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Case Report

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Navigated Placement of Odontoid Screw for Type 3 Anderson and D'alonzo Fracture Under Fluoroscopy–Technical Case Report

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ABSTRACT

Background: Odontoid fractures, particularly Type III Anderson and D'Alonzo fractures are uncommon but potentially unstable cervical spine fractures. Precision anatomical reduction and screw fixation are paramount to re-establish alignment, ensure fracture healing, and prevent neurological compromise. Navigated anterior odontoid screw fixation is an evolving technique, with limited literature detailing its use in Type III fractures.

Methods: A 60-year-old female patient developed bilateral upper limb weakness and neck pain following a road traffic accident. Motor weakness of the right upper limb was 4/5, and of the left upper limb was 3/5, and tenderness was noted at the level of C2–C3 on clinical examination. Imaging revealed Type III odontoid fracture with posterior subluxation and spinal cord edema. The patient received open reduction and internal fixation with a single anterior odontoid screw under real-time fluoroscopic guidance with a C-arm navigation system.

Results: The operation was performed without complications. Intraoperative navigation provided accurate screw trajectory and optimal reduction. Postoperative imaging confirmed appropriate screw placement and alignment. The patient showed neurological improvement in the early postoperative period.

Conclusion: This case shows that anterior odontoid screw fixation using C-arm navigation is a viable and safe treatment for unstable Type III odontoid fractures. Intraoperative real-time visualization enhances the accuracy of the surgery, reducing the risk of malposition and improving results. This case shows the expanding role of intraoperative navigation in spinal trauma surgery and provides quality evidence to validate its application in cervical spine injury with complex cases.

Key-words: Odontoid fracture, Type III Anderson and D'Alonzo, Anterior screw fixation, C-arm navigation, Cervical spine trauma, Intraoperative imaging

INTRODUCTION

Odontoid fractures are one of the most common cervical spine fractures, especially in the elderly due to bone weakening with age and fall (Guiot and Fessler; Jeanneret and Magerl) [1,2]. Fractures are divided based on the Anderson and D'Alonzo classification type into 3 types, Type III fractures involving facets or side masses at the base of the odontoid extending into the axis body, typically (Stulík *et al*.) [3]. Type III fractures, while fairly uncommon, are unstable by nature and can require long-term external immobilization or surgical stabilization in high-risk individuals (Castro-Castro) [4].

Surgical stabilization of odontoid fractures may be done by an anterior or a posterior approach. Anterior fixation with an odontoid screw is advantageous to preserve atlantoaxial rotation and avoid dissection of the posterior muscles (Jeanneret and Magerl [2]; Patkar) [5]. The intervention is linked to the requirement of obtaining an accurate screw trajectory for optimal

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fracture reduction as well as prevention of neurological or vascular compromise (Pisapia *et al*.) [2,6]. Malreduction Current intraoperative imaging and navigation technology has enhanced screw placement precision in spinal surgery. Image-guided technology like O-arm and cone-beam computed tomography (CBCT) provides better visualization and real-time guidance, minimizing the use of fluoroscopy alone (Starkweather *et al.*; Pisapia *et al.*) [6,7]. While the use of navigated procedures in spine surgery is increasing, there is sparse literature to this point detailing navigated anterior odontoid screw fixation, within Type III fracture. Herein we document a technical report of navigated anterior odontoid screw fixation of a patient with a Type III Anderson and D'Alonzo fracture with a C-arm-based navigation system. The case exemplifies the use of real-time fluoroscopy-assisted navigation to improve the accuracy of screw insertion in anatomically challenging and unstable cervical injuries.

CASE PRESENTATION

One 60-year-old woman presented to the emergency department following a road traffic accident with neck pain and increasing bilateral upper limb weakness. There was no history of head injury, loss of consciousness, seizure at injury, vomiting, or otorrhagia/epistaxis at injury.

On inspection, the patient was awake and hemodynamically stable. There was no external swelling or injury to the adjacent neurovascular structures is a risk of improper use.

or cervical spine deformity. Local tenderness was elicited at the C2–C3 spinous processes. Arm weakness was noted on neurological examination, 4/5 on the right and 3/5 on the left sides as per Medical Research Council (MRC) grading. Lower limb strength and sensory examination were normal. Involvement of the cranial nerves was not observed.

