

Post Traumatic Anterolisthesis of Sub Axial Cervical Spine: A Case Series with Literature Review

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Abstract

The term anterolisthesis refers to anterior displacement (forward slip) of a vertebral body relative to the one below. Cervical anterolisthesis is defined as the dislocation of the spinal column most often caused by trauma.

This study includes a case series and literature review. We studied 10 cases of post-traumatic cervical anterolisthesis in the sub axial cervical spine and reviewed the literature, which largely consists of isolated case reports.

Based on the 10 cases from the literature and our experience of three cases, we obtained the following results.

The sub axial cervical spine C7–T1 was the most common location of anterolisthesis (n=4/10). Though the injury could be seen in various age groups (32–67 years), it was most common in middle-aged people (mean age, 45 years) and males, with road traffic accidents being the most common cause because of the nature of force required for this injury to occur. 6 patients were classified as category 1 and 4 were classified as category 2. As expected, all category 1 patients had a complete injury and category 2 patients showed incomplete or normal neurological status on presentation.

The majority of cervical injuries occur in the sub axial spine (approximately 65% of fractures and more than 75% of all dislocations). This study found an overall success rate of traction achieving a reduction of 80% and a permanent neurologic complication rate of 1%, with a 2% rate of transient neurologic deterioration. It found that the causes of deterioration were not limited to disk herniation. Such causes also included over distraction, spinal cord edema, and a more rostral noncontiguous injury.

Sub axial cervical anterolisthesis is a common injury with varied clinical presentations. Management of these patients requires the most care in terms of methods of reduction of the fracture and subsequent surgical stabilization.

Keywords: Anterolisthesis, post-traumatic effects, neurological complications

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Introduction

The term anterolisthesis refers to anterior displacement (forward slip) of a vertebral body relative to the one below. Cervical anterolisthesis is defined as the dislocation of the spinal column most often caused by trauma. Due to compression or transection of the spinal cord, severe neurological deficits are common.

Here, we review the literature and report a case series of post-traumatic anterolisthesis that was successfully treated using an anterior-only surgical approach[1].

Patients present with varied neurological statuses, ranging from complete quadriplegia to normal clinical features. Knowledge of this clinical history is necessary for the proper management of these patients. Most of the literature related to this condition includes isolated case reports. Three patients with anterolisthesis presented to our trauma center over a period of 1 year[2].

We have reviewed the available literature and presented it along with the experience of these three cases, including the clinical features, biomechanics, and management strategies[3].

Materials and Methods

This study includes a case series and literature review. We studied 10 cases of post-traumatic cervical anterolisthesis in the sub axial cervical spine (Table-1) and reviewed the literature, which largely consists of isolated case reports. Our three cases were added to this list to help understand the clinical features and summaries' management strategies for this rare condition (Table-2).

Analysis was carried out in terms of the neurological status on presentation, level involved, method of reduction spine, whether surgery was performed or not, and the complications faced during the management of each of these cases.

Based on clinical presentation, the patients were divided into two groups. Patients in group 1 had a complete cervical injury on presentation, and MRI report showed a cord transection at the level of injury. Patients in category 2 had a partial injury or normal neurological status at presentation, and the cord showed an almost normal lordotic curve (Figure-1).

All the patients presenting to our trauma center unit had a complete injury and were classified as group 1. one patient is already operated on, other one patient achieved reduction with closed methods but could not be operated on due to severe respiratory distress. For the third patient, the complete reduction could not be achieved by using a closed method, so an open reduction with anterior fusion was carried out. The outcomes for all the patients were very poor due to the nature of the injury to the cord and the involvement of spinal structures.

The review of the literature showed that patients can present with incomplete injuries and even with normal neurology, in which case management has to be more important.

This study aimed to highlight these problems and suggest the best protocol for the management.

