
Whiplash Injuries: A Historical Review

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Abstract

Whiplash injuries of the cervical spine are frequently reported following motor vehicle accidents. Whilst many affected patients recover, their treatment can often present challenges. The history of this condition and its precursor 'railway spine' demonstrates a long period of controversy between proponents of physical or psychological causes or even malingering. This paper analyses the evolution of ideas about whiplash from the nineteenth century to the present which reveal the improved understanding of the nature and mechanism of this disorder.

WHIPLASH INJURIES

The whiplash syndrome is recognised as a common consequence following motor vehicle accidents and although much progress has been made in understanding the pathophysiology of the condition, controversy still abounds. The term 'whiplash' was first used in 1928 by Crowe when he described the effects of sudden acceleration-deceleration forces in motor vehicle accidents which resulted in injuries to the cervical spine. ¹ He drew attention to the lash-like effect on the cervical spine from these high-energy impacts. Prior to whiplash, the syndrome of 'railway spine' was diagnosed in persons injured in train accidents in the nineteenth century. This was a controversial diagnosis in its time with many sufferers suspected to be suffering from hysteria or other psychological causes. This review highlights the long history of controversy in whiplash and the evolution of understanding the nature of this disorder and its treatment.

In the second half of the nineteenth century symptoms were recognised in patients who were injured in minor railway crashes. This diagnosis of 'railway spine' was predominantly a British phenomenon, but the diagnosis was made throughout Europe and in North America. ² It corresponded with a rise in litigation in compensation cases with post-traumatic symptoms but no external signs. Medical opinion differed on the physical or psychological basis of these symptoms. There were notable cases in which fraudulent claims were brought which further added to the controversy. Many of the features were suggestive of a functional neurosis.

Rigler in 1879 highlighted the issue of compensation

neurosis in relation to post-traumatic states. ³ He reported the increased rate of post-traumatic symptoms after a system of financial compensation was established for injuries in the Prussian railways in 1871. The first full-length medical study of this condition was by John Eric Erichsen, in *Railway and Other Injuries of the Nervous System* which was published in 1864. ⁴ Erichsen was a British surgeon born in Copenhagen and was the son of Eric Erichsen, a member of a well-known Danish family. He trained as a surgeon and subsequently became Professor of Surgery at University College in London.

Erichsen took the view that minor injuries of the head and spine could result in severe disability due to 'molecular disarrangement' or anaemia of the spinal cord. He was considered an authoritative figure at the time and his text and other publications were frequently cited in court. In 1882 he published *On Concussion of the Spine: Nerve Shock and Other Obscure Injuries of the Nervous System in the Clinical and Medico-Legal Aspects*. ⁵ Erichsen and other physicians considered that the symptoms in the spine were due to the excessive speeds (about 30mph) of the trains and that the human body could not cope with speeds as fast as that. Because of the stature of Erichsen's publications, the condition of railway spine was often referred to as 'Erichsen's Disease'.

Towards the end of the nineteenth century, there was a greater perception that such injuries may have a basis in neurosis rather than a physical cause. In 1888 Strümpell speculated on the desire for compensation leading to elaboration of symptoms. ⁶ The concept of traumatic neurosis was popularised by Oppenheim in his 1889

monograph in which he proposed that a strong noxious stimulus could result in impairment in function in the central nervous system. ⁷

In the early 1890's Breuer and Freud used the term traumatic neurosis as an example of conversion hysteria. ⁸ In their understanding, the injuries caused psychic trauma (commotion) which acted on the nervous system which was abnormally excitable (predisposition). This hysterical disposition was a form of increased suggestibility which could lead to a conversion of affective excitation into a dysfunctional state of the nervous system. The pain and other somatic symptoms were considered to be the consequence of this mechanism. They considered the pain to be hysterical in nature and conceptualised this as 'hallucination' of pain which resulted from the mind's reaction to vivid ideas upon abnormal excitable pain pathways. Their work left unresolved the question whether this hyperexcitable state was psychic in nature or an underlying physical state of the nervous system.

