

360-DEGREE OSTEOSYNTHESIS IN DENS FRACTURE - CASE REPORT AND A LITERATURE REVIEW

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Abstract: The fractures of the craniocervical junction and upper cervical spine are connected with a high risk of neurological deterioration, severe neurological deficit, and a significant risk of life. Dens fractures are the most common cervical fracture for the population above 65 years. In elderly patients, the fractures are associated with low-energy traumas and low bone density.

We summarize the operative techniques for odontoid fractures and present a case of a seventy-year-old female who underwent an operation for odontoid screw fixation after a fall from a tree. Six days after the operation an instrumentation failure was established and revision with occipitospinodesis was performed.

Keywords: dens fracture, C2 fracture, cervical spine fixation, odontoid screw fixation, instrumentation failure

1. INTRODUCTION

Odontoid fractures have two peak incidences - between 20-30 years and 70-80 years^{1,2}. In younger patients, these injuries result from high-energy traumas while dens fractures in elderly patients are commonly caused by low-energy traumas such as falls^{3,4}. Typical symptoms include cervical pain, paraspinal muscle spasm and limited range of motion. Generally, most of the patients have preserved neurological status⁵. On the other hand, the mortality rate in elderly patients remains high, varying from 25% to 50%^{5,6}. The most widely used classifications system for odontoid fractures is that of Anderson and D'Alonzo. The treatment strategy depends on the fracture type and the presence of comorbidities⁷.

2. CASE REPORT

A seventy-year-old female was admitted to the emergency department after a fall from a tree. The patient complained of severe neck pain but her neurological status was intact. The computed tomography (CT) scan of the cervical spine revealed Type II odontoid fracture according to Anderson and D'Alonzo classification with the dens displaced anteriorly (Figure 1). Because of the presence of spinal instability, the patient underwent anterior screw dens fixation with additional external immobilization with a rigid collar (Figure 2). Postoperatively, the patient had no neurological deficit, the pain in the cervical region was reduced and early mobilization with a neck collar was initiated. On the seventh postoperative day, the patient felt sudden cervical pain during verticalization. The follow-up cervical X-ray demonstrated instrumentation failure (Figure 3). On a second stage, we performed posterior midline cervical approach and occipitospinodesis (Figure 4).

Figure 1: Sagittal CT reconstruction showed C2 odontoid fracture type II (Anderson and D'Alonzo)(Type C Eysel and Roosen) with the dens displaced anteriorly



Figure 2: Postop lateral cervical X-ray - anterior odontoid screw fixation



Figure 3: Second postop lateral cervical X-ray demonstrated Instrumentation failure



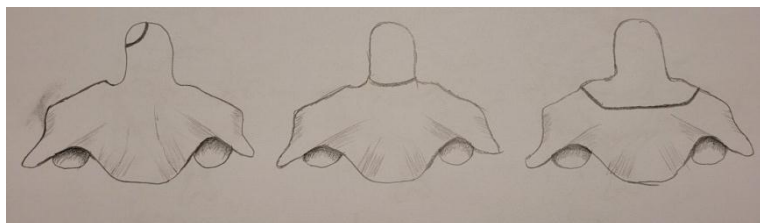
Figure 4: Postop cervical x-rays - 360-degree instrumentation with anterior odontoid screw and posterior occipitospinodesis



3. DISCUSSION

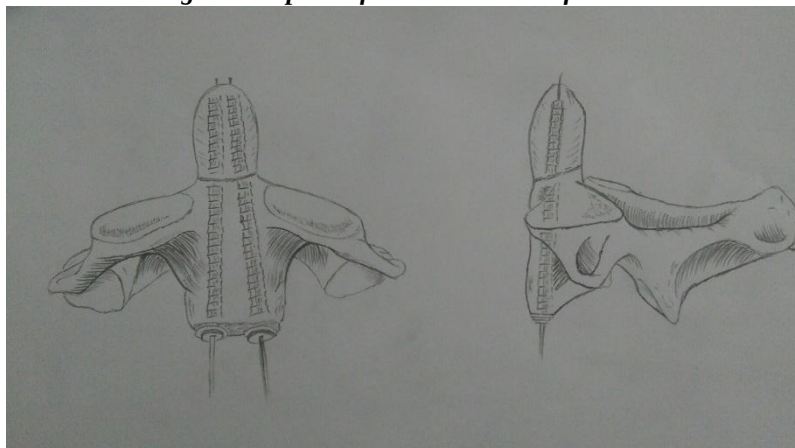
Dens fractures represent about 10-15% of all cervical spine fractures^{8,9}. Anderson and D'Alonzo divide the odontoid fractures into 3 types: Type I: fracture through the tip, Type II: fracture through the base of the dens, Type II A: fracture through the base of the dens with large bone fragment at the fracture site, Type III: fracture through the body of C2 and superior articular surface (Figure 5). Fracture type III is considered stable while fractures types I, II, and IIA - unstable^{10,11}. In 1993, Eysel and Roosen introduced new classification system dividing type II dens fracture into three subclasses - type A: with a horizontal fracture line, type B: fracture line with ventrocranial to dorsocaudal direction, and type C: ventrocaudal to dorsocranial direction¹².

Type I Type II Type III
Figure 5: Anderson and D'Alonzo classification



The treatment modality depends on the fracture type and morphology and can be conservative or surgery. Type II fracture is associated with higher non-union rates when treated initially with external cervical immobilization¹³. The indications for surgery include Type II fractures with displacement of the dens greater than 5mm, type IIA fracture, or failure to achieve alignment of the fragment with external immobilization¹³. A variety of anterior and/or posterior surgical techniques can be used for instrumentation of type II dens fracture. Anterior screw fixation (Figure 6) is an operative method that spares the atlantoaxial rotation and leads to less tissue-trauma due to the operative approach^{14,15}. The fusion rates after anterior screw fixation may vary^{16,17}. There is no data to confirm that double screw fixation is superior to single screw fixation in terms of restoring spinal stability¹⁸. The correct screw placement and good position are of significant importance for the biomechanical stability of the fixation¹⁹.

Figure 6: Options for anterior screw fixation



Posterior instrumentation could be achieved using transarticular fusion by Magerl and the screw fixation by the Harms technique^{20,21}. The atlantoaxial fixation was first described by Magerl et al. in 1979. Before choosing this technique, a CT scan should be examined to verify the width of the pedicle of C2 and the course of the vertebral artery²². Goel/Harms technique of C1 lateral mass screw and C2 pedicle screw fixation was first described by Goel in 1988 and popularized by Harms in 2001. The entry point for the C1 lateral mass screw is the midpoint of the inferior lateral mass and the junction with the posterior arch of the atlas. Before the placement of C2 pedicle screw, the axial images on the CT scan must be observed for evaluation of the pedicle width and to verify the absence of an aberrant vertebral artery. A minimum of 4mm of pedicle width is needed for safe insertion of the screw^{22,23}. In the presented case, a high-riding vertebral artery was a contraindication to the Magerl technique and insufficient C2 pedicle width made insertion of pedicle screw too risky. The occipitospinodesis with lateral mass screws and occipital plate system that we performed has provided sufficient biomechanical stability with low risk of injuring the vertebral artery.

4. CONCLUSION

Type II dens fractures are the most common dens fractures associated with high-energy trauma in young patients and low-energy trauma in elderly patients. Treatment options include conservative treatment with external

immobilization or surgery. The latter provides higher fusion rates. The selection of the optimal surgical approach should depend on the vascular and bone anatomy, the presence of osteoporosis and comorbidities. A combination of anterior and posterior operative techniques could be used in case of instrumentation failure.

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