ScientificScholar®
Knowledge is power
Publisher of Scientific Journals

www.surgicalneurologyint.com

Surgical Neurology International

Editor-in-Chief: Nancy E. Epstein, MD, Clinical Professor of Neurological Surgery, School of Medicine, State U. of NY at Stony Brook.

SNI: Spine

Editor
Nancy E. Epstein, MD
Clinical Professor of Neurological Surgery, School of Medicine, State U. of NY at Stony Brook

SNI
Open Access

Original Article

Anterior transcervical release with posterior atlantoaxial fixation for neglected malunited type II odontoid fractures

Riaz Ur Rehman[1], Muhammad Shaheer Akhtar[1], Amna Bibi[2]

[1]Department of Neurosurgery, Lady Reading Hospital, [2]Department of General Surgery, Hayatabad Medical Complex, Peshawar, Pakistan.

E-mail: Riaz Ur Rehman - drriazurrehman@yahoo.com; *Muhammad Shaheer Akhtar - muhammad.shaheer.akhtar@gmail.com; Amna Bibi - amnab12@hotmail.com

***Corresponding author:**
Muhammad Shaheer Akhtar,
Department of Neurosurgery,
Lady Reading Hospital,
Peshawar, Pakistan.

muhammad.shaheer.akhtar@gmail.com

Received : 06 March 2022
Accepted : 20 March 2022
Published : 08 April 2022

DOI
10.25259/SNI_237_2022

Quick Response Code:

ABSTRACT

Background: Type 2 odontoid fractures are associated with a high rate of nonunion without surgical treatment. If neglected, they may become fixed in an abnormal position, causing progressive myelopathy. Conventionally, odontoidectomy or transoral release is performed to relieve symptoms in such cases. Here, were report our experience with a transcervical approach for odontoid release (i.e., of a chronically fractured dens) followed by a posterior C1–C2 fusion.

Methods: The 11 patients (2017–2021) retrospectively included; in this study, all had a history of remote trauma and the radiological appearance of an old odontoid fracture that was displaced and could not be reduced with traction. There were eight males and three females who averaged 52.6 years of age.

Results: All 11 patients underwent anterior retropharyngeal release with a C4–C5 level incision followed by a posterior C1–C2 fusion. The mean Japanese orthopedic association on presentation was 9.9 ± 2.7 which improved to 13.8 ± 2.7 on final follow-up ($P < 0.01$). Patients were followed an average of 9.6 months ± 4.4 (mean ± SD) postoperatively during which time they all clinically improved.

Conclusion: Anterior release through a retropharyngeal approach coupled with posterior C1–C2 instrumentation proved to be an effective alternative to the traditional transoral approach to treat a chronic malunited odontoid fracture.

Keywords: Atlantoaxial instability, IAAD, Irreducible atlantoaxial dislocation, Irreducible dislocation, Odontoid fracture

INTRODUCTION

C2 fractures comprise 9–20% of all cervical spine fractures.[2] Most studies have focused on the treatment of these fractures during the acute stage. However, when timely management is not instituted, the fractured dens may become fixed in an abnormal position, leading to a progressive myelopathy, and/or neck pain.[4] If these fractures cannot be reduced by traction, they may require anterior decompression or transoral odontoid release followed by a posterior C1–C2 instrumented fusion.[4,8] Here, were report our experience with a transcervical approach for odontoid release (i.e., of a chronically fractured dens) followed by a posterior C1–C2 fusion.

MATERIALS AND METHODS

Demographics and patient presentations

Of the 11 patients included in this study, there were eight males and three females. The mean age was 52.6 years (33–71 years). All patients had a history of head or neck trauma, and the mean time from injury to presentation was 4.7 years (range: 6 months–15 years) [Table 1]. The most common presenting signs and symptoms were neck pain, gait abnormalities, limb weakness, paresthesia, and sphincter dysfunction. The mean Japanese orthopedic association (JOA) score on presentation was 9.9 ± 2.7 (mean ± SD) [Table 2]. Imaging studies included; dynamic cervical X-rays, MR, and CT examinations confirming chronic angulated type 2 odontoid fractures.

Statistical analysis

Data analysis was performed using the IBM SPSS 21. JOA scores were compared using a paired sample *t*-test. $P < 0.05$ was considered significant.

