



Overview of Subaxial Cervical Spine Fractures and Dislocations

**AbdulWahab Ahmed Alzahrani^{1*#}, Mohammad Saeed M. Al Fehaid²,
Abdullah Saleh A. Alaboudi³, Mohammed Ahmed Abed I. Abualsaoud⁴,
Faisal Abdulmohsen A. Bintalib³, Ahmed Asim A. Almuallimi³,
Nawaf Faisal M. Alotaibi³, Othman Yaqoub Yousef Aldayhan³,
Abdulrahman Nasser A. Alshabanat³, Sama Ali A. Halawi⁵
and Osied Hesham M. Almadani⁶**

¹Faculty of Medicine, Albaha University, Saudi Arabia.

²Imam Abdulrahman Bin Faisal University, Saudi Arabia.

³King Saud Bin Abdulaziz University for Health Sciences, Saudi Arabia.

⁴Dr. Sulaiman Al Habib Hospital, Riyadh, Saudi Arabia.

⁵Ibn Sina National College for Medical Studies, GP, Saudi Arabia.

⁶King Abdulaziz University, Saudi Arabia.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Injuries of the subaxial cervical spine are among the most common and potentially most devastating injuries involving the axial skeleton. The lower cervical spine can suffer minor bony or ligamentous injury that nevertheless results in severe neurologic injury. Plain radiography, computed tomography (CT) scans, and magnetic resonance imaging (MRI) scans are all part of the standard imaging regimen. The delayed timing of dislocation reduction and cost-effectiveness are

#Assistant Professor, Consultant Pediatric Orthopedic and Deformities

*Corresponding author: E-mail: Dr.abdlwhab@gmail.com;

two issues with routine use of MRI in the diagnosis of cervical facet dislocations. Several treatment options and approaches can be used. However Orthopedic treatment can be used to reduce the fracture or dislocation returns the vertebral canal to its normal shape and dimensions and decompresses the spinal cord. Immediate treatment should be started if there are signs of spinal cord injury or any factor that could lead to such injuries. In this review we will be looking at epidemiology, causes, evaluation and treatment of such cases.

Keywords: Spine; cervical; fracture; fissure; dislocation; vertebrae.

1. INTRODUCTION

The subaxial cervical spine is made up of levels C3 through C7, and it contains both bony and ligamentous structure. Bony, soft tissue, or a combination of both injuries can occur in the subaxial cervical spine. The goal of this review is to go through the subaxial cervical spine fractures etiology, epidemiology, diagnosis as well as the various treatment options. Pediatric cervical spine trauma, cervical spine trauma in sports, and cervical spine trauma in an ankylosed spine are among the themes covered [1].

Trauma to the cervical spine can range from muscle strain to capsular or ligament sprain/tear, as well as facet subluxations or dislocations with or without fracture. Traditionally, cervical dislocations have been linked to catastrophic spinal cord injury. The severity of these injuries, which can result in spinal cord compression and significant neurological impairments, is determined by a number of factors. The force used to induce the injury, the level of damage to the cervical spine's supporting osseous and soft tissue structures, the patient's age, syndromic disorders, bone quality, and underlying patient comorbidities are all factors to consider [2].

Treatment of cervical spine fracture dislocations remains different. Several reports have been published on different treatment protocols, but surprisingly few have compared their advantages and disadvantages. Whether conservative treatment is sufficient or whether an operation is always necessary is controversial. In recent years, early surgical treatment has become increasingly popular. Before 1988, most patients were treated conservatively with head traction and a halo vest. Surgical fusion was performed when conservative treatment did not provide adequate stabilization. Since 1988, most fractures have been treated by posterior fusion with bone grafts and interspinous Roger wire (modification of Bohlman). Closed reduction by cranial traction is performed before the operation.

If necessary, an open reduction is performed [3].

2. ETIOLOGY

High-energy mechanisms, such as car accidents and falls from great heights, can lead to subaxial cervical spine fractures, as can moderate-energy mechanisms, such as contact and non-contact sports. Lower-energy processes, such as ground-level falls, can also occur. Because of the extensive range of motion available in this region of the spine, the cervical spine is particularly sensitive to injury. Different damage processes result in a variety of fracture patterns as well as ligamentous injuries [1].