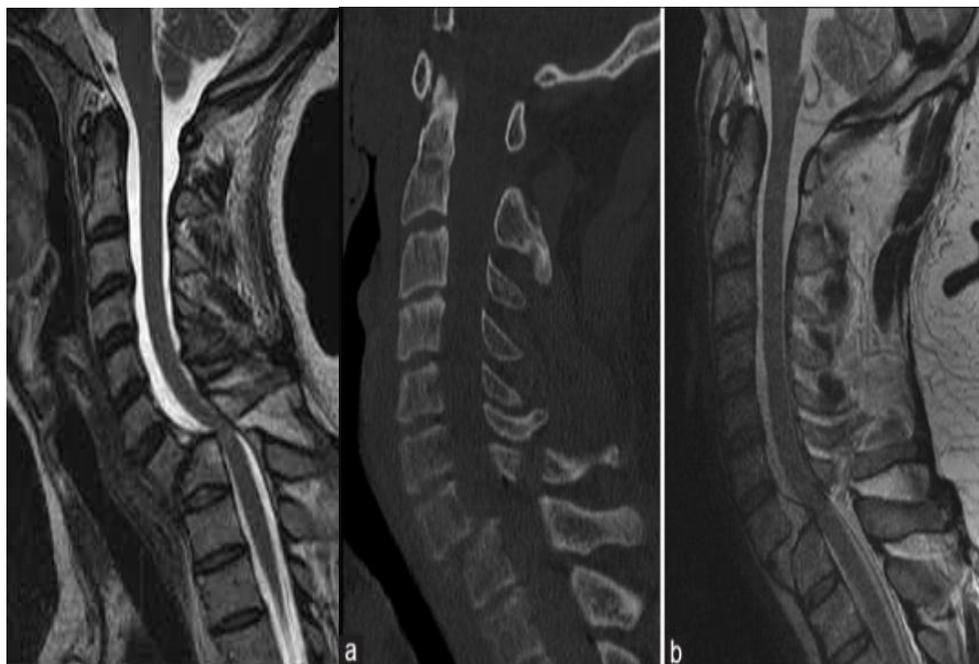


Figure 1: The new classification based on the status of the spinal cord.

(A) Spinal cord Pinched suggestive of severe cord damage.

(B) Maintenance of the lordotic sagittal alignment of the cord.

Table 1: The traumatic sub axial cervical anterolisthesis cases observed at our Trauma center

ASIA, American Spinal Injury Association Classification.

No	Age/ Sex	Cervical level	Clinical presentation	Clinical Improvement	Method of Reduction	Surgery	Complication
1	40 M	C5-6	ASIA-A	ASIA-A	Closed Reduction with 5 kg	Not operated	None
2	45 M	C5-6	ASIA-A		Close Reduction Failed open done	ACDF	Spasticity Bedsore
3	52 M	C6-7	ASIA-A		Open Reduction	ACDF	Spasticity, Bed sore

Table 2: The traumatic sub-axial cervical anterolisthesis cases in literature along with the management of these cases.

S. N.	Study	Age/ Sex	Level	Clinical Presentation	Clinical Improvement	Method of Reduction	Surgery	Complication
1	Lee et al	65M	C7T1	ASIA_D	ASIA	Open	ACDF	CSF Leak
2	Ozdogan et al.	67M	C3-4	ASIA E	ASIA E	Closed	PCDF	Initial deterioration
3	Menuk et al	35M	C6-7	ASIA E	ASIA E	None	ACDF	No
4	Gasco et al	45M	C4-5	ASIA E	ASIA E	Open	ACDF	No
5	Ahn et al	32M	C7T1	ASIA E	ASIA E	Closed	PCDF	No
6	Munakomi et al	56F	C7T1	ASIA E	ASIA E	Failed	ACDF	No
7	Tumialan et al	39M	C7T1	ASIA E	ASIA E	Closed	ACDF	No

ASIA, American Spinal Injury Association Classification; CSF, cerebrospinal fluid; B/L, bilateral.

Results

On the basis of the 10 cases from the literature and our experience of three cases, we obtained the following results.

The sub axial cervical spine C7–T1 was the most common location of anterolisthesis (n=4/10). Though the injury could be seen in various age groups (32–67 years), it was most common in middle-aged people (mean age, 45 years) and males, with road traffic accidents being the most common cause because of the nature of force required for this injury to occur. 6 patients were classified as category 1 and 4 were classified as category 2. As expected, all category 1 patients had a complete injury and category 2 patients showed incomplete or normal neurological status on presentation. Various methods of management were employed, which included initial closed reduction followed by various methods to stabilize the spine of the six patients in which closed reduction was attempted, only four were successfully reduced; one is required conversions to open surgery, and one patient developed neurological deficit on traction so the

intervention was discontinued. One patient was managed conservatively, and in the other three patients no attempt at closed reduction was made (Fig 2). The methods of Management used included conservative (n=1), anterior surgery only (n=7), anterior discectomy followed by posterior instrumented fusion followed by anterior fusion (n=1), anterior fusion followed by posterior instrumented fusion (n=1). The neurological outcomes remained the same as before the interventions irrespective of the methods of reduction and surgery used. There were various complications associated with the management of these patients including one report of intraoperative Dural tears that were managed uneventfully with lumbar drain. Patients in category 1 had a worse prognosis with no improvements in neurological status, and complications associated with spinal cord injuries, such as severe spasticity and bedsores, and comorbidities that led to mortality in two out of four patients within six months of Instrumentation.

