head or neck discomfort or dysfunction syndrome.

#### METHODOLOGY:

Demographic information obtained from each patient included age, sex, occupation, marital

status and emotional stress level. Extensive details were examined in each background. Symptomology and modalities data were also collected.

patient's treatment

#### RESULTS:

Temporomandibular joint discomfort was the most prevalent complaint made (37.1%), followed by facial and neck discomfort (33.0%). It was

found that 38.0% of the study group recalled some form of head or neck trauma, which may have been related to their current condition. The recorded incidence of emotional stress in other studies may have been higher (57% vs. 44%).

#### CONCLUSION:

A study of demographic profile, age, sex, occupation, marital status, emotional stress, and head trauma were examined on 236 patients for myofascial pain dysfunction syndrome.

#### RESOURCE No. 36:

Kennedy J. Recovery from an Airbag Induced Trauma. The Cranial Letter 50(2): 8-9, 1997 May.

#### ABSTRACT:

The author presents a case report of a 44-year-old patient injured by an airbag in an automobile accident.

#### METHODOLOGY:

The author explains his examination and treatment rationale for dealing with a traumatically induced injury. An interesting finding was the patient's lower right posterior teeth did not interdigitate properly. The patient was treated with a mandibular orthotic and cranial adjustments.

#### RESULTS:

After 6 appointments over a 3-month period, headache, ear pain, neck pain, sciatic pain, muscle spasm and TMJ dysfunction resolved.

#### CONCLUSION:

Mandibular orthotics and cranial therapy are effective for treating an injury such as the one described in this article.

RESOURCE No. 37:

Klemons IM. Neurological Findings in Patients Complaining of Head Pain Following Cervical Injuries. The New Jersey Trial Lawyer. August 1988.

ABSTRACT:

A limited survey was conducted by this author to determine the incidence of positive neurological findings (either physical or laboratory) in patients complaining of head pain following cervical whiplash.

METHODOLOGY:

Twenty-nine physicians from around the United States specializing in neurology were interviewed, either by telephone or by written questionnaire. 100% of those contacted by telephone and 80% of those questioned by mail responded. Each was told the purpose of the survey and was then asked to estimate how many patients per year complained of head pain resulting from cervical injuries, without direct trauma to the head. Each was then asked various questions pertaining to physical and other objective neurological findings.

RESULTS:

Documentable neurological physical findings were generally reported in 0-1% of the patients examined. A single neurologist reported nystagmus in approximately 10% of his patients. Two neurologists reported positive findings in less than 1% of those tested, while the rest reported no positive findings (0%) at all. Neurologists reported positive findings in EMG's of the upper extremity in 1% to a maximum of 20% of those reporting between approximately 7% and 10% as positive.

CONCLUSION:

This small survey revealed a virtual lack of neurological findings (physical exam, MRI, CAT, EMG, EEG) in patients complaining of head pain following cervical whiplash. While neurological

evaluation to rule out injury to the nervous system is recommended in virtually all individuals complaining of head or neck pain, it is suggested that it be followed by a thorough evaluation by a dentist knowledgeable in head and facial pain and temporomandibular joint (TMJ) disorders. In most cases, a major aspect of the cause of the pain, as well as a basis for judging permanency, can be objectively determined by using presently available diagnostic techniques.

RESOURCE No. 38:

Kolbinson D, Epstein J, Burgess J, Senthilselvan A. Temporomandibular Disorders, Headaches and Neck Pain after Motor Vehicle Accidents. A pilot investigation of persistence and litigation ethics. *J Prosthet Dent* 77(1):45-53.

ABSTRACT:

There is a lack of long-term follow-up studies that involve post-motor vehicle accident temporomandibular disorders and compensation. The purpose of this retrospective pilot study were

(1) to assess patients who had previously been treated for temporomandibular disorders after motor vehicle accidents to determine the nature of their symptoms in terms of jaw, head and neck pain, and jaw dysfunction and (2) to determine whether there was a difference in the pain and dysfunction between those who had settled and those who had not settled their insurance claims.

METHODOLOGY:

Thirty previously treated patients with temporomandibular disorders after motor vehicle accidents were questioned by telephone regarding litigation status and current jaw, head and neck pain, and jaw dysfunction symptoms. They did not differ substantially from a smaller group who

were not able to be interviewed. Descriptive statistics were calculated and statistical tests were performed. A total of 22 patients had their claims settled.

#### RESULTS:

Approximately  $\frac{3}{4}$  had persistent complaints of jaw pain, jaw dysfunction and headaches, and more than 80% reported persistent neck pain. No apparent differences were found between those who had and had not settled their insurance

claims.

#### CONCLUSION:

Jaw, head and neck pain, and jaw dysfunction continued to be problems for the majority of this patient population, regardless of litigation status in this retrospective study.

#### RESOURCE No. 39:

Kolbinson DA, Epstein JB, Senthilselvan A, Burgess JA. A Comparison of TMD Patients With or Without Prior Motor Vehicle Accident Involvement: Treatment and Outcomes. *J Orofacial Pain* 11(4): 337-45, 1997.

#### ABSTRACT:

Patients with TMD related to motor vehicle accident (MVA) trauma generally have more severe pain complaints, more signs and symptoms of soft tissue injuries and greater difficulty coping with their overall situation compared to non-trauma TMD patients.

#### METHODOLOGY:

Fifty TMD/MVA patients were selected. Fifty age- and sex-matched, TMD/non-trauma were also selected from the same office. The control group patients had no history of a MVA or trauma to the head or neck. All patients in both groups had, at least, 3 office visits, but were not seen for a visit within the previous 4 months.

#### RESULTS:

At initial presentation, post-traumatic TMD patients had:

1. Higher ratings of facial pain
2. Higher ratings of headache pain
3. Higher neck symptom frequency
4. Higher incidence of Tinnitus or plugged

sensation of the ears

5. Much higher incidence of sleep disturbances
6. Greater frequency of occupational/advocational disability
7. Greater masticatory muscle, neck muscle and TMJ tenderness scores
8. More myofascial pain
9. More arthralgia/capsulitis diagnoses

At initial presentation, the non-trauma patients had:

1. Significantly more TMJ crepitus
2. Significantly higher self-reports of para-functional jaw habits

At initial presentation, no significant differences were noted between both groups regarding:

1. Dental and occlusal findings
2. Incidence of reported pre-evaluation for non-trauma TMD
3. Connective tissue disorders
4. Psychophysiologic disorders
5. TMJ clicking
6. TMJ locking
7. Mandibular limited opening
8. General mandibular range of motion

#### CONCLUSIONS:

The TMD/MVA patient population had significantly higher initial symptomologies than did the non-TMD patient population. The patient population with trauma from a MVA clearly demonstrated a significantly higher subjective and objective complaint at initial presentation.

The correlation between MVA and orofacial and temporomandibular pain and dysfunction appears clear.

RESOURCE No. 40:

Kolbinson DA, Epstein JA, Burgess, JA.  
Temporomandibular Disorders, Headaches, and  
Neck Pain Following Motor Vehicle Accidents and  
the Effect of Litigation: Review of the Literature.  
J Orofacial Pain 10(2): 101-24, 1996.

#### ABSTRACT:

A literature review concerning the relationships

between motor vehicle accidents and temporomandibular disorders, whiplash, head-ache, neckpain, and litigation was undertaken. The review shows that many patients recover or resume work prior to settlement, but most unsuccessfully treated patients do not generally recover following the settlement of legal claims; the post-injury problems are not strictly psychologic. Litigating patients and non-litigating patients are often not dramatically different in most important regards (including pain and return to work), with litigating parties deserving the same treatment as other patients with chronic pain. It was found that post-injury neck symptoms and headaches can be persistent. Employment

appears to be a better predictor of long-term outcome than compensation and litigation. In addition, limited consensus is available concerning prognostic factors. Patients with post-injury temporo-mandibular disorders tend to respond less well to treatment than do non-injury patients with temporomandibular disorders, as do litigating compared to non-litigating temporomandibular disorders patients, but a cause and effect relationship is not known. The incidence of temporomandibular disorders following motor vehicle accidents may not be as high as has been claimed in whiplash cases. More research is required in the area of temporomandibular disorders, motor vehicle accidents, and litigation.

#### METHODOLOGY:

This is a review article of previous articles in the literature. Articles were divided by type: ie, prospective, retrospective, literature review and opinion/editorial.

#### RESULTS:

Various conclusions were drawn and opinions voiced in differing articles with respect to the incidents, onset, significance and resolution of temporomandibular disorders, as related to trauma and, more specifically, motor vehicle accidents and cervical strain (whiplash).

#### CONCLUSION:

The literature reviewed supports the following conclusions:

1. A temporomandibular disorder is a possible consequence of whiplash injuries, although the literature may lack conclusive evidence regarding the mechanism(s) of injury.
2. Much of the literature supports a view that pain and dysfunction frequently become chronic.
3. The majority of relevant studies demonstrate that patients do not necessarily improve shortly after litigation

is settled.

4. Two prospective and several retrospective studies show that patients frequently continue to experience chronic symptoms following litigation. These all relate to TMD/orofacial pain symptoms originated in MVA's.

5. Post-injury problems were reported by some authors to have an organic basis, although some "opinions" do propose a psychological basis. This conclusion can not be substantiated according to this review.

6. The effects of a lack or loss of concern and compassion by the patient's provider (insurance carrier) on outcome deserves further study because this factor may have an affect on outcome.

7. The available literature does suggest that TMD may occur as a result of MVA trauma.

8. Post-injury MPDS and TMD patients have reportedly responded less favorably to treatment than non-injury counterparts in a few studies.

RESOURCE No. 41:

Kolbinson D, Epstein J, Senthilselvan A, Burgess J. A Comparison of TMD Patients With or Without Prior Motor Vehicle Accident Involvement: Initial Signs, Symptoms and Diagnostic Characteristics. *J Orofacial Pain* 11(3): 206-13, 1997.

ABSTRACT:

The role of trauma in the etiology of temporomandibular disorders (TMD) is controversial. The objectives of this study were to compare presenting signs, symptoms, and diagnoses in patients who had motor vehicle accident, trauma-related TMD to patients who had non-trauma-related TMJ. The purpose of the study was to determine whether or not trauma is involved as an etiologic factor for TMD patients.

METHODOLOGY:

A review of files was performed on age and sex

matched patients. These included 50 trauma and 50 non-trauma patients. A review of the information was analyzed, particularly the signs and symptoms of TMD. The information concerning the patient's current pain, as well as the temporomandibular joint and its related symptoms with examination findings and diagnoses, were recorded and statistically analyzed.

#### RESULTS:

It was found that the post-traumatic TMD patients had higher facial and headache pain ratings. In addition, neck symptom frequency and ear-related symptoms, as well as sleep disturbances, occupational and avocational disability frequencies, were much higher. They

also had greater masticatory muscle, neck muscle, and TMJ tenderness, as well as myofascial pain and arthralgia capsulitis diagnoses. However, the non-trauma group had more subjective and objective TMJ crepitus, as well as higher self-reports of parafunctional habits.

#### CONCLUSION:

The trauma group had more severe pain complaints, more signs and symptoms of soft tissue injuries and more difficulty coping with the overall situation, as compared to the non-trauma patients. From this article, it is perceived that trauma may be an important etiologic factor for some TMD patients.

#### RESOURCE No. 42:

Kronn E. The Incidence of TMJ Dysfunction in Patients Who Have Suffered a Cervical Whiplash Injury Following a Traffic Accident. *J Orofacial Pain* 1993; 7 (2):209-213.

#### ABSTRACT:

Forty patients with acute cervical whiplash injury were compared to a control group of forty patients. The aim of this study was to compare the incidence of signs and symptoms of TMJ dysfunction, as well as the subjective need for treatment, in a group of patients who received a cervical whiplash injury as a result of an automobile collision with that of a matched control group.

#### METHODOLOGY:

The test group consisted of forty patients (26 men and 14 women, aged 17 to 53 years, with a diagnosis of acute cervical whiplash injury during a 10 week period). The delay between the accident and the examination ranged from 6 to 38 days. The control group consisted of forty patients (26 men and 14 women) who were being treated with physiotherapy for various reasons.

Joint pain was present in 12 patients (30%) and

one control subject (2.5%). Joint sounds were frequent and equally distributed in both groups (15 patients versus 17 control subjects). Limitations of mouth opening was significantly more frequent in the patients

(37.5%) than in the control subjects (7.5%).

Deviation of the mandible during opening was present in 16 patients (40%) and 9 control subjects (22.5%). Masticatory muscle tenderness was found in 12 patients (30%) and 3 control subjects (7.5%).

#### RESULTS:

When the presence of any of the above clinical signs was compared between the groups, the results showed an incidence of 21 patients (52.5%) in the list group and 18 subjects in the control group (45%). When the subjects were asked whether they would seek treatment for the TMJ pain, limitation of opening, or the TMJ sounds, a positive response was obtained by 30% of the patients and 2.5% of the controls.