The mechanism of damage varies depending on the patient's age, and cervical dislocations have a bimodal distribution. Younger patients are more likely to be involved in a high-intensity injury mechanism, such as a car accident. While low-injury causes, such as a ground-level fall, are more typically connected with senior individuals. Depending on the type of injury, facet joint dislocations can be completely ligamentous or include a fracture. Facet dislocations occur in the subaxial spine and are usually triggered by a flexion-distraction event at the time of injury [2].

Vertebral body fractures come in a variety of shapes and sizes. A flexion compression mechanism can result in an anteroinferior teardrop fracture. The failure of the posterior tension band is a common cause of this injury. When compared to a flexion teardrop fracture, an extension teardrop fracture is an avulsion injury caused by an extension mechanism. When an axial load is applied to the cervical spine in neutral position, compression and burst fractures can develop. The load is conveyed to the vertebral body via the disc, which eventually fails. The discoligamentous complex refers to the anterior ligaments, as well as the intervertebral disc and posterior ligaments (DLC). The subaxial cervical spine's three column lesions might be totally bony, completely discoligamentous, or a

combination of the two. Facet joint subluxations and disc or capsule disruption can occur as a result of a distraction mechanism, which often involves a rotational force. An axial load applied to a cervical spine in minor flexion causes injuries to the posterior tension band. With a distraction and extension moment, injuries to the anterior ligaments can occur [1].

3. EPIDEMIOLOGY

The subaxial cervical spine is a common region within the cervical spine, with 50 percent of injuries occurring between C5 and C7. Cervical spine injuries occur in 3% of blunt force trauma patients. These can be noticed in young individuals who have high-energy injury mechanisms or older patients who have low-energy damage mechanisms. Ankylosis spondylitis (AS) patients can have very low energy mechanisms, and even minor trauma should raise a strong suspicion of cervical spine fracture. A patient with AS is four times more likely than a patient without the illness to suffer a vertebral fracture over their lifetime. The cervical spine will account for more than 75% of these fractures. This propensity is caused by the spine's stiffness as a result of long-segment fusion [1].

Cervical dislocations can occur in two places: axially, at the occipitocervical (occiput/C1) and atlantoaxial (C1/C2) articulations, and subaxially, from C2/C3 to C7/T1. Dislocations caused by acquired instability can occur in the axial spine and are common in children. The bulk of these dislocations, however, are caused by a traumatic event, and roughly 75% of them happen in the subaxial spine. Males are more likely to have subaxial dislocations, and high-energy causes in younger patients, such as a car accident, are more common. Cervical dislocations, on the other hand, are frequently linked to low-energy processes in the senior population, such as falling from a standing position. Because of the increased risk of spinal cord injury and death associated with cervical trauma, special concern should be given to the paediatric population. Cervical spine injury is more common in children under the age of eight due to their larger heads, weaker muscles, and higher ligamentous laxity [2].

Athletes under the age of 30 are more likely to sustain cervical spine injuries as a result of physical exercise. Sports that cause cervical spine injuries differ by region; in the United

States, American football, wrestling, and gymnastics are the most common. Rugby is the most prevalent activity that causes these injuries in Europe, while ice hockey is the most common sport in Canada. When an athlete appears with a focused neurologic impairment, neck pain, torticollis, or describes diving as the mechanism of injury, there should be increased concern for a cervical spine injury [1].

