



Case Report

A novel technique of managing an irreducible posteriorly displaced type 2 odontoid fracture: A case report

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ABSTRACT

Background: Type 2 odontoid fractures with posterior displacement are rare. Most acute cases reported in the literature are readily reduced with traction alone. Here, we reviewed the management of a chronic, posteriorly displaced odontoid fracture that was managed with a unique posterior reduction maneuver.

Case Description: A 58-year-old male with a chronic type 2 retro-odontoid displaced fracture was managed with traction and an anterior force applied to the displaced odontoid fragment using rods attached to bilateral C1 lateral mass screws. Notably, this included a simultaneous cantilever maneuver using a lever placed between the C1 and C2 facet joints. Following reduction, an atlantoaxial fusion was performed. The postoperative course of the patient was uneventful and the bone union was achieved in 1 year.

Conclusion: Closed reduction is rarely successful in chronic posteriorly displaced type 2 odontoid fractures. These cases require meticulous open reduction and fixation.

Keywords: Atlanto-axial fusion, Bone union, Lateral mass, Odontoid, Reduction technique

INTRODUCTION

Displaced type 2 odontoid fractures are associated with a higher risk of nonunion due to interruption of the blood supply and displacement. Posterior displacements of the proximal C2 fragment are rare, and those reported in the literature were typically acute, effectively responding to closed reduction. Here, a 58-year-old male presented with a chronic posteriorly displaced odontoid fracture and was successfully managed with a posterior approach and a unique reduction technique.

CASE REPORT

Clinical presentation

A 58-year-old male had a history of a fall 3 weeks ago. He presented with complaints of severe neck pain, throbbing headache, and tingling numbness involving all four extremities. The

patient's neurological examination revealed grade 4/5 power in bilateral shoulders (ASIA Grade D) and hyperreflexia involving all four extremities (i.e., grade 2 spasticity involving all limbs as per the Modified Ashworth Scale).

Radiological studies

Lateral and open-mouth radiographs showed a posteriorly displaced type 2 odontoid fracture [Figure 1]. The computed tomography (CT) demonstrated a posteriorly displaced odontoid fragment sitting in the spinal canal. There was displacement of the anterior C1 arch posterior to the axis vertebral body. The magnetic resonance scan showed the fragment compressing the spinal cord [Figure 2]. The CT angiogram showed a dominant left vertebral artery; there was no evidence of any vascular injury.

A trial of closed reduction

Under general anesthesia, on Jackson's table, a closed reduction was attempted in the supine position using Gardner–Well tongs/skull traction without neuromonitoring. After three unsuccessful attempts at reduction (10 kg,

increased to 25 kg, followed by sustained traction for 30 s with flexion), the option of traction was abandoned.

Open reduction via the posterior approach

With neuromonitoring and through a midline posterior approach, the atlantoaxial complex was exposed. Under fluoroscopy, bilateral lateral mass screws were initially passed in the C1 lateral masses. Rods were attached to the screws so that a forward thrust maneuver could be utilized during reduction. Under fluoroscopic control, a blunt and long periosteal elevator was passed underneath the C1 lateral

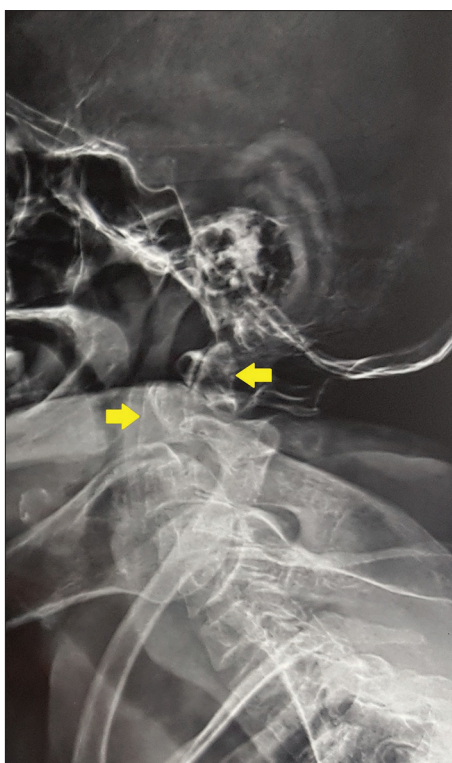


Figure 1: A lateral radiograph of the cervical spine shows the presence of a type 2 odontoid fracture fracture with a posterior displacement of the proximal fragment (the yellow arrow at the top shows the posteriorly displaced proximal odontoid fragment).