Magnetic resonance imaging (MRI) of the cervical spine demonstrated a fracture at the junction of the odontoid process and the axis body (C2), with posterior subluxation of the fractured odontoid fragment—classical for a Type III Anderson and D'Alonzo fracture. T2-weighted and STIR sequences showed hyperintensity within the spinal cord at the level of the C2 vertebral body, characteristic of spinal cord edema.

Other degenerative changes were identified on MRI:

- A left paracentral disc tear at the C4–C5 level with disc extrusion and caudal migration, resulting in mild spinal canal stenosis, bilateral nerve root compression, and narrowing of the neural foramina.
- A posterior disc osteophyte complex at the C5–C6 level with an asymmetrical disc bulge indenting the anterior subarachnoid space, resulting in mild canal stenosis.
- Asymmetrical disc bulges at the C3–C4 and C6–C7 levels also indent the anterior subarachnoid space.

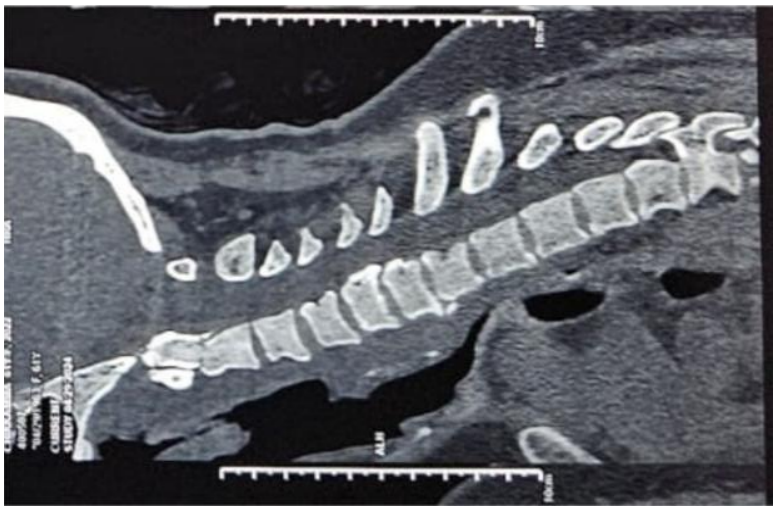

Fig. 1: Pre-operative MRI image showing the Type III odontoid fracture and associated cord signal changes

Due to the instability of the fracture and the neurological presentation of the patient, surgery was warranted. The patient was operated on by open reduction and internal fixation of the odontoid fracture by a single anterior odontoid screw under fluoroscopic guidance with intraoperative navigation.

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Fig. 2: Intraoperative images demonstrating screw placement under C-arm fluoroscopy guidance

The surgery was performed without intraoperative complications. Post-operative radiographs were consistent with the satisfactory placement of the odontoid screw and satisfactory fracture reduction.

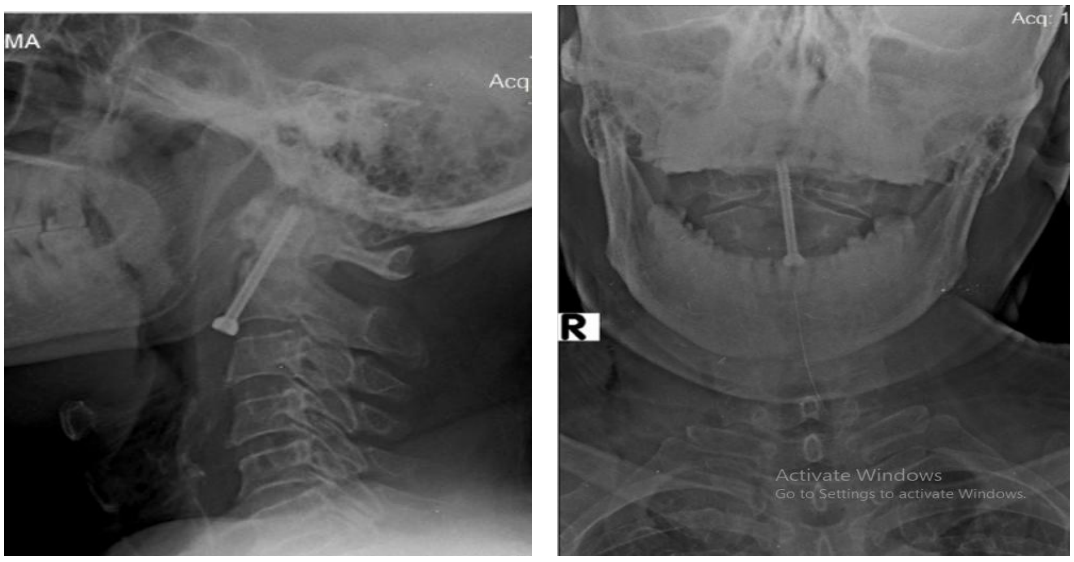

Fig. 3: Postoperative X-ray images confirming screw trajectory and alignment of the odontoid process

The patient was observed postoperatively with neurologic examinations and recommended cervical immobilization. Neurological recovery and postoperative courses were good during early recovery.