#### CONCLUSION:

The present findings concerning a significantly higher presence of cardinal signs and symptoms of TMJ dysfunction, together with a relatively high demand for treatment, warrant further study and, from a clinical point of view, are a valid argument for the routine examination of the TMJ and masticatory system in all patients with a cervical whiplash injury.

#### RESOURCE No. 43:

Lader E. Cervical Trauma as a Factor in the Development of TMJ Dysfunction and Facial Pain. *J Craniomandibular Pract* 1983;1(2): pp. 86-90.

#### ABSTRACT:

Cervical musculature spasm can directly cause the development of a pathological occlusal relationship, which can in turn lead to the development of a TMJ disorder and/or myofascial

pain and chronic headache.

**METHODOLOGY:**

This editorial is a discussion, literature review and case study.

**CONCLUSION:**

Traumatic injury, failure to use appropriate treatment modalities, and lack of recognition of whiplash injury can all lead to TMJ syndromes,

headaches and myofascial pain.

RESOURCE No. 44:

Levandoski DR. Mandibular Whiplash: Part I -  
An Extension-Flexion Injury of the Temporomandibular  
Joints. The Functional Orthodontist  
January-February 1993.

ABSTRACT:

The effects of macrotrauma on the TMJ  
apparatus.

METHODOLOGY:

This editorial is a discussion, literature review  
and case study.

CONCLUSION:

Macrotrauma injuries cause elongation of joint  
ligaments, laceration of joint soft tissues,  
perforation, discal tears and crushed articular surface tissues. These injuries often  
precipitate a  
cascade of events that result in altered joint  
morphology, protective muscle cramping,  
impaired joint function, degenerative osteoarthritis  
and compensatory changes in occlusion.

Approximately 80 to 95% of a TMJ disorder  
patient population will eventually recollect some form of significant macrotrauma;  
sometimes long  
after Phase I stabilization treatment to manage  
pain has been initiated.

RESOURCE No. 45:

Lynn JM, et al. Diagnosis and Treatment of Craniocervical Pain and Headache Based on  
Neuromuscular Parameters. Amer J Pain  
Management 1992;2(3): 143-150.

ABSTRACT:

There is increasing evidence supporting the

premise that hypertonicity within facial muscles is an etiologic factor for some chronic headache

patients. This muscular hypertonicity is the result of neurovascular imbalances within the head and neck. Through the analysis of electromyograph (EMG) data, it is possible to construct an intraoral orthosis, which creates neuromuscular balance and, subsequently, relieves the pain.

#### METHODOLOGY:

The sample (N=203) was composed of consecutive patients referred to Craniofacial Pain Diagnostic Associates of Pennsylvania for evaluation and treatment of chronic and/or acute craniocervical pain. The study attempted to identify (i) the relationship of EMG measured neuromuscular dysfunction to reported craniocervical pain and (ii) the effectiveness of EMG - based orthoses on reversing myospastic conditions.

#### RESULTS:

There was a significant ( $p < .0001$ ) decrease in muscular myospasm at rest and a significant ( $p < .0001$ ) increase in muscular activity during function following treatment with EMG - based orthoses. Reported craniocervical pain was significantly reduced.

#### CONCLUSION:

Results support the hypothesis that creation of a physiologic neurovasomuscular envelope of craniocervical motion allows reduction of muscular hypertonicity, resulting in the reduction of pain. Furthermore, utilization of electromyography is a valuable tool during the assessment and treatment of chronic facial pain patients.

RESOURCE No. 46:

Macnab I. Acceleration Extension Injuries of the Cervical Spine. March 1991, The  
Wesley  
Hospital, pp. 647-660.

**ABSTRACT:**

The mechanism of injury to the cervical spine  
due to acceleration extension injuries and  
pathology changes were directly related to the

rate of the acceleration of the head. They range from blurring of vision, tinnitus, dizziness, muscle ruptures and dysphasia.

#### METHODOLOGY:

This editorial is a discussion, literature review and case study.

#### CONCLUSION:

Patients need to be treated carefully and thoroughly for their basic needs following an acceleration extension injury.

#### RESOURCE No. 47:

Maquire RJ, et al. TMJ Syndrome Diagnosis Treatment and Legal Problems. J New Mexico Trial Lawyers Association 1988; 16(6).

#### ABSTRACT:

The goal of this article is twofold. First, it seeks to evaluate the medical and legal problems inherent in the representation of clients with traumatic TMJ syndrome. Secondly, it discusses the legal problems that holders of health insurance policies face in today's market. In the first section of the article, Dr. Thomas Meade laid out the dynamics of TMJ syndrome and its proper diagnosis and treatment. Maquire discusses how to present your case to the trier of fact and how to handle legal problems arising out of claims to health and dental carriers for TMJ problems.

#### METHODOLOGY:

This editorial is a discussion, literature review and case study.

#### RESULTS:

The article gave a general description, from a dental aspect, of the anatomy and function of the TMJ. He described the diagnostic steps for TMD, with emphasis on history and biomedical

diagnostic equipment. A summary of conservative treatment was given. Maguire then detailed his approach to presenting the case to the court and jury in order to get insurance coverage for the treatment of TMD. He also gave emphasis to kinesigrams and electromyographic results to legitimize the claim.

#### CONCLUSION:

Maquire concluded the article with information concerning the legal problems with TMJ and health/dental coverage. He discussed the insurance industry's subjective condition. He also mentioned that the court places a plain, clear and prominent test on insurance contracts and, depending on the state, the language of the contract may be an approach to take in court.

#### RESOURCE No. 48:

Malliaris A, Digges K, DeBlois J. Injury Patterns of Car Occupants under Air Bag Deployment. Society of Automotive Engineers Technical Series, 1995, 950867.

#### ABSTRACT:

The purpose of this paper was to investigate the injury patterns of car occupants, as a function of air bag deployment, with and without belt use and using a harm protocol and an all injuries protocol.

#### METHODOLOGY:

Data from previous accidents is used to provide the information for this investigation.

#### CONCLUSION:

The air bag, even without seat belt use, is very effective in reducing the number of critical and untreatable injuries. By contrast, especially without use, the air bag is ineffective in reducing brain, head and upper extremity injuries. These account for 80% of the harm to cars driven protected by air bags and seat belts when the

evaluation protocol is harm. When all injuries are selected in the evaluation, flesh injuries of low severity dominate the pattern with the head area having 50% and the trunk and each of the extremities with 15% to 20%.

RESOURCE No. 49:

Mannheimer JS, Rosenthol RM. Acute and Chronic Postural Abnormalities as Related to

Craniofacial Pain and Temporomandibular Disorders. Dent Clin N Amer 1991;35(1):185-208.

#### ABSTRACT:

The influence of posture and stress on musculoskeletal pain and dysfunction is a prime etiologic factor that is commonly overlooked, especially in patients presenting with craniofacial pain with minor or no temporomandibular disorder. The craniomandibular system is an integral part of the upper quarter composed of the head, neck and shoulder girdle. Any dysfunction, occlusal disorder, postural abnormality, or trauma of this area must be considered in the evaluation of any patient with craniofacial pain (CFD) or temporomandibular disorder (TMD). Postural anomalies producing muscular hypoactivity can alter the normal anatomic relationship between head, neck and shoulder girdle and the suboccipital region. Pain can result from dysfunctional changes of neurological origin, primarily the trigemincervical complex and vascular origin. Each of these may be related by such factors as work situation, sleep disorders, trauma, depression and stress.

Management of pain includes a multidimensional program of physical therapy management and medical and dental intervention. Goal and aspects of treatment need to be specific and understood by all parties involved and self-responsibility, through active participation, needs to be encouraged.

#### METHODOLOGY:

This editorial is a discussion, literature review and case study.

#### CONCLUSION:

Habitual patterns, producing abnormalities particularly in the head, neck and shoulder girdle, contribute to craniofacial pain and dysfunction. A program, incorporating medical and dental care and physical therapy, is indicated for successful treatment of TMD. It is also

essential for the patient to be re-educated and to be an active participant in his own recovery.

RESOURCE No. 50:

Mannheimer JS, Attanasio R, Cinotti WR, Pertes R. Cervical Strain and Mandibular Whiplash: Effects upon the Craniomandibular

Apparatus. Clin Prevent Dent 1989;11(1):29-32.

ABSTRACT:

One of the most common injuries that can lead to a multitude of problems is cervical strain and mandibular whiplash resulting from a motor vehicle accident. Many individuals do not fully recover from such injuries, develop additional areas of pain and dysfunction week or months after the accident, and/or sustain major trauma that may require surgical intervention. Other than fractures or dislocations of cervical vertebrae, which are usually easily discerned from radiological analysis, two prime factors frequently lead to a prolongation of pain, a long rehabilitation course and the development of problems at adjacent structures, such as the craniomandibular region. These two factors are: 1) the lack of early comprehensive evaluation and referral for definitive therapeutic intervention, and 2) a minimal awareness of the relationship of upper quarter structures to one another. The purpose of this paper is to foster within the reader an appreciation of the interrelationship of the cervical and craniomandibular architectures, as well as the significance of proper evaluation and treatment of cervical strain and mandibular whiplash injuries.

METHODOLOGY:

This paper appears to be a literary review of many studies done by others, as evidenced by significant referrals to various references.

CONCLUSION:

A significant number of whiplash victims never fully recover from dysfunction of the TMJ and associated neuromusculature. Proper safety methods in automobiles, elevation of headrest, shoulder harness and anterior airbag, can significantly prevent the effects of whiplash. Early implementation of treatment by dentists and physical therapists, including patient education and definitive therapy, can minimize effects and return normal function to the craniomandibular, cervical spine and shoulder girdle regions.

RESOURCE No. 51:

Marien M. Trismus: Causes, Differential Diagnosis, and Treatment. *Gen Dent* 350-55, 1997 July/Aug.

## ABSTRACT:

Successful treatment of trismus depends on prompt recognition of its cause and early management. Permanent functional impairment could otherwise result.

## METHODOLOGY:

The author gives a cursory review of TMJ mechanics and states a maximum incisal opening of 35 mm. as a low normal measurement. He then reviews causes of trismus, differential diagnosis and treatment of the condition dependent upon the cause.

## RESULTS:

Causes of trismus are listed as infectious, trauma, dental related, TMD, tumors or cancer, drug therapy, radiation/chemotherapy, congenital/developmental and some miscellaneous causes. Dental related causes include inflammation of the masticatory muscles of direct trauma from a tooth extraction or dental anesthetic injection (with possible local hematoma). TMD causes are divided into extra- and intra-capsular. The former include mostly myofascial and the latter include disc displacement, arthritis, fibrosis, etc.

Differential diagnosis is made on the basis of a complete history and clinical examination with radiographs if necessary. Infections are critical to diagnose with the patient's temperature and complete blood count needed to rule out tetanus or dental infections (pulpal or periodontal). If not life threatening, heat therapy, analgesics, and a soft diet and, possibly, muscle relaxants are ordered. Light physiotherapy for opening and closing the jaws should be instituted. Obvious dental causes should be treated. If infectious, antibiotics are needed. After 2 or 3 days, if no improvement is realized, referral to an oral surgeon is necessary.

For local TMJ inflammation, direct injections of air or fluids has been suggested as has been the pressurized infusion of sodium hyaluronate into the closed locked joint.

CONCLUSION:

Dental professionals are the first line of evaluation for trismus patients and are in a unique position to treat or refer as necessary.

RESOURCE No. 52:

Mark BM. Cervicogenic Headache Differential Diagnosis and Clinical Management: Literature Review. J Craniomand Pract October, 1990, 8(4): pp. 332-338.

ABSTRACT:

The diagnosis and treatment of patients experiencing head and neck pain is a difficult task for any clinician who pursues this area. The purpose of this paper is to elaborate upon unilateral headache, which is referred to as a cervicogenic headache. The literature provides strong evidence demonstrating the relationship of the cervical spine and the possibility of referred pain to the head and facial areas.

METHODOLOGY:

The author referred to many clinicians throughout his article and substantiates the headache pattern for cervical induced pain.

RESULTS:

It appears, from the article and review of literature, that there is a distinct headache pattern referred to as Cervicogenic headache. The author covers the similarities between various headaches. Many studies were cited. The treatment from posture, traction, soft tissue modalities, exercise, TENS, medications and invasive approaches were discussed.

CONCLUSION:

The author makes clear the relationship of the cervical spine and the unilateral headache. Any imbalance or abnormality in the suboccipital spine can give rise to problems in the head and face. Trauma, especially neck trauma, is one of the most common causes of chronic headaches. Throughout the literature, hyperextension and hyperflexion is well documented as a major cause of chronic headaches. Vertebral artery compression in the cervical region is also documented as a causative factor for face and head pain. Nerve root compression, diseases of the cervical spine, like cervical spondylosis and rheumatoid arthritis, should also be considered as a causative factor in head and face pain.

## RESOURCE No. 53:

Matsushita T, Sato T, Hirabayashi K, Fujimura S, Asazuma T. X-ray Study of the Human Neck Motion Due to Head Inertia Loading. Society of Automotive Engineers Technical Series, 942208.