Around 47% of people who suffer from spinal trauma also suffer from other injuries. In 35 percent of patients, hyperflexion and axial compression of the cervical spine caused by car accidents or falls might result in simultaneous head injuries. Extra-spinal fractures of the ribs, sternum, clavicle, scapula, mandible, and other structures are observed in 24% of patients, and ribs, sternum, clavicle, scapula, mandible, and other structures are seen in 28% of patients. In non-penetrating cervical spine trauma, vertebral artery injuries (VAIs) occur in 17–46% of cases. VAI is more likely to occur when many levels of the cervical spine are injured (73%) than when a single level is injured (27 percent). VAI is frequently caused by flexion-distraction and flexion-compression injuries (19.7%). VAI on one side is more common than on the other. This injury can be caused by either stretching or compression of the vertebral artery. Because many of these injuries are asymptomatic, they are often overlooked. Symptoms including dysarthria, dizziness, diplopia, dysphagia, blurred vision, and tinnitus might develop right after an injury or take up to three months to appear. In a symptomatic patient, a magnetic resonance angiography (MR angiogram) is performed to diagnose this injury. There is no need for formal treatment in asymptomatic patients. Treatment options for symptomatic patients include fibrinolysis with streptokinase, anticoagulation with heparin and warfarin, and surgery. When a dissecting vertebral artery necessitates surgery, ligation of the wounded artery proximal and distal to the site of lesion is indicated if collateral blood flow is adequate [4-14].

4. EVALUATION

Plain radiography, computed tomography (CT) scans, and magnetic resonance imaging (MRI) scans are all part of the standard imaging regimen. During a routine trauma evaluation, three views of odontoid plain films are used: AP, lateral, and open mouth. The whole cervical spine, including the C7-T1 junction, must be seen on the plain films. Because up to 17% of

cervical spine injuries occur at the C7/T1 intersection, it's critical to look at T1 while analysing cervical trauma. A swimmer's vision can thus be produced if not visualised on the normal 3 view series. On a lateral radiograph, these might be utilised to check cervical alignment. Vertebral body subluxation compared to the vertebral body below can be a sign of cervical facet dislocation. The 4 parallel lines of the cervical spine can be used to show reversal or loss of the typical cervical lordosis. Bilateral facet dislocation can result in around 50% subluxation, while unilateral facet dislocation can result in about 25% subluxation. A retropulsed disc in the canal could cause disc height loss. Due to its higher sensitivity and capacity to better examine osseous structure than X-rays, CT scans are quickly becoming the standard of care for imaging in the initial trauma examination, especially at the cervical-thoracic junction (C7/T1) [2].

Specific radiographic features seen on CT that could indicate Sub Axial Spine dislocations:

- In the sagittal plane, facet dislocations are most visible. The mid-sagittal and parasagittal cascades of the anterior vertebral column, posterior vertebral column, spinolaminar line, and interspinous line must all be examined on the sagittal CT scan. Smooth and continuous lines should be used. The facet joints resemble hamburger buns in the axial plane, with the flat sections articulating.
- Facet joint diastasis/dislocation and translation of the vertebral body in the sagittal plane compared to vertebrae below are signs of dislocation. On the axial plane, a 'reverse hamburger bun' symbol can be seen [2].

Ordering cervical spine magnetic resonance imaging (MRI) is becoming more prevalent as there is a strong suspicion of a related neurological damage. For examining the spinal cord, nerve roots, disc, and ligamentous structures in the cervical spine, MRI is better than CT scans. MRI investigations can reveal the soft tissues that surround the cervical spine, including the posterior ligamentous complex and discs, as well as any hematomas that have formed [1].

The delayed timing of dislocation reduction and cost-effectiveness are two issues with routine

use of MRI in the diagnosis of cervical facet dislocations. For patients undergoing surgical open reduction and/or fixation, the use of an MRI is required to design the route to reduction and decompression of a bone fragment or extruded disc material. If a closed reduction is planned first, an MRI should be obtained first in recalcitrant patients with altered mental status to determine the health of the spinal cord as well as any disc or bone injury that could put the spinal cord at danger. It is still controversial whether an MRI should be performed before a closed reduction in an awake examinable patient [15].

Unilateral or bilateral facet dislocations and fractures are possible. A perched facet is a subluxation of the facet that occurs when the facet is subluxed. Facet joint subluxations can occur as a result of distraction processes, which generally involve a rotating force. This can result in disc or capsule disruption. Asymmetry in the shingling of the facets on lateral radiographs or the sagittal slices of a CT scan might be seen. The axial views produced by the CT scan can be used to check the facet joint articulation as well as provide information regarding posterior bone fractures that are difficult to identify with just X-rays [1].