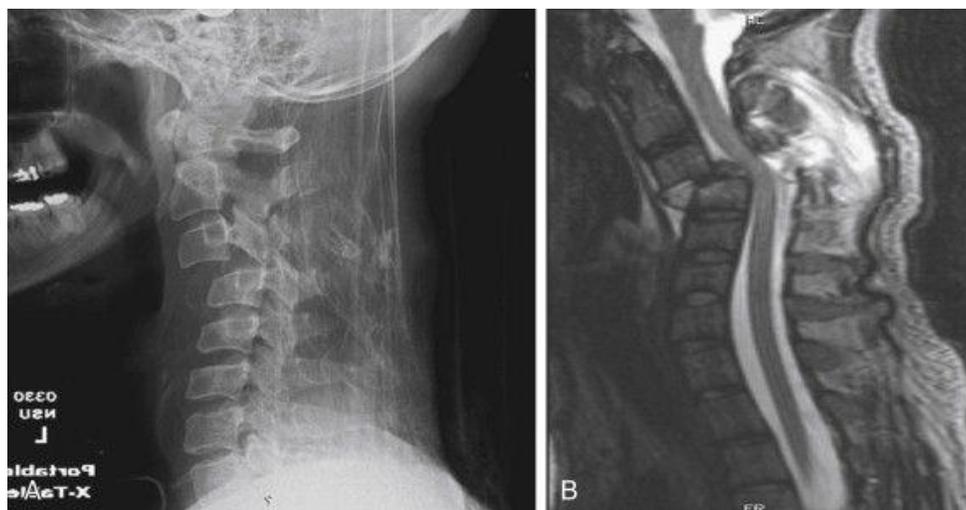


Figure 2: (A, B) *Severe sagittal malalignment complication was seen in a patient that presented to us after a delay in treatment.*

1. Biophysics and condition of the spinal cord on MRI

In the sub axial cervical spine, the ligamentous structures provide a check of hypermobility during normal motion. For example, the anterior longitudinal ligament and ventral annulus become taut during extension, whereas the posterior column ligamentous structures act as a tension band during flexion. Compressive loads are resisted by the vertebral bodies, intervertebral discs, and facet joints. Pure tensile loads are resisted by the annulus, interspinous ligament, ligamentum flavum, and facet capsules. Flexion is resisted by the interspinous ligaments, facet capsules, facet joints, anterior longitudinal ligament, and posterior annulus. The extension is also resisted by the bony block of the facet joints. The maximal sagittal plane translation occurring under physiologic loads is 2–2.7 mm.

Cervical anterolisthesis is a type of compressive extension five-stage injury. It involves bilateral vertebral arch fracture with anterior displacement of the full vertebral body. Ligamentous failure occurs at two levels, posteriorly between the suprajacent

and fractured vertebra and anteriorly between the fractured vertebra and the subjacent one. Despite this, the cord is sometimes spared compression or is subjected only to a mild compression due to the spontaneous decompression of the cord by the fractured posterior elements. However, as found in all of our three patients with complete injury (ASIA-A), the cord was found to be severely contused with edema and extensive soft-tissue edema in the paraspinal region. This suggested a high degree of trauma. The cord was compressed between the anterior vertebral body of the inferior vertebra and the posterior elements. In addition, the anterior ptosis of the superior vertebral body with the bi-pedicular fracture carrying the cord anteriorly led to the so-called pincer phenomenon. In the patients with intact neurological status, however, the cord remained in a lordotic position and was not shifted anteriorly along with the superior vertebral body. The fact that this injury has different presentations could thus be explained by the lack of shift or maintenance of the lordotic shape of the cord in category 2 patients (Fig. 1). Gasco et al. showed in a case report that in spite of intact posterior

elements, a patient continued to have an intact neurological status with an *in-situ* fusion after eight months of sub axial. The cord maintaining its near-normal contour seems to be an important factor in the neurological presentation of these patients. Although this study included only a small number of patients, the classification may be a useful method for categorizing and managing these patients. Increasing the number of cases studied will help to assess the validity of this classification.

