Can Delayed Surgical Decompression and Stabilization of Neglected Subaxial Cervical Trauma Provide Satisfactory Functional Outcomes? A Case Study

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Abstract

Aim: This article aims to describe the case of a 22-year-old male with neglected subaxial cervical trauma involving C6 and C7 vertebrae, associated with spinal cord injury/transection, who received delayed surgical treatment, however, achieved a relatively satisfactory functional outcome.

Background: The patient sustained motor vehicle accident (MVA) at a rural area in a developing country with limited access to advanced diagnostic facilities or trained medical providers. Thus, leading to delayed diagnosis and conservative treatment of subaxial cervical dislocation with associated spinal cord injury and quadriplegia.

Procedure: Two months after injury, following transfer to a tertiary center, a single-stage anterior cervical corpectomy and fusion was performed. The surgery was uneventful.

Outcomes: Complete anterior spinal cord decompression was achieved with good fixation. The patient was discharged 2 days after surgery. At 1 year follow-up, upper extremity function of both upper limbs was restored; however, limited nonfunctional improvement of the lower extremity was noted.

Scientific message: Spinal decompression and stabilization can lead to better functional outcomes in traumatic spinal cord injuries even if delayed due to lack of facilities. Anterior-only decompression and fixation with a proper technique are sufficient in single-level corpectomy.

Keywords: Anterior cervical fusion, Cervical corpectomy, Cervical trauma, Myelopathy.

Introduction

Cervical spine injuries in the subaxial region may involve bony components, such as vertebral bodies, articular pillars, and facets or soft tissue structures, such as intervertebral discs, facet capsules, and posterior ligaments. While simple injuries can be treated conservatively, unstable injuries, particularly those presenting with neurologic compromise, require operative management.

Surgical options are controversial with reports presenting variable outcomes of anterior, posterior, or combined anterior/posterior approaches. Direct visualization of any facet dislocations can be achieved through a posterior cervical approach, which also facilitates decompression of the central canal and neural foramina. However, it is a relatively longer operation with increased muscle dissection, bleeding, postoperative neck pain, and a higher risk of surgical site infection.

Additionally, a posterior approach cannot address ventral compression by a fractured vertebral body or traumatic disc herniation. On the contrary, anterior cervical disectomy/corpectomy and fusion with plate stabilization have been widely applied in traumatic subaxial cervical injuries with a high success rate and good clinical results. This approach can allow direct decompression of the spinal canal and neural foramina with minimal soft tissue destruction.

Autologous bone grafting is considered the gold standard to achieve solid fusion in the spine. However, iliac crest harvest-site morbidity is a true concern, leading to chronic pain, donor site hematoma, infection, visceral herniation, and sensory nerve injury.

Case Report

A 22-year-old male presented to us 2 months after a high-speed rollover motor vehicle accident in a rural area, resulting in cervical spine injury at C6–C7 and C7–T1 levels with immediate quadriplegia. Although he was able to do advanced imaging studies computed tomography (CT) and magnetic resonance imaging (MRI), he was deemed inoperable by treating physicians due to lack of trained spine surgeons in his area and the slim chances of achieving neurologic recovery. He received only conservative treatment in a collar. The patient was bedridden throughout that period.

While local harvested bone from osteophytes may not be of high quality, vertebral body cancellous bone in cases of corpectomy is highly reliable to achieve fusion without the need for further bone graft harvesting.

As will be shown in this case report, a single-stage anterior-only decompression and fusion can provide stability and early solid fusion in subaxial cervical spine injuries even when fixation is delayed.

Conflict of interest: None

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When the patient was first evaluated by us, he had severe chest infection from recumbency, making him unfit for surgery.

On physical examination, the patient had 0/5 motor power in all muscle groups of the lower extremity with no rectal tone or sensation. In the upper extremity, the patient had limited function of the deltoid by Frankel’s grading:

| Muscle | Deltoid | Biceps | Triceps | Wrist flex/ Ext | Fingers | Interossei |
|--------|---------|--------|---------|----------------|---------|------------|
|        | 2/5     | 1/5    | 1/5     | 1/5            | 1/5     | 1/5        |

He also had exaggerated reflexes and spasticity in both upper and lower extremities along with bilateral ankle clonus and babinski signs.