### ABSTRACT:

This study presents results from x-ray analysis of live human head/neck motion in sled test simulations of low-speed frontal, lateral, and rear-end impacts. The experimental results suggest that the most significant factor of the head/neck response is the initial curvature of the cervical and thoracic spine. In rear-end impacts, the neck curvature was found to straighten. In the leaning-forward or stooped-shoulder posture, the cervical spine was shortened due to upward movement of the upper thoracic spine. In all tests, the flexion and extension motions measured were never beyond the physiological range.

### METHODOLOGY:

Twenty-two male and 4 female volunteer test subjects who were placed in a sled with a variety of automobile seats and in leaning-forward, upright, and recline postures. Urethane foam padding was used to simulate the front and rear-end of a vehicle. A similarly padded swung mass struck the sled to create impact equivalent to collisions at velocities from 2.5 to 5.8 kph. The test runs included 19 rear-end impacts, 4 frontal impacts, and 3 lateral impacts. Cineradiography recorded subject responses at 200 frames per second. Accelerometers were mounted on the sled and on the test subjects heads, chests and thighs. The resultant radiographs were compared with voluntary ranges of motion determined by still head/neck radiographs taken in full neck flexion and extension.

### RESULTS:

Rear-end impact: In a simulated 4.7 kph collision, rear-end impact caused a sled peak acceleration of 7.6 G and head acceleration of

5.8 G. Neck extension was stopped by the head restraint cushion and remained within the voluntary range of motion. No hyperextension was recorded. Frontal impact: At 5.7 kph with a lap-shoulder belt, head acceleration peaked at 4.5 G, and the jaw was forced to protrude due to acceleration of

the torso. Restraining the torso with the shoulder belt was equivalent to thrusting of the torso by the seatback in a rear-end collision. Again, all cervical movements were within the voluntary range of motion, without hyperflexion. In unbelted frontal impact, almost no head acceleration was recorded and the shape of the cervical spine remained almost unchanged.

Lateral impact: Since no side structure restricted the torso, the upper torso rotated toward the impact and minimized the acceleration on the head. Severe lateral flexion of the cervical spine did not occur during any test runs.

#### CONCLUSION:

1. In rear-end test collisions of less than 5 kph and with an effective head restraint, the excursion of the cervical spine was never beyond the normal range of motion.
2. In rear-end collisions, leaning-forward or stooped-shoulder posture resulted in neck flexion before extension and compression loading of the cervical spine which caused shortening of neck and straightening of the thoracic kyphosis and cervical lordosis. This compression load did not occur in upright or reclined postures.
3. In frontal collisions, remarkable differences in motion of the head and neck are created by the presence or absence of shoulder belts.

RESOURCE No. 54:

McConnell W, Howard R, VanPoppel J, Krause R, Guzman H, Bomar J, Raddin J, Benedict J, Hatsell C. Human Head and Neck Kinematics

after Low Velocity Rear-end  
Understanding "Whiplash".

Automotive Engineers Technical952724.  
Injuries –  
Society of  
Series 1995,  
ABSTRACT:

A group of rear-end crash tests with seven healthy male human volunteers were performed to obtain human head and neck velocity changes up to 6 mph.

METHODOLOGY:

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Eighteen crash tests with human subjects were performed using three vehicles with modifications for safety and practical reasons. The subject werefitted with a bite block and accelerometer assembly and marked for photographic alignment.

#### RESULTS:

Data from each test run consisted of medical history and observations pre-and post- testexposure of the driver and passenger, bite block and vehicle accelerometer data, and clinical exam results. Some test subject's heads were off centerline. From the data obtained, a chronology of kinematic events was developed. All, but one subject and all passengers, developed what is described as mild pain 1-3 days after the event and, in the 2 years since the events, no subjects have reported any symptoms referable to the crash tests.

#### CONCLUSION:

There was no cervical hyperextension occurring in any test subject. However, all the test subjects, particularly the multiply exposed ones, developed some form of typical "whiplash" symptoms. It seems reasonable to finally conclude that hyperextension was not the cause of their symptoms. After reviewing the data from both studies, the authors conclude that there is no biomechanical event that could cause permanent cervical injury and none of the test subjects have persistent soft tissue injuries.

#### RESOURCE No. 55:

McNeill C. Management of Temporomandibular Disorders: Concepts and Controversies. *J Prosthet Dent* 77(5): 510-22, 1997.

#### ABSTRACT:

This article reviews the literature concerning

TMD and orofacial pain and summarizes the concepts published in the 1993 and 1996 AAOP guidelines. The basic precept is that the field is replete with testimonials and clinical opinion, but it has been lacking in scientific foundation.

Temporomandibular disorders rarely occur as single entities, but rather as multiple problems with overlapping symptoms. Epidemiologic studies report that approximately 75% of the population have, at least, one sign of dysfunction

(joint noise, deviation on opening, episodic locking) and approximately 33% have at least one TMD symptom (face pain, jaw pain).

#### METHODOLOGY:

McNeill begins the article with the basic epidemiological information regarding TMD and orofacial pain. The article is broken down into assessment, diagnostic classification, diagnostic process and management. These are abbreviated restatements of the AAOP guidelines published in 1996.

#### RESULTS:

The article states that, of the large percentage of the population who have signs and/or symptoms, it is estimated that only approximately 5% to 6% are in need of treatment.

There are 4:1 females to males seeking treatment. Assessment of patients requires baseline records and comprehensive history. Tomography is recommended when the clinical exam suggests some form of joint disorder. MRI is the soft tissue imaging method of choice, but is not recommended for routine use. The classification system does not address trauma directly. McNeill also cautions that pain in the orofacial region can be associated with intracranial pain disorders, vascular disorders, neurogenic disorders, primary headache disorders, extracranial disorders, and psychogenic pain disorders. In discussing management, the author promotes a multidisciplinary model that includes patient education and self-care, cognitive behavioral intervention, pharmacotherapy,

physical therapy, and orthopedic appliance therapy. No scientific data is presented to support this model. It is the opinion of the author and the AAOP. The article also states that orthopedic appliances have a reported 70% to 90% clinical success, but the explanation of the efficacy of the treatment response is less understood.

#### CONCLUSIONS:

Dentists must learn to correctly diagnose and properly treat acute orofacial pain conditions with practical, cost-effective, and evidence-based approaches. The dental profession should embrace a biopsychosocial model of chronic orofacial pain and TMD management following the medical model for chronic musculoskeletal pain management. This article concludes that a majority of temporomandibular disorder patients achieve good relief of symptoms with non

invasive, reversible therapy. CONCLUSION:

RESOURCE No. 56:

Moses AJ. Legal Perspectives on  
TMJ/Whiplash. J Craniomand Pract July 1993;11(3) pp. 237-40.

ABSTRACT:

The establishment of an intercausal relationship between cervical whiplash and temporomandi-bular disorders (TMD) has resulted in an increasing involvement by dentists as primary care treaters. The dental professional can also play an important role in the litigation of these cases for purposes of assessing damages, motor vehicle accidents or civil cases. The system of jurisprudence in the United States seeks to allocate fault to a responsible party and compensate an injured party. This is called tort law. A motor vehicle accident is not a criminal case unless a specific law is broken and the state seeks to punish the offender. The plaintiff is the injured party who files a lawsuit. The plaintiff has the burden of proof in such civil cases. The standard of proof, which operates in a negligence case, is "by a preponderance of the evident". It is not as strict a standard as the criminal standard of proof known as "beyond a reasonable doubt". The plaintiff in a civil negligence action need only demonstrate that his evidence is more probably true than not true. Most TMJ/whiplash cases involve automobile accidents, which provide a good example of breach of duty.

In addition to diagnosis and treatment, a dentist may be called upon to assess the degree and extent of impairment and disability relative to the patient's condition. Impairment is a medical condition involving loss of function and its degree of severity, which is determined by the treating doctor only after maximum rehabilitation has been achieved. A dentist or physician may also be retained by the defense to conduct an independent medical examination. Being involved with either side of litigation has

its advantages and disadvantages.

#### METHODOLOGY:

The article is written to briefly review the legal perspectives of dentist as primary care treaters of TMD as a result of cervical whiplash.

Due to the establishment of an intercausal relationship between cervical whiplash and TMD, this has resulted in the increasing involvement of dentists in primary care treatment, as well as in the litigation of these cases.

#### RESOURCE No. 57:

Moses AJ. Understanding Temporomandibular Disorders. Defense Counsel Journal 61(2):169312, 1994 Apr.

#### ABSTRACT:

This article explains the normal and abnormal temporomandibular joint function and the need for proper diagnosis and treatment. It was written to simplify the information attorneys need for analysis of temporomandibular disorder cases.

#### METHODOLOGY:

This editorial is a discussion of temporomandibular case analysis for the legal profession.

#### CONCLUSION:

A thorough clinical examination is necessary consisting of muscle palpation, neurologic check, range of motion measurement, dental and facial symmetry, occlusion habits, joint imaging, observation of function, and head, neck and back posture for a proper diagnosis. The general view is that all conservative reversible and noninvasive procedures should be undertaken before invasive procedures are considered for treatment.

RESOURCE No. 58:

Moses AJ. Understanding Whiplash and TMD.  
Defense Counsel Journal 61(3): 313-484, 1994July.

ABSTRACT:

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This article describes two possible mechanisms in which a TMD whiplash injury can occur. It discusses the various diagnostic tools and methods to record TMD injuries.

#### METHODOLOGY:

This is an editorial to attorneys to help them better understand the relationship between whiplash and TMD.

#### CONCLUSION:

Generally, no one new technique is definitively diagnostic for correlating whiplash with TMD. Several diagnostic techniques, including imaging for the temporomandibular joint, are essential.

#### RESOURCE No. 59:

Moses AJ, Skoog GS. Cervical Whiplash and TMJ. *Trial* 1986;20(3) 63-66.

#### ABSTRACT:

The authors discuss the symptoms commonly reported following cervical whiplash trauma and its close relationship to temporomandibular joint syndrome. They note that cervical whiplash trauma symptoms progress from the neck to the stomatognathic system. They discuss the functional relationship between the structures of the jaw and neck, and how forward head posture is often common to both cervical and TMJ syndrome.

#### METHODOLOGY:

This editorial is a discussion, literature review and case study.

#### CONCLUSION:

There are striking similarities in the symptoms between cervical whiplash and TMJ syndrome. Poor posture can pre-dispose a patient to both

problems and cervical collars can make a whiplash worse by aggravating the TM Joint injury.

RESOURCE No. 60:

Okeson J. Orofacial Pain – Guidelines for Assessment, Diagnosis and Management, Quintessence Pub Co 1996, p. 120.

ABSTRACT:

Page 120 of this book contains a brief summary based on a literature review of “Trauma and TMD”. Trauma is subcategorized into (1) “direct trauma” which is the result of a blow to the involved structures; (2) “indirect trauma” which is associated with a sudden blow, but without direct contact to the affected structures; and (3) “microtrauma” which is the result of prolonged, repeated force over time.

METHODOLOGY:

Literature review.

CONCLUSION:

General agreement exists that direct trauma to the jaw or TMJ produces injury with inflammation in the temporal area. Direct trauma often produces localized symptoms within 24-72 hours. Causation is difficult or impossible to establish when the onset of symptoms occurs much later.

Indirect trauma, also referred to as acceleration/deceleration or whiplash injury, can cause symptoms of TMD, although the direct causal mechanism has not yet been established. Human volunteers have not shown jaw movement during rear-end impact tests. However, pathways from the cervical area to the trigeminal area are recognized and may be associated with TMD symptoms following indirect trauma neck injuries. The author also asserts, without reference or example, that much

“misinformation” without scientific basis is being provided to indirect trauma patients.

RESOURCE No. 61:

Orner, P. A Physician-Engineer’s View of Low Velocity Rear-end Collisions. Society of Automotive Engineers Technical Series, #921574.

ABSTRACT:

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Soft tissue injuries, such as cervical strain/sprain, headache, TMJ problems, and exacerbation of cervical degenerative joint disease are commonly reported after low impact motor vehicle accidents. There is controversy regarding vehicle-occupant kinematics, treatments, causation, and prognosis.

#### METHODOLOGY:

This paper is a neuristic discussion that uses physical, biomechanical and medical commonsense as its standard.

Medical reports may not focus on injury mechanisms due to the more urgent concerns of medical decision-making; thus, recreating accident biomechanics is difficult.

#### RESULTS:

Headache mechanisms are poorly understood and mimic headache symptomology in anxiety reactions. TMJ dysfunction does not fit the accident model, and forces generated in low velocity collisions within the TMJ do not cause injury. The delay in symptomology is seen as suspicious. Chronic factors, many psychogenic, are often coincident in patients and may be important. Exacerbation of degenerative joint disease may only be a coincident waxing and waning of normal symptoms.

Low velocity rear-end collisions are simply defined as straight impacts with speeds to 5-10 mph. Soft tissue complaints are often present without evidence of vehicular damage.

The model of extension followed by flexion is assumed to make the most common sense. Whiplash models should be simple to avoid inconsistent predictions. A three-point seatbelt may increase neck-flexion. There is no satisfactory "surrogate" model for cervical and head soft tissue injury causation.