DISCUSSION

Odontoid fractures, especially Type III according to Anderson and D'Alonzo's classification, are fairly uncommon but a substantial clinical dilemma considering their inherent possibility of instability and neurological jeopardy. While the more favorable prognosis with Type III fractures is held based on the increased cancellous surface area at the break line, posterior subluxation and surrounding spinal cord edema such as in the presented case, warrant early, accurate surgery.

Anterior odontoid screw fixation provides a motion-preserving solution for the treatment of odontoid fractures, particularly in younger or neurologically complex cases. Nevertheless, the technique's success relies greatly on precise screw placement. Malpositioning may result in poor stabilization or damage to adjacent vital structures. McLain underlined the technical challenges and implications of malpositioned anterior screws, which may necessitate salvage procedures and result in suboptimal results when not adequately addressed [8].

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The application of intraoperative navigation considerably improves the accuracy of screw placement, especially in anatomically challenging areas like the craniovertebral junction. Here, successful use of C-arm-based navigation was made to provide real-time guidance and facilitate a safe and precise trajectory of the odontoid screw. Earlier research has already demonstrated the benefit of navigation-assisted methods. Smith *et al.* also had high accuracy of screw placement with O-arm navigation in atlantoaxial fusion with good results and no neurovascular complications [9]. Likewise, Martirosyan *et al.* showed that isocentric 3D C-arm fluoroscopy enhances the accuracy of anterior screw fixation over conventional biplanar fluoroscopy, especially in attaining optimal screw trajectory and minimizing radiation exposure [10].

In Yuan *et al.* comparative study, anterior screw fixation in fresh Type II odontoid fractures was found to be linked with decreased operative time and C1-C2 motion preservation in comparison to posterior instrumentation without fusion, although patient selection was still important [11]. Still, our case presented with a Type III fracture, the motion preservation and lesser disruption of soft tissue principles justified the choice of anterior screw fixation. Posterior fusion, while stiffer, compromises atlantoaxial motion and might not be the best in functionally active patients.

In addition, the fact that our patient had spinal cord edema reinforced the imperative for immediate decompression and stabilization. Although Bisson *et al.* outlined the healing of fractures pre and post-posterior fusion in Type II odontoid fractures, they also pointed out that fusion precludes direct assessment of radiographic healing at the fracture site, in contrast to anterior fixation, where the union can be directly assessed across the fracture [12].

Navigation accuracy is also important in reducing intraoperative complications. Larson *et al.* reported that 3D image-guided systems significantly improve the safety profile of screw placement, especially in deformities or in difficult anatomical conditions [13]. Navigation, in our case, helped us to have precise reduction and fixation despite anatomical challenges like posterior subluxation and multiple levels of degenerative changes.

Khattab *et al.* also described a simplified technique to facilitate anterior odontoid screw fixation, reporting that meticulous preoperative planning and intraoperative orientation are crucial to optimize outcomes [14]. Our experience is in line with this, as intraoperative navigation minimized guesswork and allowed precise targeting, minimizing risk to surrounding neurovascular structures.

Overall, the current case depicts that anterior odontoid screw fixation through C-arm-based navigated osteosynthesis is safe and effective even for complicated Type III fractures with posterior subluxation. Proper use of image-guided navigation dramatically enhances operative precision and safety according to previous studies [15].

CONCLUSIONS

This case highlights that C-arm-based navigation anterior odontoid screw fixation is a technically feasible, accurate, and safe technique for the treatment of unstable Type III Anderson and D'Alonzo fractures even in the setting of posterior subluxation and spinal cord edema. The intraoperative real-time imaging by the C-arm navigation system facilitated optimal fracture reduction and precise screw placement, which are critical to allow union and minimize neurological risk. Whereas anterior odontoid fixation is established practice, this study contributes to the sparse literature for navigated techniques in complex odontoid fractures, specifically Type III. It underlines intraoperative navigation's clinical value for spinal trauma surgery and can influence treatment strategies of the future by illustrating how specialized imaging devices may enhance outcomes with anatomically challenging cervical spine injury. This case is of special interest to spinal surgeons and neurosurgeons but also adds more generally to surgical procedures involving image-guided fixation methods.