RESULTS

Surgery

Eleven patients (2017–2021) underwent transcervical odontoid release followed by C1–C2 posterior fixation [Table 3]. A horizontal incision was centered over the medial edge of the sternocleidomastoid muscle at the C4–C5 level. We used a gloved finger to identify the depression between the fractured odontoid and the C2 vertebral body; this was confirmed on a lateral X-ray [Figure 1a]. An attempt at blunt dissection between the posterior surface of the C1 arch/odontoid complex and the C2 vertebral body failed due to release adhesions. They had to be "broken" using a small chisel and mallet under direct radiological guidance [Figure 1b]. The lower surface of the odontoid and the upper surface of the C2 vertebral body were then curetted to prepare for fusion. Direct pressure over the C1 tubercle and cranial traction was subsequently applied; nevertheless, full reduction of the fracture could not be achieved. Next, the patient was turned prone, and the C1–C2 facet joints were opened and curetted to release adhesions. After adequate reduction, a C1–C2 instrumented fusion was performed using C1 lateral mass and C2 pedicle screws. Grafts were taken from C2 spinous process and occiput to complete the fusion mass [Figures 1c and d]. Although all procedures were performed without neuromonitoring or navigation, the additional use of both of these modalities is recommended to enhance surgical safety. A cervical collar was placed for just a few days postoperatively, and X-rays showed adequate reduction of the fracture.

Table 1: Demographics and presentations.

Variable	Value
Mean age (years)	52.6±11.4* (Range: 33 years–71 years)
Gender	
Male	08 (73%)
Female	03 (27%)
Symptoms	
Neck pain	08 (73%)
Gait abnormality	08 (73%)
Limb weakness	06 (54%)
Sensory symptoms	07 (63%)
Bladder symptoms	04 (36%)
Time from injury (years)	4.7±4.8* (Range: 6 months–15 years)
Follow-up duration (months)	9.64±4.4* (Range 3 months–6 months)

*Mean±Standard deviation

Table 2: Comparison of preoperative and postoperative JOA scores.

Clinical score	Preoperative	Follow-up	Difference	*P*-value
JOA score	9.9±2.7*	13.8±2.7*	3.9±2.2*	**<0.001**

*Mean±Standard deviation. JOA: Japanese orthopedic association

Postoperative follow-up

At mean follow-up of 9.6 postoperatively months, CT scans showed good alignment and reduction [Figures 2-4]. The average JOA score at that time was 13.8 ± 2.7 (mean ± SD) [Table 2]. Postoperatively, one patient developed an infection of the posterior midline wound that was treated with antibiotics and debridement.

DISCUSSION

Type II odontoid fractures have a high rate of nonunion.[7] Transoral decompression with posterior C1–C2 fusion has traditionally been used for irreducible AAD.[4,8] Here, we proposed another alternative treatment for these lesions.

Table 3: Inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
Irreducible atlantoaxial dislocation	Patients with previous surgery of craniovertebral junction
Radiologic appearance of old odontoid fracture	AAD of congenital etiology
History of remote neck trauma (>6 months)	AAD without dens fracture
	OS odontoideum

Table 4: Summary of studies included in discussion.

Study (author, year)	Etiology of IAAD (*n*)	Management	Outcomes
Hao *et al.* 2009.[3]	Old dens fracture: 13 Rheumatoid arthritis: 02 Os odontoideum: 01	Anterior release through oblique incision 2 cm below and parallel to mandible followed by C1 lateral mass, C2 pedicle screw and rod construct.	Follow-up: 23 months. Clinical: neurological "improvement rate"=87.5% Complications: 1 temporary superior laryngeal nerve injury
Wu *et al.* 2010.[9]	Odontoid dysplasia: 3 Old dens fracture: 4 odontoid absence: 1 basilar impression: 1 malunion of odontoid fracture: 1	Stab incision at superior level of thyroid cartilage followed by placement of sequential dilators. A tubular retractor placed over previous dilators was used to perform endoscopic anterior release. This was followed by percutaneous anterior transarticular screw placement.	Follow-up: 12 months Clinical: neurological improvement in all cases Complications: one patient had partial reduction.
Aggarwal *et al.* 2016.[1]	Old dens fracture: 01	Release through an oblique incision between the thyroid notch and hyoid cartilage followed by bilateral posterior C1–C2 transarticular screw fixation.	Follow-up: 1 year. Clinical: complete neurological recovery. Complications: transient dysphagia
Yuan *et al.* 2018.[10]	Total=10 atlantoaxial transverse ligament rupture and old dens fractures.	Submandibular anterior release followed by posterior atlantoaxial reduction, bone graft placement and internal fixation. (C1–C2 screw and rod construct). Study focuses on C1–C2 angulation and reduction parameters.	Follow-up: not available Clinical: mean JOA score improved from 8.8 preoperatively to13.7 at final follow-up. (P<0.05) Complications: not available
Ren *et al.* 2019.[6]	Old dens fracture: 06 Os odontoideum: 04 Transverse atlantal ligament rupture: 03	5-cm transverse incision made 2 cm inferior to the right angle of the mandible for anterior release followed by posterior C1–C2 screw and rod fixation.	Follow-up: 22.8 months. Clinical: mean JOA score improved from 7.85 preoperatively to 14.23 at final follow-up. (P<0.05) Complications: one patient with transient voice change and increased oral discharge.
Klimov *et al.* 2020.[5]	Old dens fracture: 01	Submandibular anterior release and posterior atlantoaxial screw and rod fixation. This was followed by anterior bone graft placement in the same setting.	Follow-up: 1 year Clinical: improvement Complications: none

