CASE REPORT

Versatility of Anterior Approach for Management of Odontoid Fractures

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Abstract

Background data: Odontoid fractures comprise ~20% of all cervical fractures. Odontoid fractures have been classified according to the Anderson and D’Alonzo classification system. Anterior and posterior approaches can manage odontoid fractures, and various schools of thought favor both approaches. This article highlights the versatility of the anterior approach to treat varying types of odontoid fractures. Indications for surgical management include the age of the patient more than 55 years, displacement of fracture fragment more than 4 mm, nonunion, and disruption of the transverse atlantal ligament. The odontoid has 55% less trabecular bone than the body of the axis. This trabecular bone is required for callus formation and bone healing; hence, nonunion of type 2 fractures is more common than that of type 3 fractures. To present different anterior methods of managing odontoid fractures. A case report was presented. In the present report, we have deployed three different techniques using the anterior approach for the fixation of the odontoid fracture. Plate and screw fixation is far more effective as the odontoid is a nonweight-bearing structure, and it compresses the fragments for a better union. In all three cases, we found good evidence of radiographic healing of the fracture in the postoperative period with no significant immediate or delayed complications. Neck mobility was limited to some extent with the placement of transarticular screws but was preserved completely in the other two patients. Anterior cervical approaches in odontoid fractures carry safe and promising results in achieving solid fusion, less operative risk to vital structures, and preserving the cervical range of motion. The learning curve is also shallow compared with posterior approaches (2022ESJ262).

Keywords: Odontoid fracture, Odontoid screw, Plate and screw fixation, Transarticular screws

Introduction

Odontoid fractures comprise ~20% of all cervical fractures. The incidence of odontoid fracture increases with age and represents the most common cervical fracture in patients older than 70 years [1]. In younger patients, high-energy trauma is most commonly due to motor vehicle accidents, and in the elderly, low-energy impacts like falls lead to odontoid fractures [2]. Hyperflexion is the most common mechanism for cervical injury and results in anterior displacement of atlas (C1) on axis (C2). Hyperextension can rarely lead to odontoid fracture in which posterior displacement of the odontoid is seen [3]. Odontoid fractures have been classified according to the Anderson and D’Alonzo classification system. Type 1 fracture is an avulsion fracture through the apex of the odontoid, type 2 fracture occurs at the junction of the base of the odontoid and the body of the axis, and type 3 extends through the body of the axis. This classification has withstood the test of time and is an anatomically simple, reliable predictor of outcome and able to direct treatment. Hadley et al. [2] proposed an additional subtype 2A, which indicated marked comminution at the base of the odontoid. Maak and Grauer [4], suggested a modified classification system that was primarily based on fracture line obliquity, displacement, and...
commination. Type 2A is associated with a non-displaced transverse fracture line, type 2B is an anterosuperior to the posterior–inferior displaced fracture line, and type 2C is a comminuted fracture with anteroinferior to posterior–superior displacement of the fracture line [5]. Odontoid fractures are amenable to both surgical and nonsurgical management. The treatment choice is strongly based on the patient's age and fracture pattern [3]. Anterior and posterior approaches can manage odontoid fractures, and various schools of thought favor both approaches. This article highlights the versatility of the anterior approach to treat varying types of odontoid fractures.

The decision-making process

Treatment of odontoid fracture is based on multiple factors, including fracture type, patient age, associated comorbidities, and injuries. The generally accepted norm is that type 1 and type 3 fractures would heal with nonoperative treatment [2]. Indications for surgical management include the age of the patient more than 55 years, displacement of fracture fragment more than 4 mm, nonunion, and disruption of the transverse atlantal ligament. The odontoid has 55% less trabecular bone than the body of the axis. This trabecular bone is required for callus formation and bone healing; hence, nonunion of type 2 fractures is more common than type 3 fractures [5]. Assessment of the integrity of the transverse atlantal ligament is important to select the appropriate treatment option. In this situation, early surgical intervention is needed to avoid nonunion and delayed instability. Anterior odontoid screw fixation will not provide stability if the transverse atlantal ligament is injured [2].