The Freudian school of psychoanalysis was at its zenith in the late 1800's and first decade of the twentieth century. This influential school reclassified hysteria as a psychoneurosis. In their paradigm, sensory symptoms such as pain or hyperaesthesia and motor disturbances such as cramps, spasms and contractures were the features of this 'conversion hysteria'. In the early twentieth century, such chronic post-traumatic spinal pain in railway spine was usually diagnosed as a traumatic neurosis. The diagnoses were usually subsumed under either neurasthenia or hysteria. By the early twentieth century the diagnosis of railway spine was seldom entertained as a specific entity. Neurasthenia meaning 'lack of nerve strength' became a popular diagnostic entity. The concept of nerve force and reflex action was used to explain the nexus between bodily dysfunction and mental processes. The underlying pathophysiology was thought to relate to a deficiency in quantity or impairment in quality of the nervous tissue, hence the exhaustion of the sufferer and the morbid sensations and phenomena which followed. Charcot considered that the nervous condition following railway accidents was simply a manifestation of hysteria resulting from 'psycho-nervous commotion'. ⁹

During World War I a whiplash mechanism injury was recognised in test pilots for the US Navy. McIntyre noted that following World War I, the Navy instituted the launching of planes from the decks of battle ships and

cruisers by the catapult method. ¹⁰ The mechanics of this are well understood now, but, in the earliest days, the pilot was not properly protected. Consequently the violent force on the cervical spine in catapulting was great enough to cause a blackout for a few seconds and accidents occurred that were undoubtedly due to the whiplash effect.

Although occasional reports of neck injuries following automobile accidents began to appear in the early twentieth century, automobile manufacturers were not quick to recognise the association and head rests was not routinely in place until the 1960's. Marshall in 1919 reported the first cases of neck injuries following mild or low impact automobile accidents and noted the 'normal cervical spine Xrays in the injured patients.' ¹¹ Marshall recommended treatment with orthopaedic supports, manipulation and exercises and physical therapy. Other potential remedies included electricity, moist heat and radiant heat.

The first use of the term 'whiplash' was by Crowe in 1928 at a symposium of the Western Orthopaedic Association in San Francisco. Crowe reported eight cases of neck injuries resulting from motor vehicle accidents. ¹ He used the term whiplash as a description of the motion involved with a lash-like effect simulating a cracking of a whip. The 1928 symposium was not published and the first use of the term whiplash in press was in 1945 by Davis. ¹² In his 1945 article, he stated 'starting with the fact that the great majority of injuries of the cervical spine are in the nature of a whiplash, and accepting the meaning of the term whiplash as hyperflexion followed by spontaneous extensor recoil, the nature of a great variety of injuries of this section of the spinal column becomes understandable.' The term whiplash was widely adopted and appeared in the 4th Edition of the text, *The Management of Fractures, Dislocations and Sprains* by Key and Conwell in 1946. ¹³ A section was written by Davis in which he suggested that the majority of automobile accidents causing this injury are head-on collisions.

In 1953 Gay and Abbott observed that it was a rear-end collision which resulted in the majority of these injuries. ¹⁴ Initially the mechanism of the whiplash in rear-end collision was incorrectly attributed to acute flexion followed by extension. They noted however from a series of 50 patients that 'characteristically, these patients were more disabled and remained handicapped for longer periods than was anticipated, considering the mild character of the accident.'

In 1955 Severy reported a series of rear end collisions

utilising dummies and using high-speed photography.¹⁵ He correctly identified the sequence of injuries in whiplash as being hyperextension of the neck followed by flexion. The paper observed, 'unlike most types of collisions, the rear end collision frequently results in minor car damage with major body injury. Also unlike most injury-producing accidents, there is generally no visible sign of injury from the rear end collision victim.'

CURRENT PERSPECTIVES

Although a greater understanding of the whiplash mechanism has emerged in the twentieth century, the condition remains contentious. The rate of litigation in the condition is at a high level which adds to this controversy. In a follow-up study of 144 patients presenting to a hospital emergency department, 81% were claiming compensation. Whiplash injuries are frequently diagnosed with the incidence of insurance claims for whiplash about 1 per thousand population per year. However not all persons involved in motor vehicle crashes develop symptoms and those who do, many recover. After acute injury approximately 80% are asymptomatic in 12 months. Of long-term sufferers, approximately five percent are severely affected and it is these who constitute a group of patients with challenging treatment needs.¹⁶