Cervical sprain is due to ligament rupture. Strain is injury without rupture and there is minimal, if any, edema or hemorrhage. The

author notes the various theories of muscle spasm: protective, myotatic reflex.

#### CONCLUSION:

According to this author, symptoms commonly reported after low velocity rear-end collisions include headache, TMD, and neck pain and do

not have clear mechanism of precipitation or perpetuation from a common sense understanding of accident mechanisms. Much is unknown about the potential relationships of these symptoms to the trauma.

#### RESOURCE No. 62:

O'Shaughnessy T. Latent Dysfunctions Resulting from Unresolved Trauma-Induced Head and Neck Injuries. *Funct Orthod*, p. 22-28, 1995 Mar/Apr.

#### ABSTRACT:

Latent dysfunction of the TMJ system and/or craniocervical system is common following trauma. It becomes increasingly evident as acute symptoms subside and singularly focused diagnostic and treatment regimens are followed. As chronicity develops, accurate diagnosis and successful treatment becomes difficult. Patients and/or health practitioners may become frustrated with a lack of progress and give up treatment, thereby, perpetuating the dysfunction and pain.

Development of an objective forensic standard by the author helps in the evaluation of patients to assign reasonable causation to a specific trauma episode or multiple episodes using time-date-referencing of radiographs and other objective parameters.

#### METHODOLOGY:

The author reviewed his trauma records to discern common observations in head and neck trauma cases and performed a literature review supportive of trauma-induced TMD, as well as

referencing his previous publications regarding time-date-referencing of traumatic bony changes of the TMJ's.

The author proposes and introduces the concept of Forensic Trauma Integrity Rating (FTIR) as an objective method of evaluating the causation of chronic head and neck pain as it may relate to past trauma.

#### RESULTS:

The author has used his system to objectively determine, with a high degree of medical

certainty, whether trauma has been/was responsible for a patient's present dysfunction and/or pain. This is valuable both from a patient/plaintiff perspective, as well as from an insurer's perspective.

#### CONCLUSION:

A proper understanding of trauma-induced injury to the head and neck is essential by those treating/diagnosing it. A multi-disciplinary team with parallel treatment will bring maximum resolution and, by following such protocol, cost effective, successful treatment will result.

#### RESOURCE No. 63:

O'Shaughnessy T. Tomographic Proof of Trauma-Induced Injury to the TM Joint and Other Sites in the Body. *Funct Ortho* 12(5):20-28, 1995 Nov/Dec.

#### ABSTRACT:

This paper introduces the author's protocol for tomographic study of the mandibular condyle which allows proof of trauma-induced damage to the tissues of the TM joint. This paper also includes a review of cellular structure of the pertinent areas mentioned.

#### METHODOLOGY:

The author has developed his protocol for radiographically documenting injury and healing time from corrected tomograms of accident victims since 1990. He has radiographic records of trauma spanning less than 48 hours antecedent to more than 8 years. From those records, he has observed the radiographic changes that comprise his time-date-referencing system.

#### RESULTS:

The author reports helping to objectively document evidence of soft tissue trauma to the TMJ's by proper radiographic protocol, knowledge of anatomy and microscopic anatomy, knowledge

of the trauma incident, and his experience.

He reports successfully being able to document and time-date-reference injuries from several traumas to one patient.

#### CONCLUSION:

It is possible to objectively document soft tissue trauma to the TMJ using the author's protocol(s) and further time-date-reference injuries where more than one trauma has occurred.

The ability to provide such information is hoped to decrease litigation in trauma cases and provide necessary evidence for treatment of injured patients in a timely manner.

TMJ injuries occur frequently in motor vehicle trauma and do not always correlate with the amount of damage to the vehicle.

#### RESOURCE No. 64:

Parker M. A Dynamic Model of Etiology in Temporomandibular Disorders. JADA March 1990; 120:283-289.

#### ABSTRACT:

A dynamic model is proposed to depict the etiology of temporomandibular disorders. A balance is described between destructive factors in the masticatory system that result in dysfunction and adaptive factors that tend to return it homeostatically to normal.

#### METHODOLOGY:

This editorial is a discussion, literature review and case study.

#### CONCLUSION:

The model focuses on the roles of hyperfunction and adaptability in TMD dynamics. It

encompasses trauma and occlusion as two major factors. The intent of the model is to help with the diagnosis and treatment planning for the individual patient and to be mindful of multiple etiologic factors. The clinician must not only distinguish between factors, but must also distinguish how much of each is involved.

RESOURCE No. 65:

67

Phillips DJ, et al. Recommended Guide to the Evaluation of Permanent Impairment of the Temporomandibular Joint. J Craniomand Pract January 1989, 7(1):pp. 1-6.

#### ABSTRACT:

This paper provides a method to evaluate the extent of permanent injury to the temporomandibular joint. The authors have used the same values as the American Medical Association for other disk - protected and functional joints. These guides may serve as a tool in helping physicians and dentists who treat temporomandibular joint injuries to rate the degree of permanent injury.

#### METHODOLOGY:

The authors incorporated the AMA guidelines of other disk - protected joints and fabricated a guideline for the impairment to the temporomandibular joint based on three criteria.

1. Disk derangement
2. Range of Motion
3. Arthroplasty

#### RESULTS:

This article gives specific guidelines for the impairment rating of a patient who has suffered a temporomandibular joint injury. Any discrepancies from normal were given a specific value to determine the correct impairment rating according to disk derangement, range of motion and arthroplasty.

#### CONCLUSION:

Trauma is an etiologic factor, causing permanent damage to the temporomandibular joints. This guideline gives specific values to follow and allows the practitioner to uniformly formulate a percentage of permanent impairment.

RESOURCE No. 66:

Pintar F, Yoganandan N, Voo L, Cusick J, Maiman D, Sances A. Dynamic Characteristics of the Human Cervical Spine. Society of Automotive Engineers Technical Series 1995, #952722.

**ABSTRACT:**

This paper presents the experimental dynamic tolerance and the force-deformation response of the human cervical spine under compression loading. Twenty human cadaver head-neck complexes were tested using a crown impact to the head at speeds from 2.5 m/s to 8 m/s. The cervical spine was evaluated for pre-alignment by using the concept of the stiffest axis. Mid-cervical column (C3 to C5) vertebral body wedge, burst, and vertical fractures were produced in compression. Posterior ligament tears in the lower column occurred under extension. Mean values were: force at failure, 3326 N; deformation at failure, 18 mm; stiffness, 555 N/mm. The deformation at failure parameter was associated with the least variance and should describe the most accurate tolerance measure for the population as a whole.

**METHODOLOGY:**

Dynamic compression tests were performed on a total of 20 human cadaver head-neck complexes. The age ranged from 29 to 95 years; there were 9 females and 11 males.

Each primary injury was defined as minor, moderate or severe as follows:

Minor – vertebral and/or soft tissue trauma not requiring appreciable clinical intervention, i.e.; neither internal nor external intervention.

Moderate – vertebral and/or soft tissue trauma requiring moderate clinical intervention with external and, possibly, internal (surgical) intervention.

Severe – vertebral and/or soft tissue trauma requiring appreciable clinical intervention, including both internal (surgical) and external (orthosis) intervention.

#### RESULTS:

Injuries occurring under compression were consistently mid-column fractures of the vertebral bodies, with burst, wedge, and vertical fractures. Injuries occurring in the flexion mode were more ligamentous having a component of posterior ligament involvement. The three spines that failed under an extension mechanism all had anterior ligament involvement.

## CONCLUSION:

The human cervical spinal column has to resist physiologic, as well as traumatic forces. Under these circumstances, it is important to maintain the normal functional relationships between the bony elements of the spine and the cervical spinal cord. Clinical studies indicate that, under traumatic situations, such as motor vehicle crashes, surviving victims with cervical injuries often have compression related trauma to the mid column. These injuries have significant societal costs. To reduce the risk of injury to the occupant of a motor vehicle, safer vehicles must be designed. A major tool in the development of safer vehicles is the anthropomorphic test devices. To increase the biofidelity of Anthropomorphic Test Devices (ATD), human volunteer and cadaver experimentation must be done. This paper describes the compressive tolerance of the human cadaver head-neck under axial loading to the crown on the head. The dynamic force-deformation corridor has been determined as a guide for further improvement to the ATD neck.

## RESOURCE No. 67:

Pressman BD, Shellock FG, Schames J, Schames M. MR Imaging of the Temporomandibular Joint Following Cervical Extension-Flexion Injury (Whiplash). J Magn Reson Imaging 1992; 2(5): 569-74.

## ABSTRACT:

Determining abnormalities of the temporomandibular joint (TMJ) associated with cervical extension-flexion injury (whiplash) with the use of MR imaging.

## METHODOLOGY:

Sixteen patients (32 joints) with TMJ syndrome-related symptoms, after whiplash

injuries from automobile accidents, were evaluated by MR imaging. None of the patients had direct trauma to the jaw, mouth or face. T1 weighted closed- and opened-mouth views were obtained in the sagittal plane and closed-mouth views were obtained in the coronal plane. T2-weighted closed-mouth views obtained in the sagittal plane were also obtained to optimize identification of fluid/edema.

#### RESULTS:

Fourteen (87%) of 16 patients had one more of the following TMJ abnormalities: 11 (34%) had anterior displacement of the disk with reduction and 2 (6%) had anterior displacement of the disk without reduction. On T2-weighted images, 17 TMJs (53%) had joint fluid and 5 (16%) had fluid localized to the capsule and/or pterygoid muscle.

#### CONCLUSION:

The data demonstrated a high incidence of TMJ abnormalities related to whiplash injury. The predominant finding was associated fluid/edema, suggesting that T2-weighted images are particularly useful for the evaluation of patients who present with whiplash injury.

#### RESOURCE No. 68:

Pullinger AG, et al. TMJ Osteoarthritis: A Differentiation of Diagnostic Subgroups by Symptom History and Demographics. J Craniomand Disord, Facial and Oral Pain 1987,1(4): 251-256.

#### ABSTRACT:

A sample of 12 patients with derangement and arthrosis were identified from a group of 219 consecutive patients evaluated in a private practice for temporomandibular joint (TMJ) pathosis according to histories, strict clinical criteria and TMJ serial tomograms.

#### METHODOLOGY:

122 patients with TMJ derangement and with

arthrosis were identified from 219 patients. These patients were assigned to five independent subgroups, based on history and clinical criteria.

#### RESULTS:

It was concluded that not all closed lock patients are the result of a dysfunction progression beginning with disc derangement. Arthrosis patients, who had no history of prior locking, were older than those with histories of a clicking - locking - arthrosis continuum ( $p < .001$ ). Men, in particular, were not found to be a part of the clicking - locking - arthrosis continuum groups. Female patients over 35-45 years, and male

patients of all ages, probably have nonprogressive derangements, usually secondary to the arthrosis, and treatment should be directed at the acute symptoms of arthrosis. Macrotrauma, especially

motor vehicle trauma, was associated with a significant percent of derangements, and to lesser extent, with arthrosis.

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#### CONCLUSION:

The results of this study support the hypothesis that there are at least three distinct arthrosis populations that can be differentiated by age and sex.

#### RESOURCE No. 69:

Pullinger A, Seligman D. Trauma History in Diagnostic Groups of Temporomandibular Disorders. Oral Surg Oral Med Oral Pathol 71:529-34, 1991.

#### ABSTRACT:

Trauma was studied for association with disease among 6 diagnostic subgroups of 230 patients with temporomandibular disorder with

(1) disc displacement (DD) with reduction, (2) DD without reduction, (3) osteoarthritis (OA) with prior derangement history, (4) primary OA, (5) myalgia only, and (6) subluxation only.

#### METHODOLOGY:

Trauma history was obtained through personal interview from 230 consecutive patients with TMD referred to a private general dental practice. Trauma was classified as motor vehicular or other head or neck trauma. Three control groups were used for comparison: asymptomatic group, an asymptomatic group, and a group of general dental patients.

#### RESULTS:

The frequency of associated trauma was higher

in the TMJ derangement groups 1 and 2, than in OA groups, 3 and 4, or in the myalgia-only group,

5. Trauma history in all but group 6 (subluxation only) was significantly greater than in any of the 3 control groups.

#### CONCLUSION:

Patients with TMD have a higher prevalence of trauma history compared with patients without TMD.

#### RESOURCE No. 70:

Rauschnig W. Cervical Spine Trauma: Soft Tissue Injuries and Diagnostic Fallacies. Uppsala, Sweden. No referral journal cited.

#### ABSTRACT:

Major and minor injuries to soft tissues in the cervical spine from whiplash-type trauma are often overlooked. Plain radiograms are usually negative while cervical MRI's show more lesions. The study examined these injuries in fatal car accidents, as well as diagnostic findings in a patient population.

#### METHODOLOGY:

Part I: 22 cervical spines were examined at autopsy from victims of skull fracture or other craniocerebral injuries resulting from fatal car collisions. Frozen specimens were microsectioned and examined for direct or indirect signs of injury.

