

Cervical Spine Lesions after Road Traffic Accidents

A systematic review

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FROM ABSTRACT

Study Design. A systematic critical literature review.

Objectives.

To determine whether occult pathoanatomical lesions in the cervical spine of road traffic fatalities exist and if they can be identified using optimal autopsy techniques.

Summary of Background Data.

Previous investigations have examined pathoanatomical conditions of the cervical spine of road traffic fatalities. However, different methods of investigation have been used, and results of studies are conflicting. Hence, potential pathoanatomical conditions in fatalities and survivors remain a controversial issue.

Methods.

Articles were retrieved searching the MEDLINE, Mantis, and Cochrane libraries. Studies examining the cervical spine of road traffic fatalities at autopsy were included and evaluated according to a set of quality criteria. For in-depth review, only studies using surface cryoplaning microtomy autopsy technique and a control group were included.

Results.

Twenty-seven articles of which three fulfilled the quality criteria were reviewed. In these studies, subtle pathoanatomical lesions were found in the cervical intervertebral discs, cartilaginous endplates, and the articular surfaces and capsules of the zygapophysial joints.

The lesions were found exclusively in the traumatized patients and in none of the patients in the control group. **[IMPORTANT]**

Conclusions.

Occult pathoanatomical lesions in the cervical intervertebral disc and zygapophysial joints after fatal road traffic trauma may exist.

Present imaging methods, especially conventional radiography, do not visualize these subtle lesions; hence, underreporting of pathoanatomical lesions during standard autopsy is probably common.

These findings may have clinical relevance in the management of road traffic trauma survivors with potentially similar pathoanatomy.

THESE AUTHORS ALSO NOTE:

Since 1970:

- (1) There has been an increase in the number of vehicles on the road by 50%.
- (2) Vehicle crashes causing injury have increased by 12%.
- (3) Vehicle crash fatalities have declined.
- (4) Therefore, there has been an increase in "mild" injuries, including cervical acceleration/deceleration trauma, also known as whiplash."

"Potentially serious lesions after road traffic accidents may result in minor symptoms only, whereas 'minor' traumas have been reported to result in more severe symptomatology." **[IMPORTANT]**

Survivors of road traffic crashes may sustain lesions that "do not show on conventional radiology, (9 references), magnetic resonance imaging (MRI) (4 references) or computed tomography (CT) scanning (4 references)."

The best autopsy technique to show optimal pathoanatomical conditions in the spinal column is "surface cryoplaning microtomy."

This study reviewed the previously published literature dealing with cervical spine lesions after fatal road traffic trauma using autopsy findings from surface cryoplaning microtomy technique.

Results

Twenty-seven articles were identified, but only 3 included a control group that fulfilled the inclusion criteria for this article.

PATHOANATOMICAL LESIONS FOUND IN THE THREE SELECTED STUDIES

"The types of pathoanatomical lesions found in the three studies using optimal autopsy technique were similar."

Multiple lesions were usually found.

- (1) [Schonstrom N, Twomey L, Taylor J. The lateral atlanto-axial joints and their synovial folds: an in vitro study of soft tissue injuries and fractures. J Trauma 1993; 35: 886-92.]

This study investigated the atlantoaxial articulations of 41 traumatized patients. 30 patients were killed outright, 11 lived for 1 month to 10 years post accident.

In the acute dead group (30), "the most common injury was extracapsular bruising around the second spinal nerve and its dorsal root ganglion, posterior to the joint."

Bruising of the synovial folds was seen in half (15/30).

Tearing of the joint capsule was found in 17% (5/30).

12% (5/30) also had fracture of the articular surfaces of the lateral masses of C1.

In the group that survived 1 month to 10 years (11) showed posterior extracapsular hematomas, injury to the posterior synovial folds, and one case of anterior capsular rupture.

"None of the lesions could be found in the 10 patients in the control group."

(2) [Taylor JR, Twomey LT. Acute injuries to cervical joints: an autopsy study of neck sprains. *Spine* 1993; 18: 1115-22.]

This study of 14 dead victims from motor vehicle accidents found:

- (A) Injuries to the cartilage plate of the intervertebral disc (all 14 patients).
- (B) Hemarthrosis of the zygapophysial joint (5 of 14 patients), from small capsular or synovial tears.
- (C) Traumatic disc rupture with herniation (6 discs in 4 of 14 patients).
- (D) Annular bruising (4 of 15 patients).
- (E) Zygapophysial cartilage fracture (6 fractures in 2 of 14 patients).

"None of the lesion types were found in the nontraumatized patients in the control group."

"Postmortem radiography did not show fractures, dislocations, or subluxations in any patient."

(3) [Taylor JR, Taylor MM. Cervical spinal injuries: an autopsy study of 109 blunt injuries. *J Musculoskeletal Pain* 1996; 4: 61-79.]