In 1995, the Quebec Task Force (QTF) established a working definition and criteria for whiplash and whiplash associated disorders (WAD) which redefined whiplash and its management.¹⁷ The task force was sponsored by the Société de l'assurance automobile du Québec, the public auto insurer in Quebec, Canada. Whiplash was defined as 'an acceleration-deceleration mechanism of energy transferred to the neck which may result from rear end or side impact, predominantly in motor vehicle collisions, but also from diving accidents, and from other mishaps.' The energy transfer may result in bony or soft tissue injuries (whiplash injury), which in turn may lead to a wide variety of clinical manifestations (whiplash associated disorders - WAD). Whiplash patients are also classified according to the severity of signs and symptoms. The QTF – WAD classification system consists of five levels:

- 0 = no neck pain complaints, no physical signs
- 1 = neck pain complaints, only stiffness or tenderness, no other physical signs
- 2 = neck complaints and musculo-skeletal signs (decreased range of motion and point tenderness)
- 3 = neck complaints and neurologic signs (weakness,

sensory and reflex changes)

4 = neck complaints with fracture and/or dislocation.

The incidence of whiplash injuries is remarkably uniform in studies throughout the world, between 70 – 200 per 100,000 population. The most common presenting symptoms after motor vehicle collision of this type are neck pain (88 – 100%) and headache (54 – 66%). Other commonly reported symptoms include shoulder pain, arm pain, numbness and paraesthesia, visual and auditory symptoms and dizziness.¹⁸

Experimental studies on animals and human cadavers have revealed a variety of musculo-skeletal injuries.¹⁹ These range from muscle and ligament tears to small micro-fractures or larger fractures of cervical vertebra. Radiological studies however indicate that fractures are uncommon as a result of uncomplicated whiplash. Considerable research has led to a focus on the zygapophyseal (facet) joints in the generation of pain and dysfunction in the whiplash injury.²⁰ Experiments on healthy volunteers have demonstrated that in the rear end collision, the lower cervical vertebra undergo extension but without translation. This motion causes the vertebral bodies to separate anteriorly and the zygapophyseal joints to impact posteriorly.²¹ The lesions resulting from this force are likely to be tears in the anterior annulus fibrosis and fractures or contusions of the zygapophyseal joints. Such lesions have been demonstrated in post-mortem studies of victims affected in motor vehicle crashes. Blocking the sensory nerves that innervate these joints has consistently reduced symptoms in 50% of patients with chronic whiplash pain. The segments that are most commonly affected are C5/6 and C2/3. In patients with chronic headache as the dominant complaint after whiplash, the source of the pain can be traced to C2/3 zygapophyseal joints in the majority of cases.

Although zygapophyseal joint pain is considered to be the basis of the chronic neck pain after whiplash injuries, it cannot be diagnosed clinically or by medical imaging. The diagnosis relies upon imaging guided diagnostic blocks of a joint or the medial nerve branch. In patients who respond to blocks with local anaesthetic and hydrocortisone, more permanent control of pain can be achieved with percutaneous radiofrequency neurotomy.²²

Routine treatment of cervical injuries involves rest, analgesic and anti-inflammatory medications. At times muscle relaxants and use of a cervical collar is recommended. There are few prospective studies of conservative modes of treatment in this condition. Generally early mobilisation of

the neck and utilising the Maitland technique followed by neck muscle exercises are associated with better outcomes than the use of cervical collar for prolonged intervals and rest. Physiotherapy and zygapophyseal joint mobilisation are often employed, but a recent study had shown no additional benefit from cervical traction. ²³

Treatment for the post-traumatic headaches may involve analgesics and non-steroidal anti-inflammatory medications. Sufferers may be susceptible to analgesia over-use headache and caution should be applied with all analgesic agents but particularly codeine-containing compounds. Tricyclic antidepressants are frequently employed for chronic tension headache associated with the whiplash condition. Psychological distress is also common after whiplash and is secondary to the chronic pain. The view that the chronic neck pain is due to a compensation neurosis or malingering for financial gain has been challenged by many published studies and reviews. Nonetheless the stress imposed by litigation may be diminished by counselling and appropriate treatment administered by the treating physician.

