Cervical Spine Injuries: Occipital Condyle Fractures (OCF), Lower Cervical Spine Injuries, Odontoid Fracture and C1 & C2 Vertebrae Spinal Cord Injuries

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Fractures of the cervical spine are common in polytrauma patients. Any patient presenting with neck pain post-trauma should be evaluated for the possibility of a cervical spine injury and/or fracture. Cervical spine fractures are more common in young men and are commonly seen in those injured in automobile accidents. In this article, we will focus on cervical spine fractures and the common forms of spinal cord injuries associated with such fractures.

Epidemiology of Cervical Spine Injuries

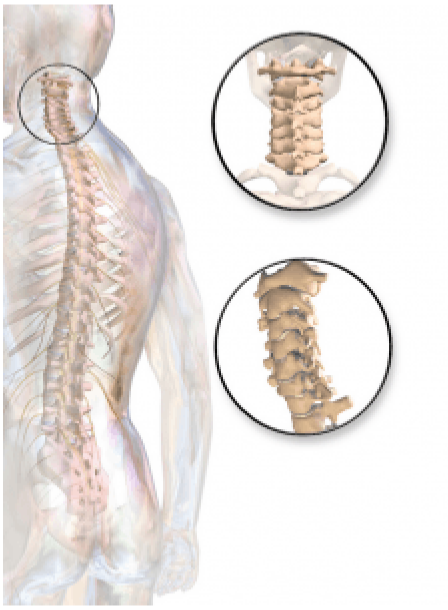
The most common cause of cervical spine injury in the young is trauma due to automobile accidents. Road traffic accidents are also involved in the mechanism of injury in the elderly; however, falling becomes more common in this age group.

Up to 5-10% of unconscious patients presenting to emergency departments in the United States have a cervical spine fracture. Of these, 50% involve the C6/C7 vertebrae, while 30% involve the C2 vertebra.

Cervical spine injuries are more common in men.

Cervical spine injuries follow a bimodal age distribution. The first peak in the incidence of cervical spine injuries occurs in patients aged between fifteen and twenty-four years, whereas the second peak is observed in those older than fifty-five years of age.

Anatomy of the Cervical Spine



Picture: "Cervical Spine" by BruceBlaus. License: CC BY 3.0

The cervical spine is made up of 7 cervical vertebrae with intervertebral disks between them and strengthened by various ligaments.

Cervical spinal nerves emerge above the corresponding vertebra with an additional C8 spinal nerve emerging below C7; thus, there are eight cervical nerve roots despite there being 7 cervical spines.

For the study of fractures, vertebrae can be divided into three columns that determine the stability of a fracture in these regions:

- Anterior column that covers the anterior longitudinal ligament and anterior two-thirds of the vertebral body and adjoining disk.
- Middle column that consists of posterior longitudinal ligament and posterior third of the vertebral body and the adjoining disk.
- Posterior column involves the remaining ligaments that strengthen the vertebrae, such as ligamentum flavum and nuchal ligament.
- An unstable fracture is one that involves two or more regions of the vertebrae.

Occipital Condyle Fractures

These are fractures that involve the craniocervical junction; the upper part of the cervical spine that has a limited range of extension due to the transverse portion of the alar ligaments. When there is flexion of the head combined with head rotation, the alar ligaments become lax and dilated; therefore, cervical spine injuries are more common when the head is in that position.

These fractures are of significance because of three unique characteristics:

1. Lead to instability of the atlantoaxial joint that supports the head.
2. They pose a diagnostic challenge as routine X-ray views cannot be used to

visualize the atlantoaxial joint and hence the need for special views or alternative imaging, such as a computerized tomography scan of the cervical spine.
3. Fractures of the occipital condyle are often associated with other cranial, brain, and cervical injuries.

Fractures of the occipital condyle often happen in patients involved in high-energy trauma due to automobile accidents or sports-related injuries. The patient is typically young.

There are no specific signs of occipital condyle fractures and **patients generally complain of pain on the posterior aspect of the neck** which is associated with paravertebral muscle spasm.

Classification of occipital condyle fractures as postulated by Anderson and Montesano:

1. Type I is an impacted fracture with communition of the occipital condyle. It is a stable fracture.
2. Type II is a basal skull fracture that arises from direct blows to the skull. The alar ligament and tectorial membrane remain intact making it a stable fracture.
3. Type III is an avulsion fracture that occurs following combined rotational injury and lateral bending. It is unstable.

Conservative treatment of occipital condyle fractures is often associated with a good outcome and the patient is very likely to become free of neck pain and regain full range of motion of his or her neck. A Philadelphia cervical collar might be needed in mild and moderate cases of occipital condyle fractures. Rigid immobilization of the cervical spine is needed for type III fractures. Patients who have instability after a period of immobilization should undergo occiput-C2 arthrodesis.