5. TREATMENT

Facet dislocation treatment seeks to keep the spinal cord's functional and anatomical integrity throughout by restoring spinal canal alignment and achieving spinal stability. All of this should be done in order to stabilise or recover any neurological deficits induced by the injury, as well as to avoid long-term discomfort, stiffness, and instability. To achieve these objectives, the displaced facets must be reduced to allow wounded tissue to heal, neuronal components to decompress, and normal anatomy to be restored. Facet dislocation can be reduced closed or open, much like any other joint dislocation. Closed reduction is contraindicated in circumstances where the patient is reluctant or unexaminable, and the neurological examination is unreliable, as well as cases where imaging investigations reveal problematic disc prolapse or bone debris that could compress the cord during reduction. However, the question of whether an MRI scan is always required before the decrease in awake cooperative patients is currently being debated. Several studies, including those by Vaccaro et al., have suggested that closed reduction in an awake and conscious patient without a prereduction MRI may be safe. Closed reduction

in sedated patients may be safe in most circumstances, according to several recent studies [15-20].

Immediate treatment should be started if there are signs of spinal cord injury or any factor that could lead to such injuries. Recent studies support the idea that the sooner the spine is stabilized by decompressing the injured spinal cord, the better the chances of recovery. Radiological examinations including profile, anteroposterior, oblique, and transoral views of the cervical spine should be performed. CT can be used to clarify unclear findings on plain radiographs, reveal an occult injury, and further evaluate an identified fracture or a dislocated fracture [21-23].

Closed reduction should be performed in the operating room, intensive care unit, or intensive care unit, where monitoring of vital signs, resuscitation, medication, and equipment, including traction sets, traction weights, and fluoroscopic equipment are readily available. Patients should be relocated with all precautions for the spine and Logroll transfer. Patients are neurologically evaluated prior to initiation of traction to define the neurologic baseline. Analgesia and sedation, including opioids, benzodiazepines, and antiemetics, can be used. The most common cranial traction device currently in use is the forceps design introduced by Gardner in 1973. The use of this spring tensioning device made the pliers easy and safe to use. The pins were then placed just below the superior temporal line, avoiding the temporalis muscle and the artery. The newly developed Singhal traction bed uses a load cell tensioning handle to create incremental traction while flexing the cervical spine [15].

Orthopedic treatment to reduce the fracture or dislocation returns the vertebral canal to its normal shape and dimensions and decompresses the spinal cord. Cranial halo traction reduction is a commonly used technique in some emergency departments and is effective and well tolerated by the patient. Reduction by manipulation under general anesthesia is contraindicated as it is an extremely dangerous method; Even with gradual pulling, caution should be exercised and small weights should be used first. Due to the instability associated with dislocations, the latest guidelines indicate that surgery is required to achieve adequate reduction and stabilization, ensure decompression of the spinal cord, and prevent uncomfortable immobilization. The operation can

be performed anteriorly, posteriorly, or double. Recent anatomical and biomechanical studies support the use of instruments with the latest synthetic materials such as cages and front plates or posterior lateral grinding screws [21,24-27].

According to a study the incidence of complications in patients treated surgically and conservatively is similar. However, conservative treatment has clear disadvantages. The average hospital stay is longer. Late deformities and instabilities are very common in conservatively treated patients, and nearly a third (29%) had to undergo late surgical stabilization. Beyer concluded that non-anatomical reduction and residual cervical translation are associated with late-stage neck pain and stiffness. There's also a correlation between the incidence of late-stage neck pain and the extent of residual displacement. Conservative treatment was also strongly correlated with the occurrence of chronic neck pain [3].

6. CONCLUSION

Lower cervical spine fractures and dislocations are one of the challenging surgical cases that medical teams can face. High-energy mechanisms, such as car accidents and falls from great heights, can lead to subaxial cervical spine fractures, as can moderate-energy mechanisms, such as contact and non-contact sports. Around 47% of people who suffer from spinal trauma also suffer from other injuries. The reason for that is usually intense accident or trauma that causes such injury. Treatment of cervical spine fracture dislocations remains different. Several reports have been published on different treatment protocols, but surprisingly few have compared their advantages and disadvantages. Immediate treatment should be started if there are signs of spinal cord injury or any factor that could lead to such injuries. Surgical procedure depends on the injury itself.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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