Part II: 50 consecutive patients presenting with neck pain, some with radiating pain resulting from whiplash during car collisions, were examined. 17 males and 33 females with the mean age of 33 years had normal radiograms. Signs and symptoms were noted, as well as any radiographic changes.

#### RESULTS:

Part I: In the upper cervical spine, only one in ten ligamentous disruptions were suspected on the radiograms. Numerous false positive and false negative diagnoses were realized, especially in the transverse process region. In the subaxial spine, over 198 multilevel lesions were missed. In the two adolescents, 8 cartilaginous endplate avulsions of the discs were missed. On a second look at the radiograms, only four of the total 245 bone and discoligamentous lesions could be detected.

Part II: After 6 weeks, 24 patients still had persistent or increased neck pain and 19 had escalated to radicular symptoms. Radiograms failed to reveal pathology in the radicular patients, but did show segmental instability in a

scant 5 of the deep pain patients. MRI of the symptomatic patients missed all posterior soft tissue ruptures, but did detect signal changes in 49 discs and 27 discs with protrusions. Although ten patients with severe radicular pain had

Grade 3 and 4 disc protrusions/herniations on the MRI scan, it took a Gadolinium contrast enhancement to further delineate the extent of the herniations. Nine of these were confirmed during surgery.

#### CONCLUSIONS:

Cervical radiograms failed to recognize large numbers of fractures and soft tissue injuries associated with craniocerebral trauma in car accident victims. False positive/negative diagnoses were common. Half of the whiplash-type neck injury patients had persistent symptoms and the extent of the discoligamentous injuries were confirmed by MRI and surgical findings.

#### RESOURCE No. 71:

Rogal OJ. Mandibular Whiplash - The Medical-Legal Aspects of Whiplash and TMJ Injuries. 1987.

#### ABSTRACT:

The author recognizes causal inter-relationship between cervical whiplash and TMD and the dentist's role as primary caregiver, and as an aspect in the litigation of these cases. This paper discusses legal concepts of tort law (which finds fault and assesses damages) and practical applications to the dentists.

The defendant is responsible for exacerbations to the plaintiff. Negligence law entitles a plaintiff to fair and reasonable compensation both tangible (expenses, loss of income etc.) and intangible (pain and suffering, sexual dysfunction etc.).

A well written report is helpful for the judicious settlement of the case. A report should be accurate and factual, containing history, a

complete exam, corroborative objective testing, proper diagnosis (not TMJ or TMD) and a professional opinion as to the degree and extent of injury and cause of treatment.

#### METHODOLOGY:

The editorial is a discussion, literature review and case study.

#### CONCLUSION:

The dentist who treats trauma from cervical whiplash and TM Joint can be called upon to be an expert for the plaintiff or the defense. A knowledge of tort law and legal issues can increase the level of the dentist's effectiveness as an expert.

#### RESOURCE No. 72:

Romanelli GG, Mock D, Tenebaum HC. Characteristics and Response to treatment of Post-traumatic TMD: A Retrospective Study. Clin J Pain 1992;8:6-17.

#### ABSTRACT:

A retrospective analysis of 104 patients undergoing treatment of the TMD's. This study was undertaken to characterize further the features of post-motor vehicle accident TMD vs. control TMD patients and to analyze their overall response to treatment methods under routine clinical conditions.

#### METHODOLOGY:

The patient sample consisted of 104 patients diagnosed with TMD. The patients were subclassified into three groups:

1. Patients having primarily myofascial pain dysfunction.
2. Patients demonstrating TMJ dysfunction, pain on palpation of TMJ and joint noises, as well as

locking.

3. Patients demonstrating MPD/TMJ dysfunction.

Group 1 consisted of 52 patients with a diagnosis of MPD, TMJ dysfunction, or MPD/TMJ dysfunction syndrome. These patients had no history of an MVA or other macrotrauma to the jaws, neck or TMJ prior to the onset of their symptoms.

Group 2 consisted of 52 patients who had been involved in a MVA prior to the onset of their symptoms and who denied a longstanding history of TMD problems prior to the traumatic event.

Treatment modalities were used accordingly for the clinical management of TMDs, post-traumatic TMDs or other conditions. Most frequently used were the (A) flatplane mandibular bite plane, (B) physiotherapy, (C) NSAIDS and (D) moist heat application and massage. Response to therapy was recorded at each appointment by asking specifically if there was either improvement, no change, or worsening of condition. Duration of therapy ranged from 4 months to 5 years after the MVA.

#### RESULTS:

In Group 1, following therapy, 39 of the 52 patients (75%) experienced an overall improvement of symptoms and were satisfied with their present condition. Those patients who did not improve (25%) continued to return for more and different types of therapy, however, they did not obtain adequate relief of their symptoms over the course of this study.

In Group 2, following a course of treatment, only 25 of 52 patients (48%) reported an overall improvement. Accordingly, a larger number of individuals [27 of the 52 patients (52%)] did not experience significant improvement.

#### CONCLUSION:

The data shows that, over the time frame of this study, post-traumatic TMD patients recover at a significantly lower rate than control TMD patients. It appears that post-traumatic TMD patients do not respond to therapy as well as the control subjects, suggesting a difference in underlying pathophysiology or an incomplete or inaccurate diagnosis.

#### RESOURCE No. 73:

Savage DJ. Anatomy of a Jury Decision: TMJ and Cervical Injuries. The New Jersey Trial Lawyer. Winter 1989.

#### ABSTRACT:

A judgement of \$260,000 was awarded in Middlesex County for TMJ and cervical injuries, resulting from a 1985 automobile collision in the

Martinez vs. Kocha (1988) case.

#### METHODOLOGY:

This editorial is a discussion, literature review and case study.

#### CONCLUSION:

Mrs. Martinez presented to Dr. Ira Klemons' office 22 years following an automobile accident. She had symptoms from probable cervical and TMJ trauma, with permanent dysfunction and discomfort. TMJ disorders are recognized by New Jersey courts without absolute, objective evidence of soft tissue injury, along with cervical whiplash injuries, if both are proximately caused by the accident.

#### RESOURCE No. 74:

Schneider K, Zernicke RF, Clark G. Modeling of Jaw - Head - Neck Dynamics During Whiplash. J Dent Res 1989;68(9):1350-1355.

#### ABSTRACT:

Clinicians report signs and symptoms of temporomandibular joint (TMJ) disorders in many patients who have experienced automobile rear-end collisions involving neck hyperextension (whiplash). In order for relationships between TMJ disorders and rear-end collisions to be explored, the dynamic response of the jaw to hyperextension of the neck associated with automobile rear-end collisions needs to be quantified. To achieve this goal, we extended an existing head-neck model by adding a moveable jaw and performed preliminary computer simulations of the jaw movements during rear-end collisions at 6.71 ms (15mph) and 13.41 ms (30mph). The initial computer simulations

produced promising kinematic and dynamic results, such as: relative angle between the head and jaw (jaw/opening angle), predicted TMJ torques, and displacement and linear acceleration of the jaw's center of mass.

#### METHODOLOGY:

To generate quantitative data to analyze the dynamics of the jaw during whiplash, the authors extended an existing head-neck model by adding a moveable jaw and performed preliminary

computer simulations of the jaw movements during 6.71 ms (15mph) and 13.41 ms (30mph) rear-end collisions. From their computer simulations, they analyzed kinematic and dynamic results, and although the jaw - head - neck model has not yet been fully validated, even the first version of the model produced encouraging results. Their approach is significant because, for the first time: (1) a dynamic model of the jaw - head - neck system,

including a moveable jaw, was implemented, and

(2) in preliminary simulations, jaw dynamics were quantified during hyperextension/hyperflexion (whiplash) of the neck associated with automobile rear-end collisions. However, refinements must be made to the model during the course of validation, with experimental data for whiplash, for the accurate dynamic responses of the jaw/head/neck system, during impulsive loading, to be predicted.

#### RESULTS:

The kinematic and dynamic results were analyzed from computer simulations: jaw opening angle, predicted TMJ torques, and displacement and linear acceleration of the jaw's center mass.

The absolute values and time course of our results for the jaw segment must be viewed with caution; nevertheless, the initial phase of the model development produced encouraging results.

#### CONCLUSION:

The term whiplash, first used by Gay and Abbott (1953), generally defines a hyperextension injury to the soft tissues of the neck.

In many of the patients who have received a traumatic whiplash injury, but have not received a direct physical injury to their jaw, clinicians report the presence of signs and symptoms of temporomandibular joint (TMJ) disorders such as jaw - joint clicking and locking and pain. Rather than immediately after the accident, a collection

of symptoms and disabilities may later develop.

RESOURCE No. 75:

Severy D, Mathewson J, Bechtol C. Controlled Automobile Rear-End Collisions, an Investigation of Related Engineering and Medical Phenomena. Canadian Services Medical Journal, Vol XI 1955,

p. 727-59.

ABSTRACT:

Rear-end collision injuries are common and the injury is, most often, a soft tissue one. The reason for this controlled study, using 1941 Plymouths to strike the rear of 1947 Plymouths at speeds of 7 to 20 mph, was to determine the nature and extent of the force systems on both the human occupants and vehicle structures. The information obtained can be used for engineering revisions of automobiles to make them safer and to evaluate the medical aspects of neck injuries associated with this type of impact. Unlike most injury producing accidents, there is generally no immediate visible sign of injury to the victim of rear-end collisions which may require weeks or months of therapy before recovery.

METHODOLOGY:

A test site was located at the University of California with several cameras focusing on the contact position. The wheel positions were marked and curb reference markers at one-foot intervals were utilized. A black backdrop was placed for photographic contrast. Two humans and one anthropometric dummy were instrumented for this study. High-speed cameras were mounted adjacent to the crash site and 16 mm. GSAP cameras and accelerometers were mounted in the vehicle. Several runs at different speeds with humans and dummies were performed.

RESULTS:

The results of these experimental crashes show that considerable force is applied to the neck. The injury can be influenced by the speed of contact, the mass and collapse characteristics of the vehicles, height and strength of the seats, human body variations and positions at impact. Significant findings were listed.

**CONCLUSION:**

The low speed, rear-end collision is common and, frequently, results in minor car damage with major bodily injury. Most of these injuries are soft tissue and there is usually no visible sign of injury on the victim. Frequently, the injury is notnoticeable until a day or so after the crash and there is no explanation for the long duration of the symptoms.

**RESOURCE No. 76:**

Shankland WE. Ernest Syndrome as a Consequence of Stylomandibular Ligament Injury: A Report of 68 Patients. J Pros Dent, 1987;57(4): pp. 501-506.

**ABSTRACT:**

The disorder associated with pain of the styloid process is termed Eagle's syndrome. It involves the mineralization of the stylohyoid ligament, elongation of the styloid process, or even the continued growth and subsequent ossification of the second brachial arch cartilage. A similar, but different, disorder that also involves the styloid process has also been described. In contrast to Eagle's syndrome, this condition involves the stylomandibular ligament, particularly its mandibular intersection. It is referred to as the Ernest Syndrome.

Clinically, the patient has symptoms similar to Eagle's Syndrome and internal derangements of the temporomandibular joint (TMJ): pain in and around the TMJ, the ear, the temple, the body of the mandible, and pain in the eye. In addition, pain in the throat, and even in the shoulder, are common. In this study, 68 patients with the Ernest Syndrome were investigated to determine

(1) specific symptoms associated with injury to the stylomandibular ligament, (2) various epidemio-logical data that would be useful in differential diagnosis, and (3) various modes of treatment.

**METHODOLOGY:**

Sixty-eight patients were diagnosed as suffering from Ernest's Syndrome according to these criteria: (1) a history of reporting pain in the specific anatomic regions noted previously, (2) pain on palpation of the insertion of the stylomandibular ligament, and (3) relief of pain after a diagnostic anesthetic injection into the ligamentous insertion, as described by Ernest. A specific questionnaire was completed for each

patient in this study and the results were tabulated and analyzed.

## RESULTS:

Eighty-two percent of the patients (56) were women with an average age of 35 years and symptoms of over 4 years in duration, demonstrating a maxillary - incisal opening averaging 38 mm, having 11mm in right and left

lateral excursions and 5 mm protrusive jaw movement. The etiology of the symptoms presented was mixed trauma (including automobile accidents) 59%, unknown - 49% (including multiple traumas with no known single trauma cause). Areas of reported pain were predominately of the ear, TMJ and temporal (85%), followed by the mandible and teeth (75%), then the throat and eye (59%).

Additional craniomandibular disorders were found co-existent to Ernest's Syndrome with internal derangement and myofascial pain comprising 78% of all other pain diagnosis made.

Treatment requirements were 78% non-surgical and 35% surgical in final outcome.

## CONCLUSION:

Injury to the stylomandibular ligament is a real and frequent disorder, causing craniomandibular pain with trauma the most common etiology (over 78%) verified.

A diagnosis of Ernest's Syndrome may be based on an adequate history, palpation of the insertion of the stylomandibular ligament, and a diagnostic local anesthetic block of the affected ligamentous insertion.