The focus of prevention of whiplash has been on automobile seat design and the use of head restraints often incorrectly called headrests. Unfortunately the injury reducing effects of head restraints has been modest, approximately 5-10%. Improvements in the design of car seats with better energy absorption could offer additional benefits. Some manufacturers have implemented active devices in their products which may provide greater whiplash protection. Whether these devices provide substantial risk reduction is unclear with conflicting evidence in different studies. In tests undertaken by the Swedish National Road Administration whiplash protection devices gave no guarantee against injury while a separate study reported in the *Journal of Trauma* found that active head restraint reduced the risk of neck injuries by 75% in rear end collisions. ^{24,25}

The history of whiplash demonstrates that there are few conditions which are as likely to rouse dissent as much as this. There has been a long period of debate about the physical or psychological basis of this disorder as well as its precursor, railway spine. The background of litigation in many cases has also magnified this dispute. Plausible explanations derived from research highlight the role of zygapophyseal joints in the generation of chronic pain and have established whiplash as a recognised injury predominantly in motor vehicle accidents which can be approached with appropriate treatments.

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References

1. Crowe H. A new diagnostic sign in neck injuries. *Cal Med* 1964; 100: 12-13.
2. Trimble M. Post-traumatic neurosis: from railway spine to the whiplash. Chichester, Wiley, 1981.
3. Rigler J. Ueber die Verletzungen auf Eisenbahnen Insbesondere der Verletzungen des Rueckenmarks. Berlin, Reimer, 1879.
4. Erichsen J.E. Railway and other injuries of the nervous system. London, Longmans, 1864.
5. Erichsen J.E. On concussion of the spine: Nervous shock and other obscure injuries of the central nervous system in their clinical and medico-legal aspects. London, Longmans, 1882.
6. Strümpell A. Traumatic neurosis. In: Clinical lectures on medicine and surgery by various German authors. London, The Sydenham Society, 1894: 304-325.
7. Oppenheim H. Diseases of the nervous system. London, J B Lippincott, 1901.
8. Freud S. Breuer. The Pelican Freud Library. Vol 3 Studies on hysteria. Middlesex, Penguin Books, 1974.
9. Charcot J.M. Clinical lectures on diseases of the nervous system. London, The Sydenham Society, 1889: 220-259.
10. McIntyre R.T. Opening remarks of the symposium on Whiplash injuries. *Int Rec Med*. 1956; 169:2.
11. Marshall H.W. Neck injuries. *Boston Med Surg Jnl*; 1919: 93-98.
12. Davis A.G. Injuries of the cervical spine. *JAMA* 1945; 127: 149-156.
13. Key J.A. Conwell H.E. The management of fractures dislocations and sprains. St. Louis, Mosby, 1946.
14. Gay J.R. Abbott K.H. Common whiplash injuries of the neck. *JAMA* 1953; 152: 1698-1704.
15. Severy D.M. Mathewson J.H. Bechtol C.O. Controlled automobile rear-end collisions an investigation of related engineering and medical phenomenon. *Can Services Med Jnl* 1955; 11: 727-759.
16. Hachinski V. Whiplash. *Controversies in Neurology*. *Arch Neurol* 2000; 57: 594-595.
17. Spitzer W.O. Scientific monograph of the Quebec task force on Whiplash-Associated Disorders: redefining whiplash and its management. *Spine* 1995; 41: 1S-73S.
18. Jonsson H. Cesarini K. Sahistedt B. Rauchning W. Findings and outcomes in whiplash-type neck distortions. *Spine* 1994; 19: 2733-2743.
19. Taylor J.R. Twomey L.T. Acute injuries to cervical joints: an autopsy study of neck sprain. *Spine* 1993; 18: 1115-1122.
20. Barnsley L. Lord S. Bogduk N. The pathophysiology of whiplash. In: Malanga G.A. ed *Cervical Flexion-Extension Whiplash Injuries*. *Spine: State of the Art Reviews*. Vol 12. Philadelphia, Hanley and Belfus; 1998: 209-242.
21. Kaneoka K. Ono K. Inami S. Hayashi K. Motion analysis of cervical vertebrae during whiplash loading. *Spine* 1999; 24: 763-769.
22. Lord S. Barnsley L. Wallis B.J. McDonald G.J. Bogduk N. Percutaneous radiofrequency neurotomy for chronic cervical zygapophyseal-joint pain. *N Engl J Med* 1996; 335: 1721-1726.
23. Bogduk N. Whiplash. *Controversies in Neurology*. *Arch Neurol*. 2000; 57: 590-591.
24. NTF Sweden. Whiplash protection not always safer.

Available at <http://www.ntf.se/Tidning/default23209.asp>.
Accessed 7 November, 2007.

25. Viano D.C. Olsen S. The effectiveness of active head restraint in preventing whiplash. *J Trauma* 2001; 51: 959-969.

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