Due to the chest infection, he required IV antibiotic treatment for one week prior to being fit for surgery.

Imaging studies including X-rays, CT, and MRI were performed.

CT showed a fracture involving the C7 vertebral body retropulsed into the spinal cord as well as minimally displaced fracture of C6 and C7 lamina. MRI showed high signal intensity with possible laceration and contusion within the spinal cord opposite C6 and C7. Cord edema extended from C4–T1. There was also boney contusions at multiple levels; C5, C6, and C7 as well as increased signal within the surrounding soft tissues and muscles. The pattern of injury shows mixed compression as well as extension injury mechanisms, given the anterior and posterior failure mechanisms in the vertebrae.

Also noted was the position of the manubrium sterni in relation to the cervico-thoracic junction. Fortunately, given the patient anatomy, there was good access to the surgical site without the need for using an extended approach or sternotomy (Fig. 1).

**Surgical Procedure**

Under general anesthesia, a Smith–Robinson approach was used to access the injury site exposing the involved segment between C6–T1 through a transverse incision centered and C7. Surgical loupes and headlights were used for magnification. After confirming the surgical level with C-arm imaging, the C6–C7 and C7–T1 discs were removed with endplate cartilage removed to expose boney endplates. The C7 vertebral body was removed by Leksell Rongeur and not burr in order to preserve the cancellous bone for later grafting.

The posterior edge of the vertebral body was carefully peeled off the dura using micro-curettes and Kerrisons. Wide decompression of the cord and neural foramina was achieved. Meticulous hemostasis was applied throughout the procedure.
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Intraoperative images after full decompression and stabilization during follow-up which is defined as narrowing of the disc height and endplates with no radiolucency around the cage or screws or instrumentation. For the above, anterior stabilization in this case was deemed necessary.

**Radiologic Assessment**

X-rays were done at 1 and 4 weeks and 3 and 6 months. CT scan was done at 6 months showing bridging bone through the cage and endplates with no radiolucency around the cage or screws or signs of implant failure.

Additionally, adjacent segment disease was not observed during follow-up which is defined as narrowing of the disc height adjacent to a fused level with anterior or posterior osteophyte formation, when comparing postoperative radiographs with the last follow-up radiographs (Fig. 3).

**Clinical Outcome Assessment**

The patient was examined clinically at 1, 3, 6, and 12 months postoperatively. The clinical outcome was assessed using visual analog scale (VAS) scores for neck pain (0 = no symptom; and 10 = maximum pain).

Neurologic assessment was done using the Frankel grading: grade I had no motor or sensory function; grade II had sensory, but not motor function; grade III had useless motor function with sensations; grade IV had useful motor function and sensation with some deficit; and grade V had normal motor function and sensation.

The patient showed gradual and significant improvement from preoperative neurologic status in upper extremities. Immediate improvement in his biceps function was noted on POD1, suggesting that decompression of the neural foramina was beneficial. During that time, the patient was using a wheel chair with assisted ambulation. At 1 year follow-up patient examination showed:

| Deltoid | Biceps | Triceps | Wrist flex/Ext | Fingers | Interossei |
|---------|--------|---------|----------------|--------|------------|
| 5/5     | 4/5    | 4/5     | 4/5            | 3/5    | 3/5        |

Spasticity in the upper extremities was recovered. The patient was able to self-feed and use wheelchair independently. Unfortunately, no significant functional improvement was noted in the lower limbs and urinary/defecation function did not recover (Fig. 4).

**Discussion**

Traumatic subaxial cervical spine injuries often require surgical stabilization. Particularly, those presenting with gross instability or neurologic deficits. Anterior, posterior, or combined approaches have been described with successful outcomes.