C1 and C2 Cervical Injuries

Fractures of the C1 vertebra, i.e. atlas fractures, represent 2% of all vertebral spine fractures. These fractures are more commonly seen when there is axial compression of the skull on the atlas which results in **rupture fracture of the anterior and posterior arches of the vertebra**. This type of fracture is known as a Jefferson fracture.

The stability of the spine is dependent on the status of the transverse ligaments. This forms the basis of classification by Dickman as follows:

1. Type 1 fractures entail those with intrasubstance tear and are treated by C1/C2 fusion.
2. Type 2 involves body avulsion of the tubercle and can be treated with a halo vest.

Injury to the transverse ligaments might complicate the picture in Jefferson fractures. The diagnosis of an atlas fracture can be made with frontal radiographs of the C1-C2 joint. There should be continuity of the vertical line on the lateral margins of the lateral masses of the atlas. This is lost in a Jefferson fracture.

Image : “Fig. 1” by Korean J Spine, MD.
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When there is a separation between the two arches of more than 7 mm, the possibility of transverse ligament injury becomes quite high. Treatment of Jefferson fractures includes a reduction by cranial traction and immobilization of the cervical spine for three to four months. Immediate occiput-cervical arthrodesis is indicated in cases that are complicated by transverse ligament rupture. Dislocations of the atlas-axis joint or pure C1-C2 dislocations are rare and often fatal.

Odontoid Dens Fractures

Fractures of the odontoid dens represent 5 to 15% of cervical spine fractures. They are often caused by shear forces. There is usually a hyperflexion component in the mechanism of injury. In odontoid dens fractures, the C1-C2 joint might be dislocated; however, the chances of preserved integrity of the spinal cord are better; therefore, odontoid dens fractures are often compatible with life.

These fractures might be seen on plain radiographs; however, their visualization is better on computerized tomography studies of the cervical spine, especially if there is no deviation of the odontoid dens.

Types of odontoid dens fractures can be summarized in the following:

- Type I: Fracture of the upper part of the odontoid dens
- Type II: Fracture at the base of the odontoid dens
- Type III: Fracture affecting the body of the axis “C2”

Type I fractures are treated with cervical arthrodesis for three months. Type II fractures should be treated surgically if:

- There is more than a 5 mm fracture-dislocation.
- There is more than a 10 -degree angulation.
- Failed attempts at a closed reduction with a halo brace.

The treatment of Type III is similar to Type II.

Lower Cervical Spine Injury

The subaxial injury classification (SLIC scale) can be used to classify the type of injury of the lower cervical spine below the axis. This classification system takes into account the following three characteristics:

- The morphology of the fracture
- The status of the disco-ligamentous complex
- The neurological assessment of the patient

Based on these three features, a score is calculated that can classify patients with lower cervical spine injuries into the following groups:

- **A total score below 4:** No surgical intervention is needed.
- **A score of 4:** Treatment could either be conservative or surgical depending on the experience of the treating surgeon.
- **A score above 4:** Surgical intervention is needed.

The following table can be used to determine the SLIC score of a patient with a lower cervical spine injury:

Morphology of fracture	Points
No abnormality of the vertebral body	0
Compression plus burst fracture	1 if only one, 2 if both
Distraction, for example, of the facet perch	3
Facet dislocation, advanced flexion-compression injury, or unstable teardrop fracture	4
Disco-ligamentous complex	
Intact	0
Interspinous widening	1
Widening of the anterior disk space or facet joint dislocation	2
Neurological status	
Intact spinal cord	0
Root nerve injury	1
Complete cord injury	2
Incomplete cord injury	3
Continuous cord compression	1

If the patient was found to have a SLIC score that is indicative of surgical intervention, the following guidelines should be followed while providing the required surgical intervention:

Injury Description	Recommended Treatment
Central spinal cord injury	Laminoplasty or laminectomy with arthrodesis
Vertebral burst fracture with compression	Anterior cervical vertebrectomy with cage graft of allogeneic or autologous bone
Distraction fractures due to hyperextension or avulsion injury	Anterior discectomy plus arthrodesis

Early spine stabilization should be attempted as early as possible for optimum recovery when there is evidence of a spinal cord injury. In addition to the stabilization of the spine, one should also **aim to decompress the spine from any compression**. Computed tomography studies of the cervical spine are beneficial in the evaluation and exclusion of fractures; whereas, magnetic resonance imaging might be needed to evaluate the spinal cord.

References

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Notes