CONTRIBUTION OF AUTHORS

Research concept- Bolla Kamal Chaitanya, Arun H. Shanthappa

Research design- Bolla Kamal Chaitanya, Manoj K. Ramachandraiah

Supervision- Arun H. Shanthappa, Manoj K. Ramachandraiah

Materials- Bolla Kamal Chaitanya, Manoj K. Ramachandraiah

Data collection- Bolla Kamal Chaitanya, Arun H. Shanthappa

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Article editing- Bolla Kamal Chaitanya, Arun H. Shanthappa
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REFERENCES

[1] Guiot B, Fessler RG. Complex atlantoaxial fractures. J Neurosurg., 1999; 91(2 Suppl): 139–43.
[2] Jeanneret B, Magerl F. Primary posterior fusion C1/2 in odontoid fractures: indications, technique, and results of transarticular screw fixation. J Spinal Disord 1992; 5(4): 464–75.
[3] Stulík J, Suchomel P, Lukás R. Primá osteosyntéza dentu: multicentrická studie. Acta Chir Orthop Traumatol Cech., 2002; 69(3): 141–48.
[4] Castro-Castro J. Anterior odontoid screw fixation using intra-operative cone-beam computed tomography and navigation. Neurocirugia (Astur)., 2014; 25(6): 261–67.
[5] Patkar S. Anterior retropharyngeal plate screw fixation with bilateral anterior transarticular screws for odontoid fractures is a new comprehensive technique. Neurol Res., 2017; 39(7): 581–86.
[6] Pisapia JM, Nayak NR, Salinas RD. Navigated odontoid screw placement using the O-arm: technical note and case series. J Neurosurg Spine, 2017; 26(1): 10–18.
[7] Starkweather CK, Morshed R, Rutledge C, Tarapore P. Navigated placement of two odontoid screws using the O-arm navigation system: a technical case report. Cureus, 2020; 12(9): e10724.
[8] McLain RF. Salvage of a malpositioned anterior odontoid screw. Spine (Phila Pa 1976)., 2001; 26(21): 2381–84. doi: 10.1097/00007632-200111010-00016.
[9] Smith JD, Jack MM, Harn NR, Bertsch JR, Arnold PM, et al. Screw placement accuracy and outcomes following O-arm-navigated atlantoaxial fusion: a feasibility study. Global Spine J., 2016; 6(4): 344–49. doi: 10.1055/s-0035-1563723.
[10] Martirosyan NL, Kalb S, Cavalcanti DD. Comparative analysis of isocentric 3-dimensional C-arm fluoroscopy and biplanar fluoroscopy for anterior screw fixation in odontoid fractures. J Spinal Disord Tech., 2013; 26(4): 189–93.
[11] Yuan S, Wei B, Tian Y. Comparison of clinical outcomes of fresh type II odontoid fracture treatment between anterior cannulated screws fixation and posterior instrumentation of C1–2 without fusion: a retrospective cohort study. J Orthop Surg Res., 2018; 13(1): 3.
[12] Bisson EF, Mumert ML, Mazur MD, Dailey AT, Schmidt MH, et al. Fate of type II odontoid fractures after posterior atlantoaxial fusion: where does healing occur?. J Neurol Surg A Cent Eur Neurosurg., 2015; 76(4): 274–78.
[13] Larson AN, Polly DW Jr, Guidera KJ. Accuracy of navigation and 3D image-guided placement for pedicle screws in congenital spine deformity. J Pediatr Orthop., 2012; 32(6): e23–29. doi: 10.1097/BPO.0b013e318263a39e.
[14] Khattab MF, Mahmoud AN, Younis AS, El-Hawary Y. A simple technique for easier anterior odontoid screw fixation. Br J Neurosurg., 2019; 33(2): 135–39. doi: 10.1080/02688697.2018.1550191.
[15] Herren C, Pishnamaz M, Lichte P. The anterior "triple-/quadruple" technique for C1/C2 trauma in the elderly: first experience with 16 patients. Z Orthop Unfall., 2015; 153(5): 533–39. doi: 10.1055/s-0035-1546133.