Discussion

The majority of cervical injuries occur in the sub axial spine (approximately 65% of fractures and more than 75% of all dislocations)[4]. The reported causes of anterolisthesis include an ongoing pathological process of an aneurysmal bone cyst, Klippel-Feil syndrome, neurofibromatosis, absent posterior elements, and, importantly, birth trauma. Isolated traumatic anterolisthesis in the cervical spine has been reported sporadically [5]. However, the reason for this may be not only the rarity of the injury but also the poor outcomes for these patients and a lack of data reporting, especially in developing countries. In our trauma center, one must be familiar with the scientific management of these patients as they present differently, and inappropriate management can be disastrous. In our trauma center unit, we have treated 50 patients with Anterolisthesis out of a total of 200 patients with cervical spinal injuries over a period of one year; this suggests that the injury may be much more common than is reported. There is a lack of literature on the management of these injuries; most are sporadic case reports. A literature study of 1,200 cases by the American Association of Neurological Surgeons reported only level III evidence on the use of closed reduction as a tool to reduce fracture-dislocation in patients with cervical dislocation [6]. This study found an overall

success rate of traction achieving a reduction of 80% and a permanent neurologic complication rate of 1%, with a 2% rate of transient neurologic deterioration. It found that the causes of deterioration were not limited to disk herniation. Such causes also included over distraction, spinal cord edema, and a more rostral noncontiguous injury. The authors noted that the number of deteriorations due to disk herniation in awake patients undergoing closed reduction was extremely small. Considering these data even in patients with, anterolisthesis the author recommends an initial trial of closed reduction by a sequential increase in weight with continuous monitoring of the neurological status of the patient. However, this should not be attempted, or the attempt should be abandoned, in patients in whom there is a deterioration in neurology or in whom an awake analysis of neurological status is not possible.

For patients in whom closed reduction fails, the open reduction can be achieved by either a posterior approach or by an initial anterior discectomy to decompress the cord and to prevent any further compression of the cord while reduction by retropulsion of the disc fragments followed by posterior reduction or an *in situ* anterior fusion is carried out. The opinion in the literature is divided on how to manage these patients, ranging from conservative care or anterior fusion only, to an anterior discectomy followed by posterior instrumented fusion and again anterior fusion. However, in each of the literature reports, the outcome of the patient did not have any relation to the method of treatment used. Accordingly, in category 1, the outcomes of the patients remained poor due to the pinched cord and severe hemorrhage and edema in the spinal cord, so these patients benefit from a more conservative approach such as an attempt at a closed reduction with continuous neurovascular status monitoring and close

monitoring of the patient's general condition and vitals, especially respiratory function. These patients can be managed well by anterior fusion surgery only and avoiding prolonged surgery, as seen in one of our patients. In category 2, we recommend an initial MRI scan before reduction is attempted, followed by a controlled attempt at reduction under strict neurovascular monitoring.

An attempt should be made to at least partially reduce the dislocation. In case of any deficit observed on the sequential increase in weight, the attempt should be aborted and surgery planned. The appropriate surgical methods are controversial, with every approach having pros and cons. However, considering the biomechanics, an initial anterior discectomy followed by a posterior reduction (if not reduced with instrumented fusion) followed an anterior fusion procedure seems to be the most appropriate as it provides the best stability and also prevents any chance of disc compression while the reduction is done in the prone position [7].

In patients in whom complete reduction is achieved, management by anterior discectomy and fusion followed by posterior instrumented fusion can be used the most common complication was Dural injury with cerebrospinal fluid leakage, which was managed in both cases by standard management. Another complication that should be borne in mind is possible vertebral artery injury, especially while using the posterior approach for reduction.

Conclusions

Sub axial cervical anterolisthesis is a common injury with varied clinical presentations.

Management of these patients requires the most care in terms of methods of reduction of the fracture and subsequent surgical stabilization. Classification of this fracture on the basis of the MRI and clinical presentation is meaningful to understand the nature and prognosis of the cervical spinal cord injury and can be useful for the management of these patients.

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