This study investigated 109 cases of cervical spine injuries after blunt trauma, 72 of which were caused by MVAs, and compared these to 71 cases in which death was from nontraumatic causes.

Traumatic lesions were found in 94% of the cases, involving multiple lesions to the facet joints and the intervertebral discs.

The majority of the disc and facet joint injuries were found at C5–C6 and C6–C7.

Other lesions found included fractures, dislocations, in severe cases articular cartilage damage, ligament injuries, dorsal root ganglion trauma, and there were injuries to the spinal cord or brain stem injury.

“Similar lesions were not found in any of the 71 nontraumatized patients in the control group.”

DISCUSSION

The injuries documented in these studies include:

- (1) Injuries to the intervertebral disc.
- (2) Injuries to the cartilaginous endplates.
- (3) Injuries to the articular surfaces and capsules of the zygapophysial joints.

“These lesions were exclusively found in traumatized patients, with no similar lesions found in the nontraumatized patients in the control group.”

“Furthermore, these changes were not consistent with normal changes caused by aging.”

In studies that did not include a control group, the “cryomicrotomy technique identified identical lesions of the intervertebral disc and zygapophysial joints at autopsy.”

In crash survivors who have undergone surgery for herniated nucleus pulposus, hemarthrosis and ruptures of the neck muscles near the facet joints, have been found.

“The material reviewed in this study suggests that conventional radiologic examination is very insensitive for detecting subtle spinal lesions in vivo and in vitro.”

Studies have shown that in juveniles, a partial or complete separation of the disc from the adjacent vertebrae can occur without macroscopic injuries to the affected disc, and this may be a nonfatal lesion.

“The detection of nonlethal injuries in the cervical spine of fatalities is suggested to be a reasonable indication of what might have occurred had the patient been subjected to forces short of lethal forces.”

CONCLUSIONS

- (1) "Cervical spinal injury occurs in road traffic fatalities with an high incidence of injuries to the spinal joints and intervertebral discs."
- (2) The injuries documented at autopsy in these studies were not found in any of the patients in the control groups.
- (3) It is reasonable to assume that nonfatal road traffic traumas may result in pathoanatomical lesions similar to those found in fatal road traffic traumas.
- (4) "Negative clinical and radiographic examinations do not prove the absence of pathoanatomical lesions." **[VERY IMPORTANT]**

KEY POINTS FROM AUTHORS

- () The consistent lesions found in the cervical spine following fatal crashes were to the intervertebral disc, cartilaginous endplates, and zygapophysial joints.
- () "Present imaging methods, especially conventional radiography, do not visualize subtle pathoanatomical lesions of the cervical spine."

SUMMARY OF FINDINGS

STRUCTURE	PATHOANATOMICAL FINDINGS	NORMAL DEGENERATIVE FINDING
Disc and Endplate	Tears of the annulus at the rim, rim lesion Disc disruption with herniation Linear clefts in cartilage endplate	Transverse fissures of disc after 10 yrs
	Avulsion/separation between endplate And vertebrae in young patients	Not found
Facet Joint	Articular cartilage microfractures	Subchondral sclerosis with fibrillation of hyaline Cartilage Irregular, thin articular surface
	Capsular tears, bleeding or bruising	Not found
Vertebral Body	New fractures found at all levels	Not found
Synovial Folds/Menisci	Bruising of synovial folds	Not found

Point of View **Nikolai Bogduk, MD**

This study has “harvested the best available evidence concerning the possible pathology of whiplash.”

The injuries documented include:

- (1) Articular fractures
- (2) Intra-articular contusions
- (3) Tears of the anterior annulus

The credibility of these injuries is enhanced because different lines of investigation, using totally independent methods, point to the same conclusion. “This constitutes convergent validity.”

“In the case of whiplash, postmortem studies, biomechanics studies, and clinical studies converge.”

“Postmortem studies point to lesions in the zygapophysial joints.”

“Biomechanics studies show how these joints can be injured to produce the lesions seen at mortem.”

“Clinical studies have shown that zygapophysial joint pain is common in patients with chronic neck pain after whiplash.”

“All three lines of investigation point to the same culprit.”

KEY POINTS FROM DAN MURPHY

- (1) The primary injuries in whiplash are to the disc and facet joints.
- (2) Many of the injuries from whiplash are occult, which means that they can't be found on conventional imaging, especially x-rays, but also including CT and MRI.
- (3) These injuries are best found with cryomicrotome autopsy, but that requires a dead subject.
- (4) These occult injuries are often not fatal, and they exist in whiplash patients, especially in those who develop chronic pain.
- (5) The severity of initial symptoms does not indicate the severity of the injury.
- (6) In whiplash, postmortem studies, biomechanical studies, and clinical studies all converge to conclude that the primary injury is to the disc and facet capsules.