Symptoms of Ernest's Syndrome in decreasing order of occurrence are: TMJ and temporal pain, ear and mandibular pain, posterior tooth sensitivity, eye pain, and throat pain. In addition, shoulder pain may be involved.

Of the patients in this study, 77.94% were treated successfully via nonsurgical management of their complaints. Resolution of this disorder is usually accomplished by a combination of diagnostic injection of local anesthetic at the insertion for the ligament, localized injection of cortisone substitute, and by placing the patient on a soft diet.

Surgical management, if necessary, is best accomplished by a radiofrequency thermoneurolysis procedure in the involved ligamentous insertion.

RESOURCE No. 77:

Shankland WE. Temporomandibular Disorders: Frequent Causes of Undiagnosed Head

and Neck Pain after Injury. Ohio Trial 1994;  
4:16-20.

#### ABSTRACT:

Injuries to the temporomandibular joint and associated structures are often overlooked by physician, dentists, and other medical personnel. Unfortunately, these patients are unfairly labeled as malingerers by doctors, defense attorneys and insurance claims adjusters. Not only do these individuals continue to suffer long after settlement, but future medical expenses arise with no chance of compensation.

#### METHODOLOGY:

This paper is an essay written to attorneys and not a scientific study. A review of the anatomy of the temporomandibular joint, symptoms of TMD, and prevalence of temporomandibular disorders are given. The process of diagnosis and basic treatment concepts are also discussed.

#### RESULTS:

TMD is a cluster of related disorders; the symptoms are also related and thus make diagnosis and proper treatment difficult. The primary symptoms are: (1) pain in the muscles of mastication in and around the TMJ and ear; (2) headache; (3) limited mouth opening; (4) deviation or deflection of the mandible upon opening; (5) temporomandibular joint popping, clicking, or grating; (6) development of acute malocclusion; and (7) pain in the neck and back.

Although it has been estimated that 33 to 75% of the general population show at least one sign or symptom of TMD, actual numbers are difficult to obtain and the ratio of females to men is approximately equal in populations not seeking treatment.

The most common cause of TMD is trauma. Other factors, which cause or contribute to TMD are: (1) oral intubation; (2) prolonged mouth

opening; and (3) sporting injuries. There is no scientific controlled study to demonstrate that orthodontics or malocclusion have any influence as initiating factors in the development of TMD.

#### CONCLUSION:

Injuries to the temporomandibular joint are often overlooked by medical personnel. Patients continue to suffer during the process of litigation and long after settlement, but future medical

expenses arise with no chance of compensation. When discussing a clients injuries, an attorney must be alerted by such symptoms as headache, facial pain, earache, temporomandibular joint clicking or locking, limitation of opening, deviation or deflection of the mandible, or a change in dental occlusion.

#### RESOURCE No. 78:

Shankland W. TMJ; A Frequently Reported Injury after a Motor Vehicle Collision. Ohio

regarding TMJ injuries, particularly following

Academy of Civil Trial  
Review 1995; 30:23-39.

Attorneys Quarterly

#### ABSTRACT:

This paper presents a review of literature

motor vehicle accidents. The author directs the information towards aiding the defense attorney of personal injury cases to help investigate claims of alleged TMJ injuries.

#### METHODOLOGY:

The author reviews in a systematic fashion the anatomy of the TMJ, disease processes, prudence in society and causes of TMD, as well as its proper diagnosis. Emphasis is placed on research, which tends to clarify TMJ injuries to the perspective attorney. Advice is given to analyze specific information in order to

investigate these types of claims. These include previous medical records, chiropractic evaluations, etc., which may show symptoms of an undiagnosed pre-existing TMD.

#### RESULTS:

This paper is a review of TMD directed for legal counsel utilization. It attempts to clarify misconceptions regarding causation of TMD and its related disorders. Some misconceptions mentioned include bruxism, malocclusion, development abnormalities, etc. This also helps to aid counsel in determining if injuries are new, from a recent whiplash-type accident, or are long-standing and, thus, pre-existing.

#### CONCLUSION:

The focus of this paper is to help the personal injury defense attorney in evaluating alleged

TMJ injury cases. The author uses excellent references to provide concise and necessary information when objective information may be missing. Although it appears to be directed at the defense counsel, this paper could also aid the plaintiff counsel in assessing TMJ-related injuries, as well as how current these injuries may be.

RESOURCE No. 79:

Sjaastad O, et al. Cervicogenic Headache C2 Rhizopathy and Occipital Neuralgia: A Connection? *Cephalgia* 1986,6:189-195.

ABSTRACT:

This editorial is a discussion, literature review and case study. It contrasts cervicogenic headache with common migraine, cluster and muscle tension headaches. The authors question the association of cervicogenic headache (nonmuscular headache of cervical origin) with occipital neuralgia and C2 rhizopathy. They point out the uniform etiology of the different types of headaches: cervicogenic, common migraine and cluster headaches. They wonder not if, but to what extent, there has been an admixture of cervicogenic headache cases in the migraine materials appearing in the literature. There has, however, been no breakthrough with regard to this headache. Occipital nerve blockade in some cases made headaches worse. But were these truly cluster headaches, or were some possible cervicogenic headache or misdiagnosed migraine? Convincing blocking experiments require (1) Correct diagnosis, (2) Blocking during a pain attack and (3) recurrence of pain after anesthesia fades.

METHODOLOGY:

This editorial is a discussion, literature review and case study.

CONCLUSION:

The editorial makes no conclusions. Closing remarks lament the graveness of misdiagnosis.

An association of trauma and headaches (but not TMD) is not directly addressed and, at best, only indirectly implied.

RESOURCE No. 80:

Smith SD. Relationship of Cervical Function and TMJ Disorders. TM Diary/AAHNFP, 4(2), 1992 Fall/Winter.

ABSTRACT:

The author reviews 18 references relating cervical dysfunction intimately to temporomandibular joint dysfunction. Various cervical disorders are shown to affect directly and indirectly, TMJ disorders, and visa versa.

RESULT:

Each reference exhibits a different element of influence on the TM joint and the cervical spine exert on each other.

Postural alignment of the cervical spine, back and neck is an important factor affecting pathological development of TMJ and jaw disorders. If one element is off balance, the normal relationship is lost and the entire system must be evaluated and treated. Physical therapy, anesthetic injections, oral manipulation, drugs, exercise and other rehabilitative therapy and oral orthopedic splint treatment can be of major benefit to correct postural abnormalities giving rise to "craniomandibular syndrome". Occlusal factors have been shown to affect orthostatic head position on the neck. Decreased curvature of the cervical spine has been related to dental and TMJ disorders.

Cervical musculature can lead to muscle contraction headaches and a myofascial pain problem. Treatment of one component of the patient's pain will not be maintained without treatment of the other components. Janet Travell's work is cited as illustrating referred pain patterns from neck musculature into the

face and TMJ (and visa versa). Continued pain from facial and cervical origin can adversely affect the trigeminal system and the muscles it innervates leading to more pain.

Ear pain can be due to cervical spine arthritis. A cervical sympathetic deficit has been related to a unilateral “migraine” headache. This type headache has also been related to a lower cervical spine disorder.

Cervical injury (trauma) is directly related to a higher incidence of TMJ pain and dysfunction. Only one paper is presented disagreeing with the relationship of posture to myofascial pain. The parameters of “normal” or control in one group in the study is questionable.

#### CONCLUSION:

Patients presenting with complex pain patterns in the head and neck must be evaluated fully for disorders in all cervical, head, TMJ and oral regions. These pain patterns, local and referred, are interrelated and the clinician must treat many cases with a team approach for all the various dysfunctions.

#### RESOURCE No. 81:

Smith SD. TMD - Cervical Somatic Disorder Correlated. News Journal of the American Academy of Head, Neck and Facial Pain 1990;2:(1).

#### ABSTRACT:

The dentist, particularly, must be acutely aware of the role of the neck problems in assessing the presenting patient. The author states that proper TMD patient workup must include palpatory findings in the entire head, neck and shoulder girdle region, as well as the TM apparatus.

Cervical pathology can elicit reflexes: somatic/visceral, visceral/somatic, and somatic/somatic and visceral/visceral. Cervical range of motion study yields information of restrictions (which can cause functional aberrations of swallowing and chewing), head posture (which can alter occlusal contact and head and neck musculature) and occipital/atlas/axis arthrokinematics (which can affect head posture and occlusal contact). TMD can be primary or secondary to cervical dysfunction or injury, which can be caused by primary flexion/extension

injury.

Cervical pain can cause secondary spasm or inflammation of facial muscles, resulting in clinical manifestations of TMD. Early documentation of TMJ injury is important, especially in emergency rooms. Dentists must be able to diagnose cervical dysfunction.

#### METHODOLOGY:

This editorial is a discussion, literature review and case study.

#### CONCLUSIONS:

The dentist must be able to assess results of trauma to the neck. Flexion/extension primary injuries can have secondary internal derangement effects in the temporomandibular joint. Not readily apparent microfractures from direct blunt trauma of a motor vehicle accident may have consequences not noted until months later. Cervical pain can secondarily cause spasm and inflammation of the facial musculature, which then can result in clinical manifestations of TMJ dysfunction.

#### RESOURCE No. 82:

Steed PA. Etiological Factors and Temporomandibular Treatment Outcomes: The Effects of Trauma and Psychological Dysfunction. *Funct Orthod* Aug/Sept/Oct 1997, pp. 17-22.

#### ABSTRACT:

This paper examines the effect of trauma and psychological dysfunction as etiological factors in temporomandibular disorder (TMD). It employs a thoroughly validated measurement system (the TMJ Scale) to determine the effects of traumatic temporomandibular joint injury, as well as pretreatment stress and psychological dysfunction levels upon presenting symptom levels. It also addresses these parameters for the eventual treatment outcome. During the course of the study, 754 patients were evaluated at the

author's practice, which is limited to the diagnosis and Phase I treatment of temporomandibular dysfunction. Of those individuals, 693 (91.9%) were found to have clinically treatable temporomandibular disorders. At the time of this study, 201 consecutive patients (29%) have completed treatment and were deemed to have reached Maximum Medical Improvement (MMI). The validated measurement system of the TMJ Scale was readministered to this post treatment population.

Data analysis revealed that trauma patients did not differ from non-trauma patients in initial symptom levels, nor in levels of symptom

improvement (with the exception of a higher palpation pain level reported by the trauma patients). Stress and psychological dysfunction were predictive of higher initial symptom perception levels, but were not significantly related to treatment outcomes. These findings have important implications for practitioners in the field of temporomandibular studies. If it can be confirmed that psychological variables have no impact on treatment outcome, it would be difficult to justify the now frequently employed “dual axis” classifications and major emphasis placed on psychological treatment for temporomandibular patients.

#### METHODOLOGY:

101 patients reaching Maximum Medical Improvement (MMI) were all screened, evaluated and treated in the same office. At the time of evaluation, the “TMJ Scale” was administered and readministered to this post-treatment population made up of 57 trauma onset patients versus 144 non-trauma patients. These 2 populations were then screened to establish demographic characteristics. A comparison of initial symptom levels and TMD treatment outcomes. Psychosocial and stress symptoms were also assessed initially and at MMI.

#### RESULTS:

The data gathered showed that the authors trauma patients generally presented with slightly higher physical symptom levels. The non-trauma patients presented with higher psychological factor scores. Trauma patients presented with slightly higher stress level scores.

Psychological factors and stress displayed a significant relationship with initial symptom levels, but no relationship at all with treatment outcomes. Through previous studies, psychological profiles among TMD patients have yet to demonstrate the clinical significance of such categorizations. The data presented in this study strongly suggests that such profiles are of little practical utility in predicting treatment outcomes.

## CONCLUSION:

Though trauma was the inducing factor in 57 of the 201 TMD patients studied, it was concluded that patients with traumatically-induced temporo-mandibular disorders did not differ significantly from patients with non-traumatic etiologies in either their presenting symptom levels or treatment outcomes. This

supports the hypothesis that trauma can be a causative factor for TMD, but does not support the hypothesis that psychological variables are a major factor in treatment outcomes.

## RESOURCE No. 83:

Steigerwald DP. Acceleration - Deceleration Injury as a Precipitating Cause of Temporomandibular Joint Dysfunction. ACA J Chiro November, 1989.

## ABSTRACT:

Indirect trauma to the TMJ, eg. whiplash, produces intracapsular bleeding, scarring, anterior disc dislocation and self perpetuating muscle spasm. Injury to cervical support tissues and orofacial musculature can, and often does,

result in latent expression of TMD. Common trauma scenarios, resulting in both immediate and latent TMD and orofacial dysfunction symptoms are: (1) direct and sudden force to the mandible; (2) acceleration/deceleration - sudden and violent changes in head, neck, jaw position;

(3) facial trauma; (4) spinal and paraspinal injury, especially cervical; (5) iatrogenic influences, eg. harness traction, cervical collars.

## METHODOLOGY:

This editorial is a discussion, literature review and case study.

