

Anterior endoscopically assisted bone grafting for iatrogenic distraction of odontoid fracture after percutaneous anterior screw fixation

A case report

Ze-Xin Chen, MD, Hui Zhang, MD, Nai-Feng Tian, MD, Xiang-Yang Wang, MD, Yan Lin, MD*, Yao-Sen Wu, MD*

Abstract

Rationale: The complication of iatrogenic distraction of odontoid fracture after anterior screw fixation has not been reported in the literature. We treated the patient with endoscopically assisted bone grafting with good results. The new technique was not reported in the management of odontoid fracture or nonunion before.

Patient concerns: A 22-year-old man presented with neck pain after a motorcycle crash. The cervical spine radiograph and computed tomographic scan demonstrated the base of dens displaced 2 mm anteriorly.

Diagnoses: Radiographic images showed a type II odontoid fracture.

Interventions: The patient was treated by percutaneous anterior screw fixation. The postoperative radiograph and CT demonstrated an iatrogenic distraction of the odontoid with a gap of 6 mm. The follow-up radiograph did not show any sign of bone union 1 month and a half later. A revision surgery was given by anterior endoscopically assisted bone grafting. The patient was encouraged to sit out of bed immediately after the surgery with the protection of a soft cervical collar for 3 months.

Outcomes: No complications such as neural structures or vascular injuries were found. Bone union was achieved at the 1-year follow-up CT scans. Physical examination showed a full range of motion in the neck.

Lessons: We reported a case of iatrogenic odontoid distraction that was managed by anterior endoscopically assisted bone grafting. It is a technically feasible and minimally invasive procedure.

Abbreviation: CT = computed tomography.

Keywords: distraction, endoscopic surgery, nonunion, odontoid fracture

1. Introduction

Odontoid fracture is a common injury in the cervical spine. It accounts for 10% to 16% of all cervical spine fractures.^[1–3] According to the classification of Anderson and D'Alonzo,^[4] almost 60% of these fractures are type II cases that are associated with a high incidence of nonunion.^[1,2,5–7] The reported nonunion

rate with no treatment is nearly 100%,^[7,8] and the nonunion rate in conservative treatments ranges from 40% to 75%,^[3] even in patients with surgical stabilization the nonunion rates are up to 20%.^[8] Odontoid nonunion is a potentially serious complication. Therefore, surgical fixation is advised by most surgeons in type II odontoid fracture.

There is still no consensus on the best surgical treatment for odontoid fractures.^[9–12] Some authors recommended the primary posterior C1 to C2 fixation as the treatment of the choice.^[13] Although this method has excellent rates of bone union, a second procedure is usually necessary to remove the instruments to preserve the mobility of atlantoaxial joint. The anterior odontoid screw fixation technique was first reported in the literature in 1982.^[14] It is now widely used to treat unstable type II odontoid fractures.^[15–17] Our previous study reported the management of odontoid fractures with percutaneous anterior odontoid screw fixation.^[17] It is a technically feasible, safe, useful, and minimally invasive procedure. However, complications are also reported that cannot be ignored such as nonunion (4%–19%),^[7,17,18] instruments failure (screw loosening, screw displacement), angina, infection, and so forth.^[15,17,19] As far as I am concerned, the complication of iatrogenic distraction of odontoid fracture after percutaneous anterior screw fixation has not been reported in the literature before.

In the present study, we reported a case of iatrogenic distraction of odontoid fracture by the anterior odontoid screw.

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Z-XC and HZ equally contributed to this work and should be considered as co-first authors.

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Department of Orthopaedic Surgery, The Second Affiliated Hospital and Yuying Children's Hospital of Wenzhou Medical University, Wenzhou, China.

* Correspondence: Yan Lin and Yao-Sen Wu, Department of Orthopaedic surgery, The Second Affiliated Hospital and Yuying Children's Hospital of Wenzhou Medical University, 109 Xueyuan Xi road, Wenzhou 325000, China (e-mails: wzlyin@126.com; wys9453@126.com).

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We successfully treated the patient with anterior endoscopically assisted bone grafting. The patient got bone union and had a good functional result.