Figure 2: Magnetic resonance imaging scan of the cervical spine shows the posteriorly displaced proximal odontoid fragment impinging on the canal resulting in cord compression and the intact relationship between the anterior arch of C1 and the odontoid process (the yellow arrow at the top shows the posteriorly displaced proximal odontoid fragment).

mass to the anterior border of the C2 lateral mass on either side to correct the dislocation between C1 and C2 (i.e., using a cantilever mechanism). Simultaneously, guarded longitudinal traction was provided to correct the overriding at the fracture site. An anteriorly directed force was applied to the rods from the posterior aspect to push the posteriorly displaced fragment anteriorly; the reduction was confirmed under fluoroscopy. Next, bilateral pedicle screws were placed in C2 followed by a C1–C2 fusion [Figure 3].

Postoperative course

The patient’s neck pain improved postsurgery and the patient’s neurological examination showed maintained grade 4/5 motor function in bilateral shoulders, and a reduced grade 2 spasticity (i.e., from the prior grade 4) in all four extremities as per the Modified Ashworth Scale. The patient was immobilized in a soft cervical collar for 3 months. At 1 year, the patient was neurologically intact except for residual grade 1 spasticity and hyperreflexia involving all four extremities. Radiographs and CT scans at 1 year showed healing at the fracture site and fusion across the C1–C2 joints [Figures 4-7].

DISCUSSION

Odontoid fractures are the most common fractures in the geriatric cervical spine and are challenging to manage in the elderly;^[6] they also account for about 55% of all axis fractures,^[2] and are most commonly type 2.

The mortality associated with these fractures is high, especially in elderly patients who have been managed with halo vests.^[4,7] Although axial traction with manipulation under fluoroscopy is usually successful in reducing mildly displaced fractures, this may fail with severe displacement.

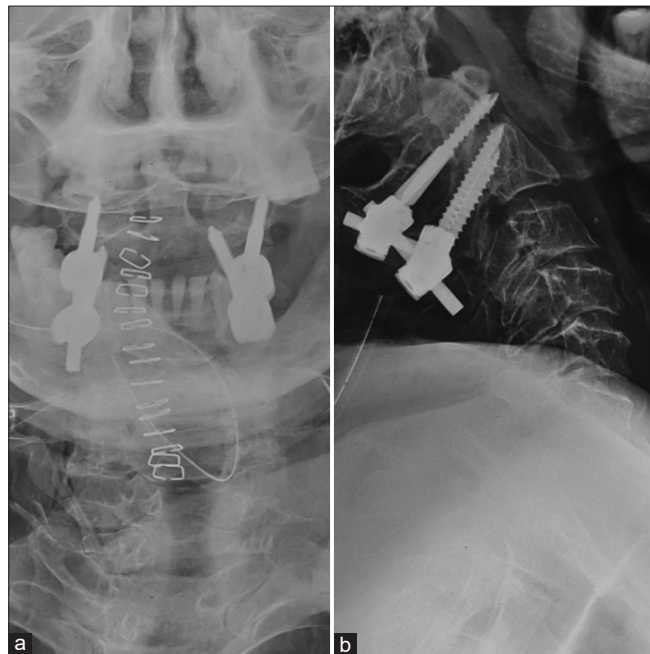


Figure 3: (a and b) Postoperative anteroposterior and lateral radiographs showing the reduced odontoid fracture fixed with screws followed by a C1–C2 fusion.

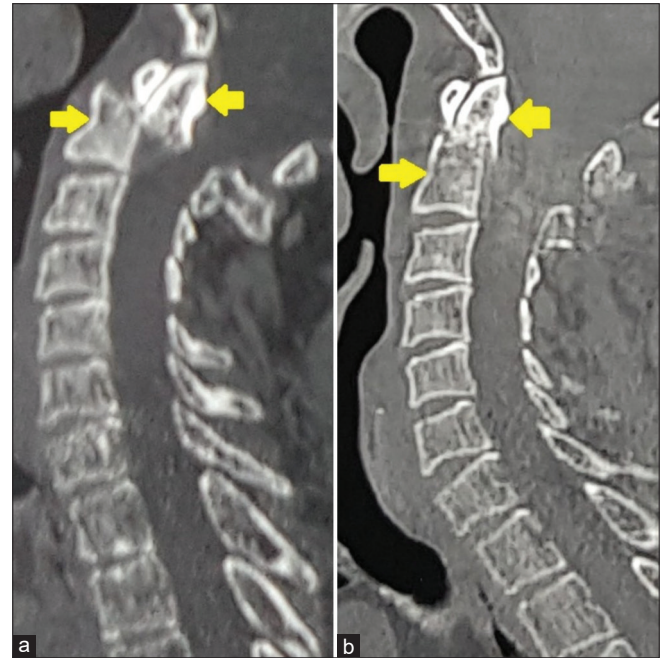


Figure 4: (a) Preoperative computed tomography (CT) scan shows the posteriorly displaced proximal odontoid fracture fragment (the yellow arrow at the top shows the posteriorly displaced proximal odontoid fragment). (b) Postoperative CT scan shows the reduced odontoid fracture.

