Cervical spine injuries

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Abstract

Amongst patients with cord injury following spinal fractures, the majority are due to cervical spine fractures. Knowledge of both immediate and definitive management of the cervical spine injuries is essential for emergency department doctors and spinal surgeons (orthopaedic and neurosurgery). This article focuses on the in-hospital management of these fractures. It discusses the presentation, evaluation, classification and management of common cervical spine fractures. Broadly speaking, the management of cervical spine injury is influenced by fracture displacement, associated disco-ligamentous injury and the neurological status of the patient. Undisplaced or minimally displaced fractures with no adverse features can be treated conservatively. For ligamentous injuries and significantly displaced fractures surgical management is favoured. This includes atlanto-occipital dislocation, C1 and C2 fractures with transverse atlantal ligament damage, displaced hangman's fracture with C2/3 disc injury and lower spine fractures with distraction or rotation injuries with accompanying disco-ligamentous damage.

Keywords adult; cervical cord; cervical vertebrae; dislocations; spinal fractures

Introduction

The risk of death and quadriplegia associated with cervical spine injury makes it highly devastating. The management of cervical spine injury is considered one of the core activities of orthopaedic and neurosurgical spinal surgeons.

Epidemiology

Following trauma, cervical spine injury is seen in 3.7% of patients.[1] The prevalence is lower in alert patients (2.8%) as compared with clinically un-evaluable patients (7.7%). Of these cervical spine injuries, 41.9% are unstable. Moderate and severe head injury is associated with a slightly higher incidence (5.4%) of cervical spine injury.[2] The majority of these are found between the level of the occiput and C3. The risk of cervical spine injury and spinal cord injury has been found to be higher in patients with a GCS of eight or less. Compared to other regions of the spine, cervical spine fractures are associated with higher risk of neurological deficit and complete cord injury.[3]

In the cervical spine, the C2 vertebra is the most commonly fractured followed by C5 and C6.[4] The C2 odontoid peg fracture is the most common cervical spine fracture in patients aged 70 years or more. C1 ring fractures are commonly associated with other cervical spine fractures, with fracture of the odontoid being the most common (53%). 14% of C1 fractures are associated with fractures of the lower cervical spine.

Amongst patients with neurological deficit following spinal fractures, the majority are due to cervical spine fractures.[3] Patients with cervical cord injury have a higher mortality rate than patients with traumatic paraplegia due to a thoraco-lumbar injury.[5] Cervical fracture dislocation injuries are more likely to have a complete cord injury as compared with burst fractures.[5]

Anatomy of the cervical spine

The cervical spine consists of the seven cervical vertebrae and the cranio-cervical junction. The occipital bone is referred to as C0, the atlas as C1 and the axis as C2. The C1, C2 and C7 are atypical cervical vertebrae. C3 to C6 are typical cervical vertebrae. A typical cervical vertebra consists of an oval body and a posterior vertebral arch. The arch is comprised of pedicles, transverse processes (with foraminae), superior and inferior articular processes, laminae and a spinous process. The facets slope backwards, with the caudal vertebra's superior facet anterior to the cranial vertebra's inferior facet. The vertebral artery passes through the transverse foraminae from C6 to C1, before turning medially towards the cervical dura over the C1 lamina.

C1 doesn't have a body and consists of an anterior arch, posterior arch, lateral masses and transverse processes. C2 has the odontoid process pointing upwards and a stocky posterior arch. The intervertebral discs are present from C2/3 onwards to C7/T1.

The range of motion of the cervical spine is 80–90° of flexion, 70° of extension, 20–40° of lateral flexion and up to 90° of rotation.[6] This osseo-ligamentous configuration confers flexibility and stability to the cervical spine. At C0/C1, the normal range of flexion extension movement is 15–20°. The normal range of rotation at C1/2 is up to 50°. The bilateral alar ligaments and transverse ligaments hold the odontoid process as a pivot on which the C1 can rotate.

Below C2, the facet orientation and capsule allow for flexion and rotation movements but resist lateral flexion. Most of the flexion-extension, lateral flexion and the remainder of rotation of the cervical spine occurs in the sub-axial (i.e. below the axis or C2) cervical spine.

Management of cervical spine injury

Occipital condyle fracture

Clinical presentation: occipital condyle fractures are associated with concomitant head or cervical spine injury in the majority of patients.[7,8] Before the advent of CT scans, these injuries were difficult to diagnose and frequently missed. These are rare injuries and are seen in 1[7] to 2.5%[8] of cranio-cervical CT scans carried out to investigate trauma. The symptoms include upper cervical or occipito-cervical pain and rarely lower cranial nerve palsies.[9]

Evaluation: occipital condyle fractures are evaluated with a CT scan of the cranio-cervical junction. Additional information regarding the ligaments may be obtained with MR when instability is suspected.