## CONCLUSIONS:

A preponderance of acceleration/deceleration injury symptoms are expressed in the head and

neck region, 40-60% being symptom-expressive two years post-trauma. Trauma is one of the more important and dramatic factors at work in the genesis of TMJ symptomology. Whether direct or indirect, TMJ trauma may manifest itself as symptoms in the head, neck, face, jaw, shoulder, midback or combination of these, and may be responsible for tinnitus, vertigo, ear pain and nausea.

TMJ evaluation should be a routine part of the acceleration/deceleration injury initial examination. Plus, follow-up examinations should occur monthly for three months, even in absence of patient complaint. Subjective symptoms are masked by the preponderance of

cervical complaints, and the nature of TMJ injury can be referred to distant sites. The implication here is that, even if the disc and the TMJ proper are not immediately injured, the abnormal orofacial biomechanics, as well as abnormal head and neck injury, can eventuate in latent TMJ derangement. Even in effectively managed cases, the post - trauma tissue is always permanently damaged to some degree.

RESOURCE No. 84:

Steigerwald D. Management of Whiplash Induced TMJ Injuries. J Amer Chiropr Assoc, p. 67-70, 1995 Mar.

ABSTRACT:

This article uses a literature search to introduce various theories regarding the etiology of temporomandibular disorders.

METHODOLOGY:

The results of various clinical studies are presented in an attempt to discover any connection between temporomandibular disorders and accident vs. pre-existing conditions.

RESULTS AND CONCLUSIONS:

Whiplash injuries are particularly complex because multiple body parts are injured simultaneously. The task of diagnosis and treatment is made more difficult, as the symptoms of cervical, TMJ and closed head injuries are very similar. Incorporating TMD exam referral and treatment protocols into the case planning for whiplash injuries will serve to improve treatment outcomes for whiplash and minimize TMD chronicity.

The potential for timely and effective management of symptomatic expressive internal derangement of the temporomandibular joints arising from whiplash has been made possible with the development of arthroscopic surgical tools and techniques, improved understanding of

the nature of the pathogenesis of the disorder, improved imaging techniques and innovations in the field of physiotherapy. Early identification of this problem, coupled with timely, specific and integrated use of the tools available to treat what is now seen to be an injury to a complex and unique joint, will result in more effective

treatment, as well as a reduction in the number of chronic TMD patients. This will potentially reduce the financial impact of this prevalent disorder in any motorized society.

RESOURCE No. 85:

Talley RL. Assessment of Temporomandibular Injury and Craniofacial Pain. Acad Internat Med. Stud Nov, 1989.

ABSTRACT:

The purpose of this paper is to provide concise information relevant to injury of the temporomandibular joint and its associated structures. It explains how these injuries occur as a result of a motor vehicle accident, fall or blow, that does not involve direct physical contact with the mandible.

METHODOLOGY:

Summary of theoretical models of dynamics of injury, based on anatomy and biochemical forces of acceleration/deceleration injuries.

RESULTS:

An overview of mechanics of injury and a brief summary of evaluation and treatment staging is given.

CONCLUSIONS:

Prompt and proper evaluation should be given to patients with acceleration/deceleration injuries.

RESOURCE No. 86:

Talley RL, et al. Standards for the History, Examination, Diagnosis, and Treatment of Temporomandibular Disorders (TMD): A Position Paper. J Craniomand Pract 1990;8(1):pp. 60-77.

**ABSTRACT:**

This paper is an overview of standards of history, examination, diagnosis and treatment of TMD by a committee of the American Academy of Head, Neck, and Facial Pain.

**METHODOLOGY:**

A committee of the AAHNFP reviewed literature and pulled vast experience to review standards of TMD evaluation and care.

#### RESULTS:

The standards of taking histories, examination and diagnosis of TMD was outlined and a general overview is given.

#### CONCLUSIONS:

This overview was based on all available documentation and takes into account the voluminous amount of clinical experience and research based on sound scientific foundation. Cervical trauma as an etiology of TMD is referenced.

#### RESOURCE No. 87:

Tankersley, J. Chiropractic Treatment in TMJ Trauma, Litigating TMJ Cases, John Wiley and Sons, NY, NY 1994.

#### ABSTRACT:

Proper documentation by the chiropractor is essential in formulating the long-term consequences of vehicular induced trauma.

#### METHODOLOGY:

This chapter is a discussion with a pertinent literature review.

#### CONCLUSIONS:

This is a well-researched discussion on soft tissue injuries of the upper quarter as a result of motor vehicular trauma. Impairment ratings are discussed and analyzed. Bioelectronic diagnostic equipment is reviewed and is portrayed as essential in defining a baseline of function.

#### RESOURCE No. 88:

Neurophysiology 73:94-106, 1989.

## ABSTRACT:

There is a constellation of post-concussion symptoms which may be present in varying degrees in the mildly injured head trauma patient.

## METHODOLOGY:

Measures of EEG power spectral analyses were obtained from a total of 608 mild head trauma patients and 108 age matched normal subjects.

## RESULTS:

1. A training set discriminant function was developed for 264 patients and 83 age-matched controls yielding an overall discriminant classification accuracy of 94.8%
2. The first independent cross validation of the discriminant function using 130 patients and 21 age-matched controls yielded a discriminant classification accuracy of 96.2% for the trauma patients and 90.5% for the normals.
3. A second independent cross-validation of the discriminant function using 51 patients and measures of test-retest reliability from 93 patients yielded classification accuracies from 77.8% to 92.3%
4. A third independent cross-validation of 70 patients tested at a different location with a different EEG computer system yielded a discriminant accuracy of 92.8%

## CONCLUSION:

The discriminating EEG power spectral analysis identified 3 classes of neurophysiological variables which are attributable to head trauma. These include (1) an increased coherence and decreased phase in frontal and frontal-temporal regions: (2) decreased power differences between anterior and posterior cortical regions, and (3) reduced alpha power in posterior cortical regions.

RESOURCE No. 89:

Thatcher RW, Walker RA, Gerson I, Geisler  
FH. EEG Discriminant Analyses of Mild Head  
Trauma. *Electroencephalography and Clinical*

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Thunnissen J, Wismans J, Ewing CL, Thomas DJ. Human Volunteer Head-Neck Responses in Frontal Flexion: A New Analysis. Society of Automotive Engineers Technical Series 1995, pg. 439-60, #952721.

**ABSTRACT:**

At the Naval BioDynamics Laboratory (NBDL) in New Orleans, a large series of experiments were conducted on human volunteers to determine the response of the head and neck to frontal flexion as might occur during a frontal impact automobile collision. This response is called the dynamic head-neck response. A number of these experiments determined the performance requirements for a dummy head-neck apparatus, which incorporated the influence of the thoracic column flexibility, but not its rotation. This was termed "non-rotated T, coordinate system". In 1987, the head-neck response of volunteer subjects was compared to the response of human cadavers (postmortem human subject "PMHS" experiments). One of the findings was that the rotation at the first thoracic vertebra (T<sub>1</sub> rotation) in live volunteers differs significantly from the T<sub>1</sub> rotation in postmortem human subjects. The present paper is an extension of the previous work.

A detailed analysis of high-speed films taken during testing revealed that, in live volunteers, the instrumentation to measure movement at T<sub>1</sub> was not mounted firmly to the spine. A methodology for correcting the resultant inconsistencies in the data is presented in the present paper. The primary objective of the present study is to correct the experimental "errors" due to T<sub>1</sub> rotation and to develop a set of new performance requirements for a dummy head-neck apparatus, which incorporates a rotated T<sub>1</sub> coordinate system. New requirements are presented and compared with previous analyses. Additionally, the dynamic response of a recently developed dummy head-neck apparatus (the Hybrid III) is evaluated on the basis of the new performance requirements.

## METHODOLOGY:

Human volunteers and postmortem humansubjects were exposed to short duration accelerations simulating frontal, oblique or lateral impacts and the forces present in the head and neck were measured by accelerometers and photographic targets mounted to the head and first thoracic vertebra. Subjects were seated in an upright position on a laboratory sled and restrained by shoulder straps, a lap belt, and aninverted V-pelvic strap tied to the lap belt. Upper arm and wrist restraints were used to prevent flailing. In addition, a loose safety belt around the chest was employed. The accelerometers and photographic targets on the live volunteers were attached with straps. On the postmortem humansubjects, they were firmly attached to the bone.

## RESULTS:

Accelerometers were used to directly measure force loads to the neck, as well as the amount of twisting motion, which resulted from various impacts. This data, as well as information from high speed film of the testing, allowed the development of a mathematical model to describe the relative head and neck motion during impact. This model was used to develop a mechanical head-neck dummy, which accurately representsthe dynamic response of the human anatomical structures during impact.

## CONCLUSION:

The current study is a part of an omnidirectional (frontal, lateral and extension) dummy neck development project. The design of such a neck should, in general, be the simplest structure necessary to produce the desired dynamic head motions and accelerations. A human-like neck must not only fulfill requirements regarding the external anatomical

appearance and mass, but it should also describe the dynamic human head and neck response.

Based on this analysis, a new set of easily measured performance requirements for the evaluation of mechanical necks and their mathematical models was defined. The minimum proposed set consists of: occipital condyle trajectories (or head center of gravity trajectories), head link rotations, head center of gravity accelerations and head angular accelerations (or moments of force around the occipital condylar joint).

One of the most important observations is that, while the T1 vertebral body rotates forward during acceleration, the T1 instrumentation mount on the live volunteers rotates backward. This implies that the T1 instrumentation mount does not accurately measure displacement of the T1 vertebral body. To obtain a consistent set of data pertaining to head-neck responses, the rotation of the T1 instrumentation mount must be taken into account by using a mathematical

correction. New performance requirements were developed after these corrections were applied.

#### RESOURCE No. 90:

Troyanovich S. Are Vehicle Damage and Occupant Injury Always Proportional. MPI's Dynamic Chiropractic, Oct, 1990.

#### ABSTRACT:

Minor vehicle damage in the presence of serious occupant injury is a frequent occurrence in acceleration - deceleration (rear-end) automobile collisions. Damage to the struck automobile and the degree and severity of injury to its occupants is explored. Special consideration is given to the physical factors that have been shown to increase the application of force of the collision to the vehicle occupants. A brief physics glossary follows the article.

#### METHODOLOGY:

A review of literature on the biomechanics of motor vehicle accidents.

#### RESULTS:

The forces on occupants in a rear end collision are 2-2.5 times greater than that of the vehicle, due to the reflex muscular contraction. An 8MPH collision produces 2 G force on the car and 5 G force on the occupants head and neck. A 15 MPH collision produces 10G acceleration on the vehicle and 20-25 G acceleration of the occupants head and neck.

Neck injuries reported in literature include muscular tears and avulsions, ligamentous tears and ruptures, intervertebral disc disruptions, hemorrhage of the muscular coats of the esophagus, avulsion fracture and vertebral dislocation. A collision with an acceleration of 5 G carries a 50% chance of brain concussion.

## CONCLUSIONS:

A lead vehicle that is easily accelerated will sustain less mechanical damage, but the occupants will be subjected to greater forces which lead to injury.

The factors that limit damage to the vehicle are

the very factors that increase the occupants injury; therefore, damage to the vehicle bears little resemblance to the forces to the occupants.

## RESOURCE No. 91:

Uppgaard RO. Conservative and Successful Treatment of Temporomandibular Dysfunction in a Private Rural Practice. *J Craniomand Pract* 1992;10(3);235-40.

## ABSTRACT:

This clinical study of 382 patients with temporomandibular dysfunction (TMD) details how successful treatment can be achieved in a rural area, without the support and services of specialized TMD clinics. Successful treatment is within the scope of the general dentist, provided the practitioner understands the patient's total problem and treatment options. The study spanned a 10-year period, including follow - up at one, five, and eight-year intervals.

## METHODOLOGY:

This study of 382 patients spanned a 10-year period including follow-up. This was a clinical study; a control group was not used. Records were kept on the patient's chief complaints, additional symptoms, range of motion, stress evaluation, contributing factors, previous treatment, diagnoses, types of appliances used (if any), age, evaluation of specific trigger points, follow-up and/or referral. A telephone follow-up was attempted on all patients at one, five and eight - year intervals.

## RESULTS:

1. No patients needed surgery.
2. 86% of the diagnoses were both internal derangement and myofascial pain of the head and neck.
3. Whiplash was the precipitating factor for 32 patients.
4. The breakdown of TMD by ages showed a range of 10 to 77 years, with the greatest concentration being between the ages of 20 and 50.
5. The breakdown of TMD by sex revealed that 79% were female and 21% were male.

CONCLUSIONS:

Successful treatment of TMD is within the scope of the general dentist, providing the practitioner has an understanding of the patient's total problem, the treatment options and a willingness to work with the patient.

RESOURCE No. 92:

Walz F, Muser M. Biomechanical Aspects of Cervical Spine Injuries. Society of Automotive Engineers Technical Series 1995, #950658.