Case 1

A 25-year-old male patient was brought to our ER following a two-wheeler collision in a road traffic accident. He presented to us with chief complaints of neck pain with the inability to move the neck completely in all directions. There were no associated neurological deficits. The patient was evaluated, and computed tomography (CT) cervical spine revealed a displaced fracture (5 mm) of the body of C2 with significant retropulsion causing spinal canal narrowing. MRI cervical spine showed a fracture of C2 with compression of the cord and myelomalacia at the corresponding level. The spinal canal diameter at the C2 level was 0.8 cm.

The patient was planned for odontoid plate fixation through an anterior approach (Fig. 1). Under general anesthesia, the patient was placed in a supine position, and a horizontal incision was taken parallel and 1 cm below the mandible on the right side. An incision was deepened through layers of the neck; subplatysma dissection was carried. The submandibular gland on the right side was visualized and safeguarded. Hypoglossal nerve was defined along with facial vein, and adequate precautions were taken to avoid injury. Longus colli muscle was identified. The vertebral body was bared and C2 vertebrae was confirmed with C-arm guidance. Intraoperatively, there was evidence of a fracture of the neck of C2 (type 2 Anderson and D’Alonzo) along with a fracture of the articular facet of C2. The anterior arch of C1 was partially excised to accommodate the compression plate placed and screws inserted under C-arm guidance in the proximal and distal portions of the odontoid. These screws were then inserted after radiological confirmation of the reduction of the displaced segments. The estimated blood loss was

Fig. 1. A 25-year-old male patient with displaced fracture (5 mm) of the body of C2, type II dens fracture as shown in A–C. (D) Postoperative anterior odontoid plate with slip reduction and adequate contact.
Postoperative imaging showed a good position of the implants. The postoperative period was uneventful, and the patient was discharged on postoperative day 10. The patient had no difficulty in axial rotation, flexion, and extension of the neck. Postoperatively, the neck was immobilized in a Philadelphia collar for 12 weeks.

**Case 2**

A 29-year-old male patient presented to us with severe neck pain following a road traffic accident that he had sustained 2 weeks before. On admission, the patient had severe neck pain without any neurological deficits. CT cervical spine revealed a transverse fracture of the base of dens with complete separation from the body of the C2 vertebra, and dens is displaced posteriorly with mild compression of the ventral surface of the cord (type 2 Anderson and D’Alonzo). Surgical management was discussed with the patient and was planned for anterior odontoid screw fixation (Fig. 2). Under general anesthesia, the patient was placed supine and an incision was made to expose the upper cervical spine. Dissection was carried out to expose the anterior aspect of the inferior margin of C2. Under C-arm guidance, a Kirschner wire of appropriate length was inserted from the anterior aspect of the inferior margin of C2 through the central axis of dens to the opposing apical cortical bone. Kirschner wire was replaced with a self-tapping 3.5-mm lag screw of adequate length. The intraoperative radiography revealed inadequate purchase. Hence, a decision was taken to fix the C1–C2 facet joints with transarticular screws. The odontoid screw was kept in situ, and C1–C2 facet joints were exposed on both sides. The joints were curetted adequately, and after packing with bone grafts, the joints were fixed with 4.5-mm transarticular screws. After that, the odontoid screw was removed. The estimated blood loss was ~150 ml. The postoperative period was uneventful and postoperative images revealed stable fixation and adequate reduction of fracture segments. The patient was mobilized on the first postoperative day and was discharged on the seventh postoperative day.

**Case 3**

A 50-year-old male presented with severe neck pain following a slip and fall while walking down the staircase. The patient had a transient episode of numbness in the left upper limb with pain on attempted movement of the neck. There was no motor weakness on presentation. On evaluation, an radiography neck and CT cervical spine revealed a type 2 odontoid fracture with 5 mm displacement. C1–C2 facet and C2 body were normal with no evidence of fracture. MRI cervical spine showed patency of the transverse atlantal ligament. The patient was planned for atlantoaxial anterior transarticular screw fixation (Fig. 3). Radiography fluoroscopy (anteroposterior and lateral view) showed the fracture and its reduction. The C5–C6 disc space was identified under C-arm guidance, and an incision was performed at that level. Dissection was carried out to expose the anterior aspect of the inferior border of C2, and a 4.5-mm lag screw was inserted in a similar manner as that described in the previous case report. Postoperative radiography showed the correct position of the screw and adequate reduction of the odontoid process. The postoperative period was uneventful, with no neurological deficits. The patient had difficulty swallowing in the immediate postoperative period, which reduced gradually by the third postoperative day. There was no difficulty in the movement of the neck in all directions in the postoperative period. The patient was discharged on the eighth postoperative day.
Discussion