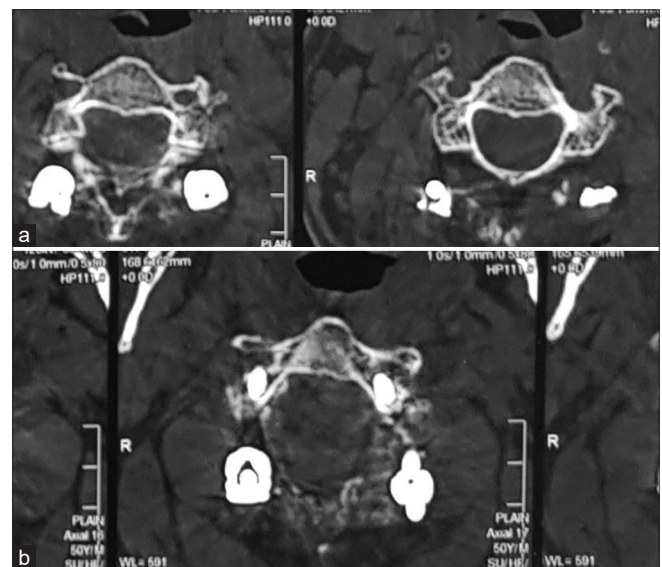


Figure 5: (a and b) Postoperative axial computed tomography scan cuts show the trajectory of screws.

Table 1: Review of the literature.

| Author | Year | Conclusion |
|-----------------------------------------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lewallen <i>et al.</i> ^[3] | 1984 | Three out of four patients suffered a fatal respiratory arrest due to the use of traction for odontoid fractures that were posteriorly displaced |
| Przybylski <i>et al.</i> ^[5] | 2000 | 14 out of 53 patients with displaced odontoid type 2 fractures suffered from respiratory arrest after the application of skeletal traction for reduction probably because of the use of flexion during the reduction in the in the background of retropharyngeal edema |
| Wang <i>et al.</i> ^[8] | 2011 | Direct reduction of a posteriorly displaced odontoid fracture was obtained by directly holding the C1 anterior arch by a Kocher's forceps and applying an anteriorly directed force via a trans-oral approach |
| Present report | 2023 | A chronic posteriorly displaced type 2 odontoid fracture that was not amenable to closed reduction was managed with open reduction using an all-posterior approach by a unique reduction technique and without any untoward longitudinal traction |



Figure 6: (a) Postoperative sagittal computed tomography (CT) scan cut demonstrates the trajectory of the screws passed in C1 and C2. As we used two-dimensional imaging, the screws passed in C1 were caudal and slightly longer, but they had a strong hold in the lateral mass. (b) Postoperative coronal CT scan cut shows the placement of the screws in the coronal plane.

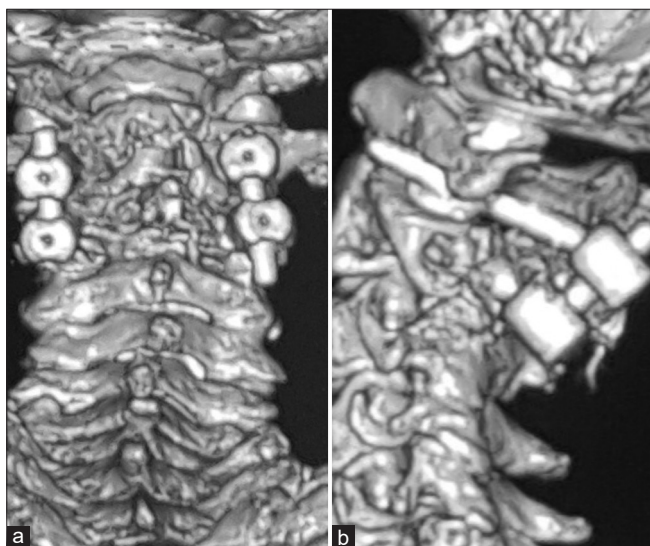


Figure 7: (a and b) Reconstructed 3D images of the postoperative computed tomography scan.

