



Image: High pressure gradients develop within the brain during rapid back and forth motion of the head during whiplash. The brain stem is labeled bs. With permission from Whiplash! A Patient's Guide to Recovery. San Diego, (C) Spine Research Institute of San Diego, 1999.

By **Matthew J. DeGaetano, DC and Steve Baek, DC**
 Certified in Personal Injury

Cervical Spine References:

- Trauma causing delayed instability
- High incidence of delayed instability
- Significance of hyperflexion injuries
- Names of the ligaments subject to injury
- Unstable nature of an anterior subluxation

Croft AC: Physical Examination, In Foreman SM, Croft AC (Eds): Whiplash Injuries: the Cervical Acceleration/Deceleration Syndrome, Baltimore, William & Wilkins (1995):

A potentially serious complication of hyperflexion injuries is delayed instability (2,3*). Green et al. (4*) reported a twenty-percent incidence of instability in hyperflexion injuries when the posterior ligament complex (ligamentum nuchae,

interspinous ligament, ligamentum flavum, and capsular ligament) was disrupted, producing an anterior subluxation of the cervical spine. Even after rigid immobilization of these injuries, severe kyphotic deformity often resulted, sometimes necessitating surgical fusion. Cheshire (5*), in an analysis of 257 conservatively treated acute cervical injury patients, found a similar incidence of delayed instability (21%), most commonly seen following initial anterior subluxation (6*). Anterior subluxation is considered one of the most unstable of all cervical injuries (5*). Page 119.

Residual disability difficult to quantify
Further cervical problems with minimal trauma
Cervical problems cause pain and disability
Degenerative changes will result from cervical trauma

[36] Jackson, The Cervical Syndrome, Fourth Edition, Charles C. Thomas (1977):

It is impossible to estimate the exact amount of residual disability, but it can be stated with certainty that these joints will be intolerant of unusual stress or strain. They will be subject to further damage on even slight provocation. Patients should be taught the importance of proper usage and protection of their necks to prevent recurrent attacks of pain and disability. The resulting disability will be dependent upon the functional demands made upon the cervical spine, and upon the ability of the patient to adjust to, and to tolerate, the limitations imposed upon his activities. Even with guarded usage degenerative changes are inevitable. Page 354. [* These reference numbers correspond to the cited reference.]

Asymptomatic degenerative condition triggered by trauma
Normal cervical motion is decreased by joint narrowing and spur formation

Gartland, Fundamentals of Orthopedics, Fourth Edition, W.B. Saunders Company (1987):

As mentioned previously, a patient may show radiographic evidence of degenerative arthritis in the cervical spine segment yet be completely asymptomatic as far as normal activities are concerned.

Flexibility of the involved spinal segment, however, is decreased by the joint narrowing and spur formation. The addition of trauma, particularly of the 'whiplash' variety, to this less resilient cervical segment may upset the functional balance of the neck. The neck may be unable to adjust to the additional insult, and

the symptoms of neck pain and stiffness may be present. In this instance, then, previously existing asymptomatic degenerative changes in the cervical spine may be sufficiently aggravated by trauma to produce the typical symptoms of stiffness and pain. The same may be true for a patient with prior asymptomatic degenerative disc disease who sustains neck trauma. Page 284.

Definition of subluxation

Subluxation results in tearing or rupturing of cervical ligaments

Subluxation is defined as an incomplete forward or lateral dislocation of one vertebra upon the one below. Trauma to the head and neck sufficient to result in tearing or rupture of the supporting ligaments may allow one cervical vertebra to drift partially away from another. Page 291.

McCarty, Arthritis and Allied Conditions, a Textbook of Rheumatology, Eleventh Edition, Lea & Febiger (1989):

Trauma to the neck predisposes one to further problems

Difficult to heal tears of the outer layer of the disc

Ligaments and muscles heal by scarring

TRAUMA

The spinal injury weakens the spine and predisposes the patient to further injury, regardless of type and extent of damage. This phenomenon is especially true when protection of the injured part is not adequate. Ligaments and muscles heal only by scar formation, and the annulus [sic] fibrosus is almost powerless to heal tears of its substance. These circumstances, unfortunately, are beyond the control of the physician, but the patient should be warned to protect his back following injury. Page 451, Chapter 92, The Painful Back, David B. Levine, M.D.

Hoppenfeld, Physical Examination of the Spine and Extremities, Appleton-Century-Crofts (1976):

Importance of Distraction and Compression testing

Physical Examination of the Spine--Chapter Four, Special Cervical Tests:

The Distraction test.

The Compression test.

The Valsalva test.
The Swallowing test.
The Adson test.

Cailliet, Neck and Arm Pain, Edition Two, F.A. Davis Company (1981):

Pain is caused by narrowing of structure and limitation of movement.
Hyperflexion injuries cause damage to posterior ligaments producing spinal instability.

Low speed rear end collisions do cause severe neck injuries.

It has been stated that the major causes of neck, shoulder and arm pain are arthritis and trauma. These may be the principal conditions leading to discomfort and disability, but they are vague, broad terms needing clarification. It would probably be more correct to state that pain in and from the neck results from the mechanical factors of encroachment of space and impairment of movement. Page xvi.

Instability results from tears of the posterior ligaments. Page 53.