In the present report, we have deployed three different techniques using the anterior approach for the fixation of the odontoid fracture. Plate and screw fixation is far more effective as the odontoid is a non-weight-bearing structure, and it compresses the fragments for better union [6]. In all three cases, we found good evidence of radiographic healing of the fracture in the postoperative period with no significant immediate or delayed complications. Neck mobility was limited to some extent with the placement of transarticular screws but was preserved completely in the other two patients. Based on our experience with these cases, we strongly advocate that successful reduction of the fracture with adequate fusion can be achieved using anterior approaches without restricting neck mobility (plate and screw fixation or odontoid screw fixation), and the same approach can be used to fix the C1 and C2 facet joints in case of irreducible/incompetent transverse ligament injuries.

Anterior odontoid screw fixation was initially described by Nakanishi and Bohler [13]. This procedure has withstood the test of time. This procedure is associated with a more physiological fusion by direct osteosynthesis of the fracture line, and it has the advantage of preserving normal rotation at the atlantoaxial joint [7]. In contrast to anterior approaches, posterior approaches eliminate 50–60% of rotation at the C1–C2 joint and 10% of flexion and extension of the cervical spine [3]. Fusion rates achieved by this procedure are similar to those of posterior atlantoaxial arthrodesis [2]. Indications for the anterior approach by plate/screw or odontoid cannulated screw for odontoid fixation include integrity of transverse atlantal ligament and good fracture reduction with the alignment of fragments. The apical cortex is the densest area, and it is essential that the screw completely integrates the cortex; hence, a precise trajectory is required [8].

Other advantages of anterior techniques for managing odontoid fracture include limited muscle dissection, no disruption of the posterior tension band of the paraspinal muscles, lesser trauma to soft tissues, and lesser chances of infection. The chances of injury to the vertebral artery are minimized compared with the posterior approach. Positioning for a patient and access to the target is easier than that in the posterior approach [9]. Denaro et al. [10], in their systematic review, reported that odontoid screws managed to perform 83% fusion rates with nonunion rates among patients aged above 65 years. In addition, they reported that the specific type of data regarding odontoid screw results, such as morbidities and mortalities, fusion rates, and complications associated with the technique, is lacking in the literature, as this was a reported limitation in their study. Josten et al. [11], in their study of combining odontoid screws with transarticular screws anteriorly, reported that the anterior approach allowed fixing the fractured dens in two forms (lag screw to the fractured dens and bilateral screws transarticular through the atlantoaxial joint). In addition, they reported a 90.2% fusion rate and concluded that this anterior approach allowed them to deliver at a 1-year follow-up low in-hospital mortality and higher fusion rates among elderly patients. Autrusseau et al. [12], reported in their retrospective study that dens screw can be placed percutaneously with a technical success of up to 100% with clinical and radiological success, and no complications were reported in their series.

The limitation of this study is the lack of organized RCTs that can achieve higher evidence-based data to set guidelines for the management of odontoid screws.
Conclusion

Anterior cervical approaches in odontoid fractures carry safe and promising results in achieving solid fusion, less operative risk to vital structures, and preserving the cervical range of motion. The learning curve is also shallow compared with posterior approaches.

Conflict of interest

There are no conflicts of interest.

Abbreviations

C1 Atlas
C2 Axis
CT Computed tomography
MRI Magnetic resonance imaging

References

الخلاصة

المنهج الأساسي في قصور القروء العنقية الثاني يحمل نتائج نجدة وواجدة في تحقيق اندماج صلب، ومخاطر عملية أقل على الهيكل العضلي والحفاظ على نطاق حركة القروء العنقية الثانية. منحنى التعلم أيضاً مقارن بالمناهج الأخرى.