2. Case report

A 22-year-old man was involved in a motorcycle crash. At the scene of the accident, he had a severe neck pain. The man was placed in a soft cervical collar and transferred to the local emergency center. No neurologic complication was noted upon admission. The cervical spine radiograph and computed tomographic scan demonstrated a type II odontoid fracture that was displaced 2 mm anteriorly. The skull traction with 3 kg was applied immediately for cervical reduction. Once the displacement was reduced, a percutaneous anterior odontoid screw fixation was made in local hospital after he signed the informed consent form. The postoperative radiograph and CT were taken immediately, and both of them demonstrated an iatrogenic distraction of the odontoid fracture with a gap of 6 mm (Fig. 1). The patient was fitted with a soft collar for 6 weeks, and the follow-up radiograph did not show any sign of bone union. After the distraction and no sign of bone union, the patient was referred to our spinal unit where the decision was made to attempt the anterior endoscopically assisted bone grafting for the distraction of the odontoid.

The anterior endoscopic approach to C1 to C2 was similar to the approach we previously reported in the microendoscopic anterior approach for irreducible atlantoaxial dislocation.^[20] The patient was placed in supine position on a radiolucent table, and a nasal intubation was performed under local anesthesia when the patient was still awake. Then the general anesthesia was given. To facilitate the open-mouth view, a radiolucent circular plastic tube was placed in the patient's mouth. After the surgical field was prepared and draped, the incision was made which the previous surgery had made for percutaneous odontoid screw fixation. Along the medial border of sternocleidomastoid blunt dissection was used to reach the anterior border of the cervical vertebra. Thereafter, a guide wire was placed through the space aiming the C1 to C2 space with the guidance of fluoroscopy. First, an initial cannulated dilator (Medtronic Sofamor Danek,

Memphis, TN) was inserted over the guide wire, and then the next bigger size dilators were sequentially placed over the initial dilator down to the anterior space of the C1 to C2. Finally, a tubular retractor was placed. All procedures were carried out under the real-time fluoroscopic images. Using the endoscope we could view the anterior space of C1 to C2, and we found that there was a 5-mm gap filled with scar tissues in the fractured odontoid. A curette was used to remove the scar tissues between the fracture site; thereafter, a high speed burr was used to remove some anterior cortical bone of the odontoid. Finally, morselized autograft from the anterior iliac crest was packed into the fracture site (anterior and bilateral of the screw) under the endoscope (Fig. 2).

Postoperatively, prophylactic antibiotics was given for 3 days, the patient was encouraged to sit out of bed immediately after the surgery with the protection of a soft cervical collar. Radiographic and clinical evaluation was obtained at 1 week, and 1, 3, 12, and 24 months postoperatively.

The operation was successfully performed with the aid of endoscope. The operation time was 90 min and the estimated blood loss was 70 mL. The patient had slightly sore throat while swallowing after the surgery. The symptom disappeared 3 days postoperatively. No complications such as neural structures or vascular injuries were found. Postoperative CT scans demonstrated some autografts in the distraction site. The 1-year follow-up, bone union has achieved based on CT scans (Fig. 3). Physical examination showed a full range of motion in the neck (Fig. 4).

3. Discussion

The type II odontoid fracture is the most common axis fracture that is associated with a high incidence of nonunion.^[1,2,5-7] The initial treatment is still controversial. It ranges from conservative treatment to surgical intervention.^[9-12] There are several factors determining the doctors' treatment strategy: surgical complications relative to the procedure; the mobility and functional result of the atlantoaxial joint; the possibility of bone nonunion; the type and stability of the fracture; the general situation of patients (patient's willingness, age, comorbidities, and so forth). Among these factors, the possibility of bone nonunion is one of the most