Posterior stabilization using various methods, such as wires, hooks, screws, and rod systems, have been used. Direct visualization of any facet dislocations can be achieved through a posterior cervical approach. Also, decompression of the central canal and neural foramina is facilitated. However, it is a relatively longer operation with increased muscle dissection, bleeding, postoperative neck pain, and a higher risk of surgical site infection.

In addition, the posterior approach requires a longer segment of fixation compared to the anterior approach which can help save fusion levels as well as directly address ventral compression by a fractured vertebral body or traumatic disc herniation which can be as high as 40% in unilateral facet dislocation and 80% in the cases of bilateral cervical facet dislocation. Failure to address anterior pathology can lead to progressive neurologic deficits and kyphotic deformity.

Conversely, the anterior cervical approach enables direct decompression of the spinal canal by removing the disc herniation or vertebral body fragments. This patient had C7 vertebral body disruption with posterior translation as shown in preoperative imaging as well as compressive fractures of the laminae of C6 and C7 posteriorly.

For the above, anterior stabilization in this case was deemed more suitable as it ensures thorough decompression of nervous structures, thus offering the patient the best chance for recovery. Although minimally displaced, the fractured posterior elements...
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The rationale in the management of this case was supported by what has been published previously in large series that anterior-only fixation is sufficient for subaxial cervical spine injuries with a high success rate and good results.\(^1\),\(^2\),\(^9\),\(^16\)

While this patient had unilateral perched facets that reduced by simple traction under anesthesia, bilateral dislocated facets would have required traction in Gardner–Wells tongs or a possible posterior approach just to achieve reduction under vision.

The patient in this case report had very acceptable clinical and functional outcomes at 1 year follow-up, allowing him to use his upper limbs and ambulate in a wheel chair independently. This supports the idea that even delayed or neglected injuries in a quadriplegic patient should still be surgically decompressed and stabilized to provide the best possible outcome for patient’s neurologic recovery.

Fig. 3: X-rays and CT scan at 1 year follow-up showing boney fusion and maintained position of hardware

Fig. 4: At 1 year follow-up. Patient is able to use his upper limbs and ambulate in a wheel chair independently
Patient demands and mortality rates are much higher in quadriplegic patients compared to semi-independent paraplegics. Thus, achieving any additional functional outcomes from delayed surgery is invaluable to patient’s quality of life. Awareness of healthcare providers in underdeveloped areas about surgical options and chances of recovery is crucial to avoid delayed care in time-critical patients.

While autologous bone grafting using iliac crest is considered the gold standard to achieve solid fusion in the spine. Donor site morbidity is a true concern, leading to chronic pain, hematoma, infection, visceral herniation, and sensory nerve injury.12

As in this case where corpectomy is done, it is advisable to preserve vertebral body cancellous bone as a graft for filling the cage. Burring out the vertebral body completely would necessitate a separate incision to obtain an iliac crest bone graft with associated morbidities and possible complications.

Other learning points in this case include insertion of the screws through the vertebral endplates above and below the cage in a diverging angle provide stronger screw purchase in the sclerotic cortical bone of the endplates as opposed to a higher entry point straight trajectory in the cancellous bone only.

Additionally, this technique ensures the use of the shortest plate possible in-front of the cage, thus decreasing the chances of adjacent segment disease. Also, while it was not necessary in this case, leveling the upper endplate of the lower vertebra using the burr can ensure an even and horizontal surface for the cage to sit on which further adds to construct stability. It is important to note, however, that excessive burring can destroy the sclerotic endplate and expose the soft cancellous bone below, leading to cage sinking into the vertebral body.

**Conclusion**

- Delayed decompression and fixation for spinal cord injury following subaxial cervical trauma can yield acceptable outcomes and precious functional gains as seen in this case report.
- Anterior-only decompression and fixation can provide sufficient stabilization of subaxial cervical trauma.
- Adjustment of the technique and construct to use the shortest possible plate and using diverging screws through the endplate can provide sufficient stabilization and avoid adjacent segment disease.
- Excellent bone fusion can be achieved using saved corpectomy bone without the need for additional iliac crest bone grafting.

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