A displacement of the dens of 6 mm or more is associated with the greatest risk of nonunion and thus, requires early surgical intervention.^[1] In our case, the odontoid fracture fragment was 100% posteriorly displaced and there was a significant overlap of the two fracture fragments. In such cases, increasing traction (i.e., increasing weight) could have fatal consequences as reported by one study, where three out of four patients suffered a fatal respiratory arrest.^[3] Multiple attempts at reduction were not recommended.

Failed closed reduction of chronic posteriorly displaced type 2 odontoid fractures

In our case, the patient had a chronic posteriorly displaced type 2 odontoid fracture that had failed to reduce with routine external traction. Interestingly, Przybylski *et al.* showed that 14 out of 53 patients with displaced type 2 odontoid fractures developed respiratory arrest following attempts at closed reduction with skeletal traction.^[5] This was most likely due to the use of flexion during reduction in the background of retropharyngeal edema. They suggested that elective nasotracheal intubation might be required during closed reduction of posteriorly displaced type 2 odontoid fractures requiring a flexed posture.

Use of open reduction for posteriorly displaced type 2 odontoid fractures

Few reports mention open reduction to treat posteriorly displaced type 2 odontoid fractures. In one case, the reduction was obtained by directly holding the C1 anterior arch by a Kocher's forceps and applying an anteriorly directed force.^[8] Using the unique reduction method described in the present report, we avoided a morbid trans-oral approach and achieved indirect reduction by taking advantage of the intact relationship between the anterior

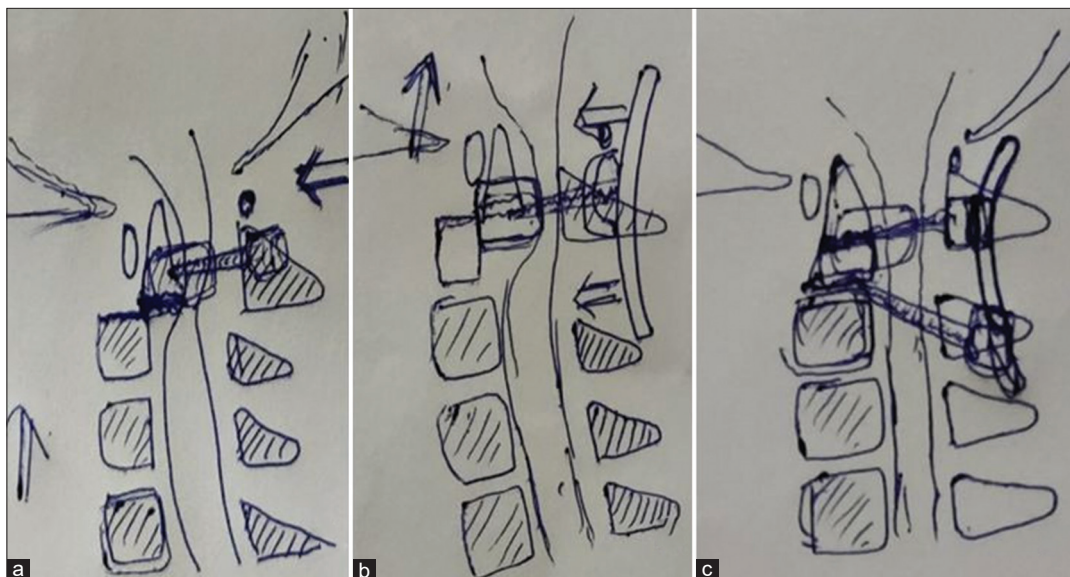


Figure 8: (a) Lateral mass screws have been passed in C1. (b) Rods have been attached to the screws and an anteriorly directed force is applied to the rods to push the posteriorly displaced proximal odontoid fragment anteriorly, along with simultaneous guarded longitudinal traction. (c) After reduction has been achieved, bilateral pedicle screws have been passed in C2 followed by an atlantoaxial fusion.

arch of C1 and dens. As the atlas and the fractured odontoid fragment were behaving as a single unit (i.e., intact alar and apical ligaments), we maneuvered the lateral masses of the atlas back on the facets of the axis, thus resulting in the reduction of the posteriorly displaced odontoid fragment back into position, and thus, decompressing the spinal canal [Figure 8]. A comparison of the different studies described above is shown in Table 1.

CONCLUSION

Chronic posteriorly displaced type 2 odontoid fractures are challenging cases that are usually irreducible with external traction and may require reduction using an open posterior approach.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The author(s) confirms that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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