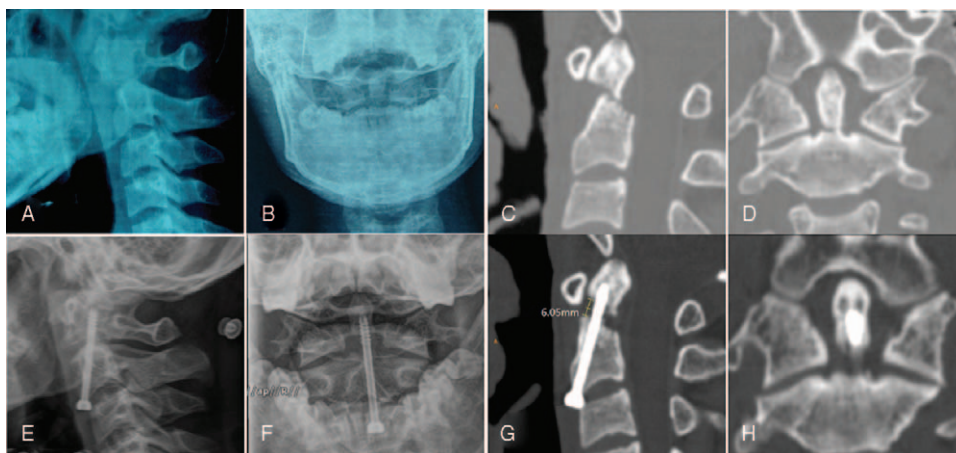


Figure 1. (A, B) The lateral and open mouth view showed a type-II odontoid fracture; (C, D) the computed tomographic scan demonstrated a type-II odontoid fracture with a displacement of 2 mm anteriorly; (E–H) the postoperative X-ray and computed tomographic scans showed a 6.05 mm distraction at the fracture site after anterior odontoid fixation.

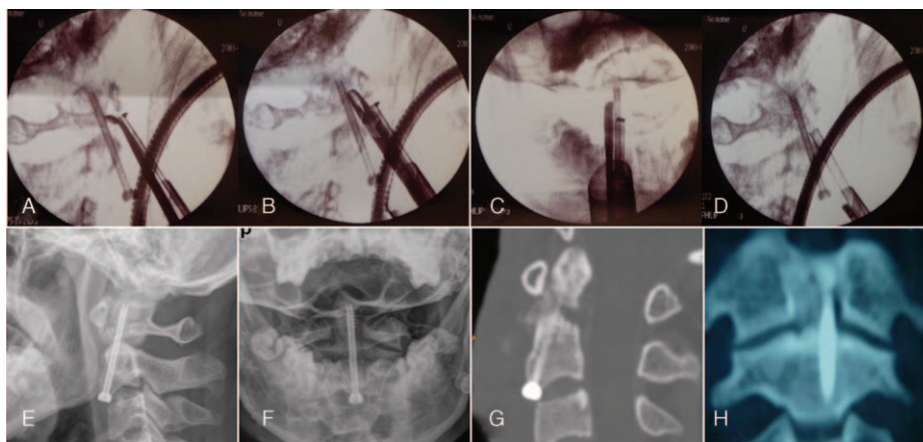


Figure 2. (A–C) With the aid of endoscope, the curette was used to remove the scar tissues at the fracture site; (D) morselized autograft from the anterior iliac crest was packed into the fracture site; (E–H) the postoperative X-ray and computed tomographic scans showed that there were a lot of autografts at the distraction site.

important the doctor concerned. Koivikko et al^[12] demonstrated that odontoid fracture with posterior displacement of >5 mm, fracture gap of >1 mm, delayed start of treatment >4 days, and posterior redisplacement >2 mm had high risk of nonunion. Korres et al^[21] found that the direction of the fracture line was an additional factor leading to pseudarthrosis. Besides these factors, Smith et al and Lewis et al reported that there were higher rates of nonunion in the elderly odontoid fracture.^[22,23] Initial displacement and distraction are 2 most important risk factors for odontoid nonunion. In this case, the patient has a 5-mm distraction in the fracture site, based on the previous study^[3,5,6,12]; it is hardly to get bone union by conservative treatment. Therefore, a revision surgery was given, although it was only 4 weeks after the first procedure.

Atlantoaxial distraction is rarely reported in the literature.^[24,25] In this case, the distraction was secondary to the percutaneous anterior screw fixation. We speculated that the distraction may be attributed to the factors below: the screw pushed the odontoid upward; the thread of the cannulated screw was not drilled completely beyond the fracture line; and the cranial tong traction under general anesthesia may be another possible reason. In our previous study, we report a type III dens fracture with vertical distraction; the distraction was secondary

to overweight skull traction.^[24] Therefore, we must keep that in mind because general anesthesia could relax all the ligamentous and muscular structures around the neck; the normal weight of skull traction could be too heavy intraoperatively. To avoid intraoperative complications, every step must be confirmed by the real-time fluoroscopy.