ABSTRACT:

Traffic accident statistics, as well as figures from insurance companies, indicate an increasing importance of cervical spine injuries. Despite this fact, biomechanical and clinical assessment of these injuries (often classified as "minor") is often compromised by a confusion between the actual findings of the medical examination (for example, distortion, luxation, "soft tissue neck injury", neck sprain, or other often barely discernible injuries) on one hand and the mechanisms leading to these injuries, such as (hyper) -flexion, -extension, translation, or compression, on the other hand. The still widespread, yet misleading, usage of the term "whiplash" is a classical example thereof. A subdivision of the criteria in terms of "accident severity" into four classes, for example dynamic loading of the car, biomechanical loading of the occupant, clinically diagnosable injuries, and subjective sequelae for the victim, is proposed. The cervical spine injury mechanisms known to date are presented. The role of shear forces in the upper cervical articulations as a possible cause of neck injuries in car impacts is discussed, as well as implications for the design of better car seats, for example with automatically positioned head restraints.

METHODOLOGY:

The authors attempt to standardize the assessment of accident severity by measuring the

dynamic loading of the vehicle during collision, the biomechanical loading to the occupant, the circumstances of the injury itself, and the subjective degree of disability felt by the patient.

Cervical spine injury is further categorized according to head contact vs. non-head contact mechanism and rear-end vs. frontal collision.

#### RESULTS AND CONCLUSION:

In cases with major legal concern, the biomechanical assessment of the injury mechanism is extremely compromised if mechanically incorrect terms are introduced by the clinical physician. Since the injury mechanisms of the neck are very complex, the clinician should concentrate on the clinical findings familiar to him; usually, he lacks technical case documentation and specific training in injury biomechanics.

#### RESOURCE No. 93:

Weinberg S, Lapointe H. Cervical Extension-Flexion Injury (Whiplash) and Internal Derangement of the Temporomandibular Joint. *J Oral Maxillofac Surg*, p 653-56, 1987.

#### ABSTRACT:

This clinical article links internal derangements seen arthrographically in 22 out of 25 patients being assessed with post-whiplash TMJ symptoms.

#### METHODOLOGY:

A sampling of patients suffering with medically diagnosed cervical extension-flexion (whiplash) injuries sought evaluation for TMJ symptoms on an average of 126 days after their accident. Histories and clinical examinations were done. Twenty-five patients received arthroscopic examinations and 10 patients had surgery.

#### RESULTS:

All patients showed signs and symptoms that reflect the entire spectrum of myofascial pain

dysfunction and internal derangements.

**CONCLUSION:**

There appears to be a relationship between acceleration-deceleration type of automobile accidents and internal derangements of the temporomandibular joint. The primary structural alteration within the joint occurs at the time of the accident. Persistent TMJ symptoms in these patients should arouse the suspicion of there being more than a muscle problem

involved.

RESOURCE No. 94:

Weinstock ML, Hoffman H. Hypertonicity of the Suprahyoid Musculature as Measured by Surface Electromyography following Whiplash as a Precursor to TMJ Disease. Publication in process.

ABSTRACT:

Internal derangement of the TM joint is commonly seen 4-6 months after a hyperextension-flexion injury (whiplash). Twenty-five adults who had been involved in a recent "rear-end" automobile accident were compared to a control group with no history of a whiplash injury. Surface electromyography (EMG) of the suprahyoid musculature was used to compare the two groups. The EMG levels were significantly higher among the participants in Group A, indicating hypertonicity of the suprahyoid musculature. This prolonged hypertonicity of the suprahyoid muscles, following whiplash injury, results in posterior positioning of the mandible and eventual disc derangement. The ramifications of these findings may dictate appropriate interceptive and therapeutic protocols.

METHODOLOGY:

Two groups of 25 consecutive adult subjects (between ages 18-50) were tested. Group A was the test group and Group B was the control group. The test group consisted of 20 women and 4 men. The control group consisted of 19 women and 6 men. Criteria for Group A was that they were involved in a recent "rear-end" automobile accident (acute phase), there was no direct trauma to the mandible, no prior history of TMJ disease and no prior automobile accidents. Criteria for Group B includes a history free of TMJ complaints and no prior automobile accidents.

## RESULTS:

The EMG values for the right and left suprahyoids were averaged together for each subject. The normal subject group had a mean EMG reading of .984 mv (SD=7.001). The results of this test indicated that the subjects involved in

whiplash accidents showed a significantly higher EMG resting level, but surface electromyography,  $t(24.2)=-3.43$ ,  $p<.01$  indicating hypertonicity of the suprahyoid musculature.

## CONCLUSION:

The suprahyoid group of muscles attaches to the lingual surface of the mandible anterior to the other muscles of mastication and influences jaw position and integrates function with related structures. During hyperextension in whiplash, the hyoid bone tethers the suprahyoid musculature in relation to the moving head and mandible. This stretching of the musculature results in injury and starts the process of muscle contracture and spasm. With hypertonicity of the suprahyoid musculature, there is continuous retrusive force on the mandible. This causes posterior displacement of the mandible and condyle in the glenoid fossa and eventual anterior displacement of the disc. With prolonged continuous hypertonicity of these muscles, the patient can progress from headache and neck pain to TM joint tenderness, intermittent dislocation, locking, anterior disc displacement and, finally, degenerative joint disease.

This model of the suprahyoid muscle involvement implies that preventive measures by the automobile industry could greatly reduce the hyperextension injury. Interceptive procedures may include physical therapy emphasizing the anterior neck and prophylactic use of an intraoral orthotic. The use of cervical traction anchoring under the mandible and the use of a cervical collar without an intra-oral orthotic may be contraindicated.

RESOURCE No. 95:

West DH, Gough JP, Harper, G. Low Speed Rear-end Collision Testing Using Human Subjects. *Accident Reconstruction Journal* 5(3):22-26, 1993 May/June.

**ABSTRACT:**

Human volunteers were subjected to the forces of low speed rear impacts (5-8 mph). The levels of head acceleration and neck extension were found to be below thresholds where cervical soft tissue injury would be expected for healthy individuals. No mandibular whiplash phenomenon was observed.

**METHODOLOGY:**

Several scenarios were used to simulate the most common low speed collisions. Human subjects were used and data collected through video and accelerometers. The subjects were females of age 25-43 in normal condition and without pre-existing spinal problems.

#### RESULTS:

The majority of test collisions resulted in no damage to the cars involved. The degree of occupant head acceleration and extension varied considerably based upon the type of headrest present. Headrest contact prevents cervical extension. Lack of proper support causes significantly more extension and discomfort and occupants were unable to brace themselves against the extension forces. Higher levels of head acceleration can be tolerated without injury, if the head contacts the head support.

When significant extension occurs, the injury-causing potential may increase rapidly for small increases in degree of extension. Cervical torque has been proposed as a more accurate measure of injury potential.

Forces experienced in impacts of 3 mph or less were generally not sufficient to cause contact with the headrest and the forces were well within physiologic ranges.

Ranges of motion tolerated without injury are reduced if the individual's head is turned at the moment of impact.

A review of videotapes fails to show any opening of the jaw during the impact(s).

#### CONCLUSION:

Forces and displacement of occupants in collisions of 3 mph or less are within the range encountered in daily life and do not generate forces associated with injury causation. In collisions in excess of 3-89 mph, the occupants may be subjected to forces that cause their heads

to contact head supports, but, often, forces are below levels commonly associated with injury.

Foreman and Croft's model of mandibular whiplash was not observed in any of the test subjects. Therefore, the model is not valid for collisions of 3-8 mph.

RESOURCE No. 96:

Westling L, et al. Background Factors in Craniomandibular Disorders with Special Reference to General Joint Hypermobility, Parafunction and Trauma. *J Craniomand Disord Facial & Oral Pain* 1990;4(2):89-98.

ABSTRACT:

Seventy-four female patients were randomly selected for an explanation of general joint mobility according to Beighton. 83% of the patients with generally lax joints had TMJ involvement, in comparison to 41% of the patients without joint laxity. Parafunction and trauma were associated with increased signs and symptoms in individuals with lax joints. In non lax joint patients, trauma to the head and jaw was specifically correlated to TMJ disorders. The results indicate that general joint hypermobility should be taken into consideration in the diagnosis and treatment of craniomandibular dysfunction (CMD).

METHODOLOGY:

The aim of this study was to analyze the occurrences of some background factors (oral parafunction, trauma to the head and jaws, and general joint laxity) in CMD patients, and to study the association of factors to signs and symptoms. 74 patients (age range 13-35; mean

25.2 years) participated in this study. They were given a self-administered questionnaire with standardized questions at the first visit. The methods used for recording clinical signs and functional disturbances of the masticatory system followed routine procedures. All patients were

examined for joint mobility before the initiation of the study. Radiographic examination was performed in 25 patients (9 by orthopantogram, 11 by tomogram, 3 by arthrogram, and 2 by fluoroscopy). Each patient was then given a diagnosis regarding main symptoms and clinical signs. Joint mobility was assessed in each individual and graded by the hypermobility score of Beighton et al. The maximum score is 8. Patients performing 3 or more maneuvers forming the score were considered hypermobile.

**RESULTS:**

Thirty patients (41%) were hypermobile (lax), i.e., they could perform 3 or more maneuvers according to Beighton et al. The highest score

was 7. Winston K. Whiplash and its Relationship to Migraine. Headache, p 452-56, 1987 Sept.

**CONCLUSIONS:**

**ABSTRACT:**

There is a significant correlation between general joint laxity and TMJ signs and symptoms found in this investigation, indicating a possible systemic factor in the etiology of TMJ dysfunctions. Patients with hypermobile joints seemed to respond differently to local micro and macro traumas. General joint hypermobility, a genetic factor, was found to be associated with TMJ derangements in this study of female CMD patients. Recurrent headaches and masticatory muscle tenderness was correlated to tooth clenching and grinding in hypermobile joints. Trauma to the head and jaws was significantly correlated to arthrogenous dysfunction in individuals without joint laxity.

**RESOURCE No. 97:**

White AA, Panjabi MM. Clinical Biomechanics of the Spine. J.B. Lippincott Company, 1978. pp153-162;455-482.

**ABSTRACT:**

Review of some specific cervical spine injuries such as whiplash, hyperextension injuries beyond whiplash, and central spinal cord (medulla) syndrome.

**METHODOLOGY:**

This editorial is a discussion, literature review and case study.

**CONCLUSIONS:**

Whiplash was discussed in detail, which included the mechanisms of injury, physiologic effects of this type injury and medico-legal considerations. Hyperextension injuries, beyond

whiplash, is said to compromise 50% of serious cervical spine injuries and they may be associated with significant cord or root damage.

#### RESOURCE No. 98:

Five patients with severely symptomatic cervical injury of the type commonly referred to as “whiplash” was discovered to also have many migrainous features and all were successfully managed with medications. The relationships of whiplash to migraine are discussed and the argument made that whiplash is trauma-precipitated cervical migraine.

#### METHODOLOGY:

Whiplash is an acceleration type injury, but the whiplash syndrome bears no relationship to the severity of the injury. Five consecutively encountered women who had whiplash also had severe and persistent headaches of the migrainous type. All five were neurologically intact and treated for migraine. Their response to therapy led to a hypothesis about the relationship between migraine and whiplash.

#### RESULTS:

The response of both the cervical and cranial symptoms in these five women to medications known to be efficacious in the management of migraine may give a clue to the disorder commonly called whiplash.

#### CONCLUSION:

Evidence from these 5 cases on migraine and whiplash is consistent with the idea that whiplash is a trauma-precipitated variant of migraine.

#### RESOURCE No. 99:

Yamaguchi M. Incidence of Headache and Severity of Head Injury. School of Allied Medical Sciences, Kobe University, July 1992, pp. 427-431.

ABSTRACT:

One hundred twenty one (121) patients with

86

headaches, injury (mild or severe), cervical xrays,

C.T. findings, and clinical history were assessed.

#### METHODOLOGY:

This study occurred from July 1986 to June 1988. All subjects were claiming compensation for work related injuries and were suffering from post-traumatic sequelae. These patients visited the outpatient clinic of neurosurgery at Kobe University Hospital or local branches of Hyogo Labor Bureau (part of the Japanese Department of Labor). Under Japanese labor law, any worker who has been injured on duty can receive proper treatment and care under full coverage from the government insurance system with regards to medical expenses and pay while off work.

#### RESULTS:

1. There was an inverse relationship between the severity of the trauma and the incidence of severe headache.
2. Patients with severe headaches were significantly more common in groups with abnormal neck x-rays.
3. A high incidence of abnormal x-ray findings, including degenerative changes, may be associated with both mild head injury and severe post-traumatic headaches.
4. The severity of injury correlated positively with the incidence of abnormal C.T. findings. An inverse relationship was found when the incidence of severe headache and abnormal C.T. findings were compared.
5. The relationship of headache and EEG findings were not statistically significant. A higher incidence of severe headache was demonstrated in the mentally normal group and less severe headache was found in the mentally impaired group.

#### CONCLUSIONS:

An inverse relationship between post-traumatic

headache and the severity of injury was proved in a population of compensation claimants. Cervical lesions were important in the post - traumatic headache group, even if only degenerative changes were demonstrated on the x-ray films.

A

higher incidence of headache was found in the normal C.T. group and also in the mentally normal group.