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Classification: the most popular classification is that of Anderson and Montesano.[10] This divides occipital condyle fractures into three types (Figure 1):

1. ***Type I*** – comminuted fracture with little or no fracture displacement. Tectorial membrane and contralateral alar ligament are considered intact. These fractures are associated with axial loading.
2. ***Type II*** – basilar skull fracture with extension into the occipital condyles. Ligaments are considered intact.
3. ***Type III*** – avulsion fracture at the insertion of alar ligament with fragment displacement. Alar ligaments and tectorial membrane may be damaged rendering these fractures potentially unstable. These fractures are associated with rotation and lateral bending and are the most frequent type in some case series.[8,11]

Treatment options:

1. ***External immobilisation using a rigid cervical collar*** – all occipital condyle fractures without ligamentous instability may be treated with a collar.[11] Mueller et al.[7] treated 21 occipital condyle fractures without atlanto-occipital dislocation with a collar and reported 95% osseous fusion. Immobilisation with a halo brace was not required in any of these patients.
2. ***External immobilisation using halo vest*** – occipital condyle fractures with suspected ligamentous instability may be treated with halo bracing.[8] Malham et al.[8] treated eight occipital condyle fractures with suspected ligamentous instability with a halo vest and 16 occipital condyle fractures without ligamentous instability with collar. No surgical stabilisation was performed and they reported 88% osseous fusion.
3. ***Occipito-cervical instrumented fusion*** – occipital condyle fractures with atlanto-occipital dislocation may be treated surgically.[7,12] Up to 10% of patients with occipital condyle fractures have been found to have atlanto-occipital dislocation.[7]

Atlanto-occipital dislocation

Clinical presentation: atlanto-occipital dislocation is a highly unstable injury of the cranio-cervical junction. Up to 10% of fatal cervical spine injuries were found to have atlanto-occipital dislocation.[13] A post-mortem study reported a frequent association with submental laceration and mandibular fracture. This would suggest hyperextension-distraction as the dominant mechanism of injury.[14] It is more common in children and young adults. Several airbag deployment-related atlanto-occipital dislocations have been reported, especially when a child is a front seat passenger.[14] Atlanto-occipital dislocation is commonly associated with traumatic brain injury and this can affect initial identification of the spinal injury. Atlanto-occipital dislocation can present with severe neck pain, lower cranial nerve palsies, spinal cord injury and vertebral and carotid artery damage. Application of traction should be avoided, as it has a 10% risk of causing clinical deterioration.[13]

Evaluation: atlanto-occipital dislocation is suspected on cervical spine X-rays and confirmed with CT or MR.

1. ***X-ray criteria*** – many methods of evaluating atlanto-occipital dislocation using X-rays have been described

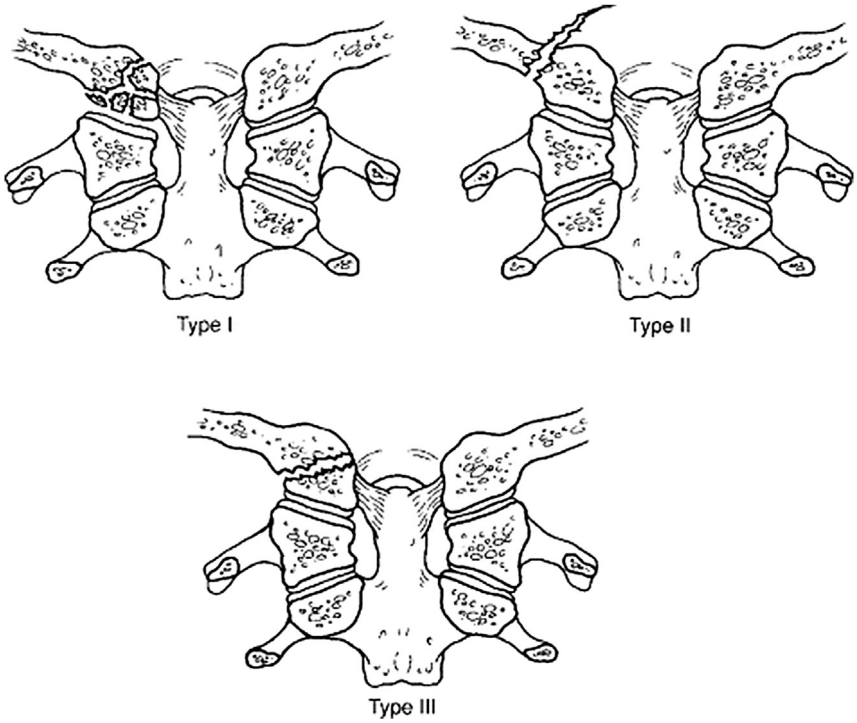

Figure 1 Occipital condyle fracture classification by Anderson and Montesano.[10] Type I is a communited fracture little or no fracture displacement. Type II is a basilar skull fracture with extension into the occipital condyles. Type III is an avulsion fracture at the insertion of alar ligament with fragment displacement. (B J C Freeman and H Behensky, http://dx.doi.org/10.1016/j.injury.2004.05.026).