Odontoid nonunion is a potentially hazardous complication. It has high risks of delayed myelopathy and severe spinal cord injury.^[26–28] Although several studies demonstrated that conservative treatment could get acceptable clinical results in some elderly patients,^[22,29] surgical intervention is usually necessary, especially in young patients. Atlantoaxial arthrodesis is a common treatment for odontoid distraction injury and nonunion.^[3,30] Surgical intervention can be done via the anterior approach, posterior approach, and the combination of the 2.^[3,31,32] Kirkpatrick et al^[30] reported 3 cases who had a type-III dens fracture with vertical displacement; in his series, 2 patients underwent a C1 to C2 arthrodesis with sublaminar wires and iliac crest bone graft, and the other one underwent a posterior C1 to C2 transarticular screws fixation. All patients had good result of bone union. In our previous report, we successfully treated an odontoid distraction fracture with C1 lateral mass and C2 pedicle screw fixation.^[24] However, all these cases were different from

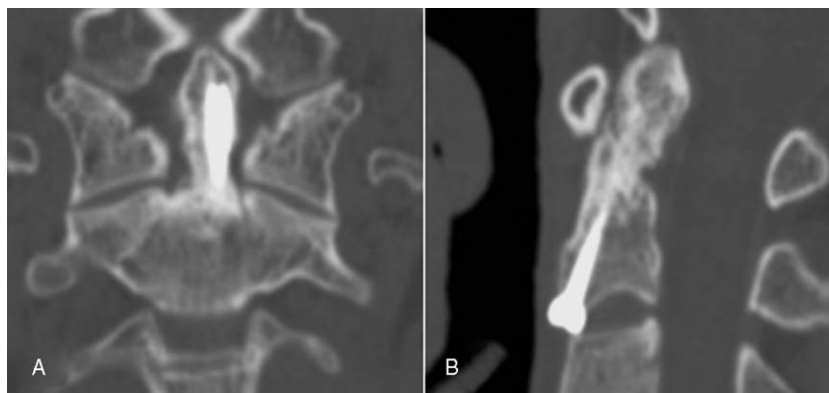


Figure 3. (A, B) Bone union was achieved at the 1-year follow-up computed tomographic scans.



Figure 4. (A–D) The 1-year-follow-up patient showed good function of rotation, extension, and flexion.

the present case because in this patient the distraction was caused by the anterior screw; furthermore, the screw was still in the odontoid. Ruf et al^[33] reported 4 cases with nonunion after anterior odontoid screw fixation. In his series, the screw was removed first, and then the dens was drilled and packed with autologous bone graft combining with atlantoaxial arthrodesis either in anterior or in posterior approach. Although the above treatments are effective and have good results, there are still some disadvantages: more screw instrumentation will increase the morbidity of the spinal cord and vertebral arteries injury; arthrodesis will lose the mobility of atlantoaxial joint; and open surgery has big trauma to the soft tissues.

Endoscopically assisted surgery as a minimally invasive procedure has been optimized for management of a variety of spinal disorders.^[34,35] Fang et al^[36] first described an anterior approach to the upper cervical spine using the Metrx tubular retractor system in a cadaveric study. Wolinsky et al^[37] reported 3 cases of endoscopic transcervical odontoidectomy. In our previous study, we successfully managed 10 cases of atlantoaxial dislocation with microendoscopic anterior release, reduction, and fixation.^[20] Therefore, it is applicable to manage the atlantoaxial disorders using the endoscopic anterior approach and technique. In this case, we removed the soft tissue and had a bone grafting in the distraction site. All the procedures were taken under the endoscope. The patient healed with bone union and had a good functional result. This technique has some advantages as follows: it is minimally invasive; it preserves the mobility of atlantoaxial segment. However, this technique is technically demanding, and needs a long learning curve.

4. Conclusions

In this paper, we reported a case of iatrogenic odontoid distraction that treated by anterior endoscopically assisted bone grafting. Although a good clinical result has been achieved,

experience with a greater number of patients and long-term follow-up is still necessary.

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