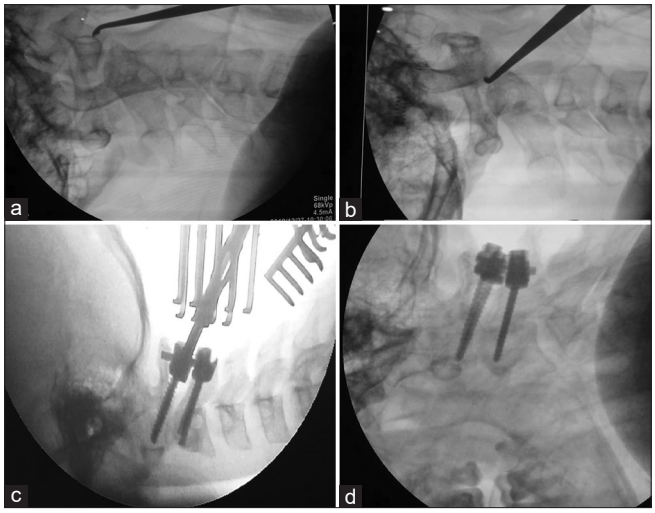

Figure 1: (a) Intraoperative X-ray with patient in supine position. Anterior arch of atlas confirmed with lateral image. (b) Small curette inserted between C2 vertebral body and lower surface of fractured odontoid after release. The surfaces are being prepared for fusion. (c and d) Patient in prone position. C1 Lateral mass and C2 pedicle screws inserted.

Pros of retropharyngeal odontoid release

Several authors have reported on the utility of the retropharyngeal approach for the release of chronic angulated odontoid fractures. Hao *et al.* used an incision that was 2 cm below and parallel to the mandible for an anterior release.[3] Yuan *et al.* used a similar method, but focused on other diagnostic parameters.[10] Ren *et al.* reported their experience with the submandibular anterior release.[6] Aggarwal *et al.*[1] used the same incision and performed posterior fixation with C1–C2 transarticular screws and posterior wiring in one of their two reported cases. Wu *et al.*[9] reported microendoscopic anterior release and anterior transarticular screw fixation in patients with irreducible atlantoaxial dislocation. Klimov *et al.*[5] used a three-stage method with anterior release and posterior fusion, followed by bone graft placement between C1 and C2 again from the anterior approach [Table 4].

Need for accompanying posterior fusion

Following mobilization of the dens, the degenerated C1–C2 facet joints must be opened and released to achieve

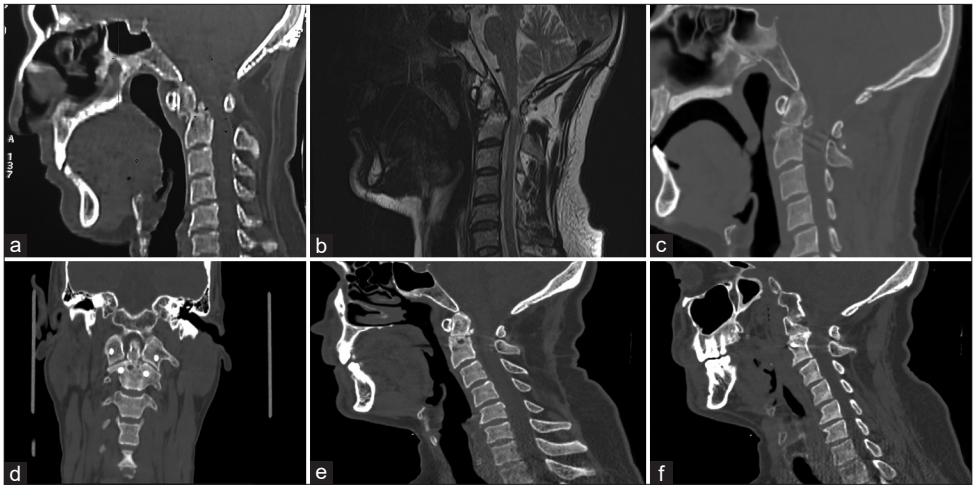

Figure 2: A 60-year-old male with a history of bike accident 7 year ago presented on a wheel chair with a history of progressive weakness and numbness in all four limbs for the past 6 months. (a and b) Preoperative CT and MRI shows old type 2 odontoid fracture with anterolisthesis of C1/odontoid complex on C2 body and some bony fusion with significant cord compression and signal changes. (c and d) Sagittal and coronal CT scan taken in the immediate postoperative period showing alignment of the released odontoid. (e and f) Sagittal and parasagittal CT cuts taken at 1-year postoperative show that the alignment is maintained.