A collision, when the offending car moves at a rate as slow as seven (7) miles per hour can cause severe tissue damage and injury. Page 73.

Kricun, Imaging Modalities in Spinal Disorders, W.B. Saunders Company (1988):

Facet joint injury results in pain and restricted movement
Hyperflexion causes rupture to ligaments and facet joints
Delayed instability results from ligamentous damage
Causes of spinal instability

. . . Intra-articular osteocartilaginous bodies capsular laxity, and bony ankylosis of the joint may be evident. Clinical manifestations include pain, tenderness and restricted motion. Page 49.

Hyperflexion sprain:

In this injury, a force to the occiput from below causes hyperflexion of the cervical spine. The spinous processes are distracted, and the posterior interspinous ligaments and capsules of the articular facets are ruptured. Page 243.

. . . Any neurologic injury sustained is usually temporary, although in 20% of cases delayed instability from impaired ligamentous healing develops. Page 244.

Spinal instability may develop secondary to degenerative changes, trauma, spondylolysis, bone destruction, post operatively and from other causes. Page 255.

Mazur and Stauffer: Unrecognized spinal instability associated with seemingly 'simple' cervical compression fractures. *Spine*, 8(7): (1983):

Muscle spasms mask overt spinal instability

As muscle spasm diminished, the patients could be given a more reliable flexion-extension radiographic examination, unmasking the hidden posterior instability.

Paley and Gillespie: Chronic repetitive unrecognized flexion injury of the cervical spine (high jumper's neck). *Amer J Sport Med*, 14(1): (1986):

Instability did not appear on flexion-extension views at the time of injury; however, the authors (Mazur and Stauffer) felt that muscle spasms prevented sublaxation and that capsular and ligamentous strains that are incomplete at the time of injury may develop into greater instability with time.

[181] Hirsh, et al.: Whiplash syndrome - fact or fiction? *Orth Clin North Amer*, 19(4): 1988:

Low speed rear end collision does produce significance injurious forces to the neck

Checklists for poor prognosis

Unfavorable prognosis where symptoms present for more than 3 months

Unfavorable prognosis where certain neurologic findings are present

Unfavorable prognosis with certain types of x-ray findings, such as loss of lordotic curve

Patients continue to be symptomatic even with the best treatment available

In an 8-mile-per-hour rear-end collision, a 2G-force of acceleration of the vehicle may result in a 5 G-force of acceleration of the occiput and head. The amount of damage to the automobile may bear little relationship to the forces applied to the cervical spine and to the injury sustained by the cervical spine.

. . .In general, the prolonged presence of significant symptoms tends to be associated with a less than favorable prognosis. This occasionally occurs when symptoms have been present for more than 3 months and frequently occurs when symptoms are present for more than a year. Prominent neurologic symptoms, including radiation of pain, paresthesias, and sensory alteration, are generally also associated with a less favorable prognosis. Particularly unfavorable in this regard is the presence of neurologic deficits on examination, including alteration of reflexes in the upper extremities, weakness, or muscle atrophy.

A number of radiologic findings are indicators of a poor prognosis. These include a sharp or irregular reversal of the normal cervical curvature, cervical osteophyte formation, and other architectural changes. The presence of congenital anomalous formations, such as interbody fusion, may also be associated with an increased potential for incomplete recovery.

Significant positive findings in any study, including EMGs, CT scanning, MRI scanning, or myelography, indicate a poor prognosis. Most patients with negative studies will heal, generally slowly and irregularly, on a program of initial rest and protection of the area, followed by immobilization, caution exercises, and guided return to function. However, some of these patients will continue to be symptomatic, despite appropriate treatment.

The prognosis is particularly poor in the chronic patient, with symptoms present for a year or longer, who describes a significant alteration of lifestyle and who has remained out of work during this time.

These patients experience extensive physical and emotional alterations, which impair the potential for good or excellent recovery.

Carroll, et al.: Objective findings for diagnosis of 'whiplash'. J Musculoskel Med, March 1986:

High percentage of whiplash patients develop degenerative changes in their necks

Pre-existing degenerative neck problems uncommon in general population over age 30.

Whiplash injuries make patients more prone to develop arthritis in the neck

Roentgenographic studies show that degenerative problems develop after injury in 39% of patients. By comparison, only 6% of the general population over age 30 develops degenerative damages over a comparable time. Thus, it would seem that whiplash injuries predispose patients to cervical osteoarthritis.

[619] Buonocore, et al.: Cineradiograms of cervical spine in diagnosis of soft-tissue injuries. JAMA, 198(1): 1966:

Motion x-rays better diagnosis abnormal neck problems
Technology has been around for a significant number of years

The permanent recording of the dynamic action of the cervical spine by cineradiography was made in 107 patients, 57 of whom had sustained flexion-extension injuries (whiplash). The ability to demonstrate localized abnormal motion in the cervical spine allows one to predict soft-tissue injuries and the quality of spinal fusions, spinal instability, and early subluxation of the cervical spine--conditions that may not be identified on static roentgenograms nor at physical examination.

[Note: some of these citations represent authors quoting from, or making comments, about other authors' statements or opinions. When citing the literature, always be familiar with the entire content and context of the cited piece.]