Figure 3: A 56-year-old man presented with clumsy hands, difficulty micturition, and gait disturbance for the past 1 year. The patient had a history of motor vehicle accident with neck injury 15 years ago. (a) Extension lateral radiograph, (b) midsagittal CT scan shows old odontoid type 2 fracture fixed in anterolisthesis and resultant spinal canal narrowing, (c) immediate postoperative X-ray to confirm alignment and screw position and (d and e) coronal and sagittal CT scan taken at 6 months follow-up showing the alignment is maintained.

complete reduction of the AAD and instrumented fixation using a posterior approach. However, unlike patients with congenital AAD, posterior manipulation/fusion alone is usually ineffective in achieving the complete reduction of the malunited remote fractures. This is because the bony and fibrous adhesions between the odontoid and C2 body found

Figure 4: A 37-year-old male with a history of neck pain and clicking, which started after a fall at a construction site 3 years ago presented with progressive upper and lower limb weakness and impaired bowel bladder function. (a and b) Sagittal, parasagittal preoperative views with fixed anterolisthesis of odontoid over C2 body and resultant canal narrowing. (c) Sagittal MRI shows extreme cord compression. (d and e) Flexion and extension radiographs show irreducibility atlantoaxial dislocation. (f) Intraoperative image of posterior C1–C2 fixation being done in the patient following release of odontoid. (g) Postoperative CT showing reduction of the displaced odontoid.

intraoperatively, fixing the fractured dens in anterolisthesis, are not accessible using the posterior approach alone. These findings along with severe C1-2 facet joint degenerative changes justify the dual circumferential procedures, that is, release of both the anterior fixed odontoid malunion and the posterior C1-2 facet joint adhesions followed by posterior fusion.

CONCLUSION

Anterior release through a retropharyngeal approach coupled with posterior C1–C2 instrumentation proved to be an effective alternative to the traditional transoral approach to treat a chronic malunited odontoid fracture.

Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Aggarwal RA, Rathod AK, Chaudhary KS. Irreducible atlanto-axial dislocation in neglected odontoid fracture treated with single stage anterior release and posterior instrumented fusion. Asian Spine J 2016;10:349-54.
2. Greene KA, Dickman CA, Marciano FF, Drabier JB, Hadley MN, Sonntag VK. Acute axis fractures. Analysis of management and outcome in 340 consecutive cases. Spine 1997;22:1843-52.
3. Hao DJ, He BR, Wu QN. One-stage anterior release and reduction with posterior fusion for treatment of irreducible atlantoaxial dislocation. Orthop Surg 2009;1:305-10.
4. Kirankumar MV, Behari S, Salunke P, Banerji D, Chhabra DK, Jain VK. Surgical management of remote, isolated type II odontoid fractures with atlantoaxial dislocation causing cervical compressive myelopathy. Neurosurgery 2005;56:1004-12.
5. Klimov V, Kosimshoev M, Evsyukov A, Stepanenko V, Rzaev J. Surgical treatment of neglected C2 odontoid process fracture with anterior atlantoaxial dislocation. Br J Neurosurg

2020;35:1-5.
6. Ren X, Gao F, Li S, Yang J, Xi Y. Treatment of irreducible atlantoaxial dislocation using one-stage retropharyngeal release and posterior reduction. J Orthop Surg (Hong Kong) 2019;27:1-5.
7. Robinson Y, Robinson AL, Olerud C. Systematic review on surgical and nonsurgical treatment of type II odontoid fractures in the elderly. BioMed Res Int 2014;2014:231948.
8. Wang C, Yan M, Zhou HT, Wang SL, Dang GT. Open reduction of irreducible atlantoaxial dislocation by transoral anterior atlantoaxial release and posterior internal fixation. Spine 2006;31:E306-13.
9. Wu YS, Chi YL, Wang XY, Xu HZ, Lin Y, Mao FM, *et al*. Microendoscopic anterior approach for irreducible atlantoaxial dislocation: Surgical techniques and preliminary results. J Spinal Disord Tech 2010;23:113-20.
10. Yuan SL, Xu HM, Fu LC, Cao J, Yang JK, Xi YM. Sagittal atlantoaxial joint inclination and reduction index values for diagnosis and treatment of irreducible atlantoaxial dislocation. Indian J Orthop 2018;52:190-5.

How to cite this article: Rehman RU, Akhtar MS, Bibi A. Anterior transcervical release with posterior atlantoaxial fixation for neglected malunited type II odontoid fractures. Surg Neurol Int 2022;13:132.