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Case Report

Anterior Screw Fixation with Endoscopic System Assisted Method for Rostral Type III Odontoid Fracture

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Abstract

Odontoid fractures are relatively common upper cervical spine injuries, comprising up to 20% of cervical spine fractures. The treatment of odontoid fractures remains controversial, and is evolving with the advent of new fixation methods. Recently, many endoscopically-assisted procedures have been performed for various types of spinal surgeries to minimize invasiveness and to avoid soft tissue injury. We present the case of a 55-year-old man who underwent endoscopically-assisted anterior screw fixation for rostral type III odontoid fracture in Taiwan. A literature review of the current management of odontoid fractures and postoperative complications was also performed. (*Tzu Chi Med J* 2008;20(3):232–236)

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1. Introduction

Rostral type III and type II odontoid fractures are less stable than other types of fractures. Treatment of these injuries includes conservative treatment with an external orthotic device, posterior C1–C2 arthrodesis, and anterior screw fixation (1,2). Anterior screw fixation is now one of the most widely used procedures for stabilization of rostral type III and type II odontoid fractures.

Recently, Hashizume et al described the use of an endoscopic system for anterior screw fixation of the odontoid fracture in order to minimize surgical invasiveness, including reduced incision size and blood loss (3). The technique also helps to reduce the incidence of injury to the surrounding soft tissue such as the esophagus, trachea, recurrent laryngeal nerve, and carotid artery. To our knowledge, this is the first case of endoscopically-assisted anterior screw fixation for rostral type III odontoid fracture in Taiwan.

2. Case report

A 55-year-old healthy man was in a traffic accident. He presented with severe neck and occipital pain and was referred to our Emergency Department approximately 2 hours after the trauma. A 10-cm laceration

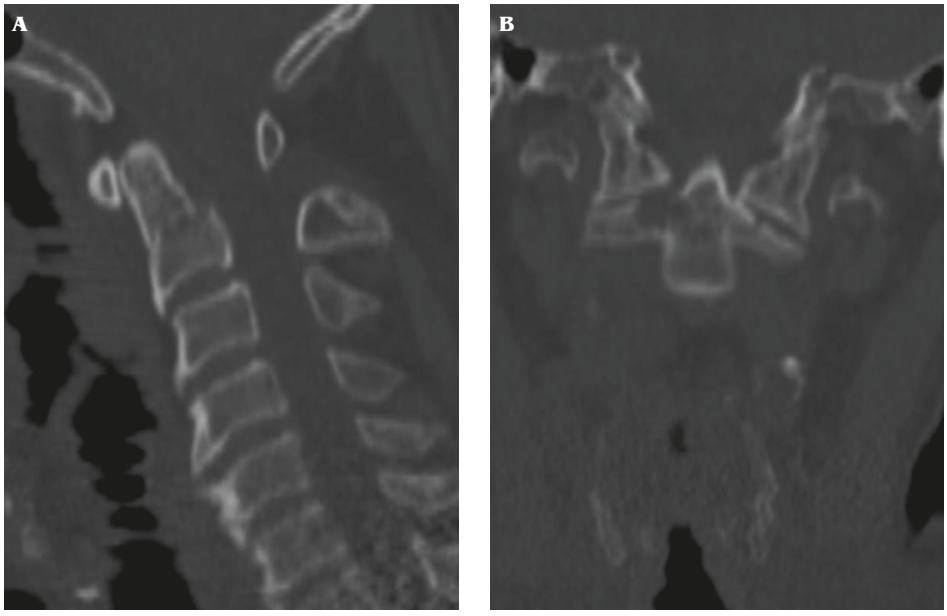

Fig. 1 — Computed tomography of the cervical spine shows a rostral type III odontoid fracture with mild lateral displacement to the left: (A) sagittal view; (B) coronal view.

was noted at the vertex over his scalp and was sutured. There was no associated neurological deficit, such as sensory or motor impairment, or changes in deep tendon reflex. Computed tomography of the cervical spine showed a rostral type III odontoid fracture with mild lateral displacement to the left (Fig. 1). The diagnosis was further confirmed using magnetic resonance imaging and spinal cord compression was ruled out. The Miami-J neck collar was applied at first, followed by surgical intervention using odontoid screw fixation thereafter. The endoscopic system was chosen to minimize surgical invasiveness. In addition, one specially designed instrument was manufactured from a 20-mL polyethylene syringe. The tip of the syringe was cut at a 45° oblique angle. The remainder was used as a tubular retractor for better endoscopic viewing during the fixation of the screw.

During the operation, the patient was placed in the supine position with a small roll behind the shoulders to allow for slight neck extension. One 3-cm transverse skin incision was made paramedially at the C5–6 level. The blunt dissection was achieved between the neurovascular bundle and the trachea and esophagus. After confirmation of definitive C2–3 level using a C-arm fluoroscope, the cut syringe was put inside to maintain the operating tract and for endoscopic manipulation. Under endoscopic and C-arm fluoroscopic view, the entry point and the horizontal and vertical direction for screw fixation were determined. The entry point was video-monitored using an endoscope to avoid soft tissue injury. One small groove was made at the anterior-superior portion of the C3 vertebral body in the midline, followed by minimal annulectomy and diskectomy at the C2–3 disc and minimal decortication in anterior-inferior edge of the C2 body. In this way, the entry point for the guide wire was allowed to be at the anterior-inferior lip of C2. The guide wire was placed in the desired direction under the monitor of the C-arm fluoroscope. A cannulated cancellous screw, 40 mm in length and 4 mm in diameter, was inserted through the prepared tract, across the fracture line, and to the tip of odontoid process (Fig. 2). The overall operation time was 145 minutes and blood loss was approximately 20 mL. The Miami-J neck collar was kept on for 3 months after the operation.

During the regular follow-up period, the original symptoms were relieved enormously. Follow-up radiography performed approximately 90 days after the operation showed that the screw remained in the correct position despite slight nonunion of the odontoid fracture (Fig. 3). At the time of writing, the patient had been followed-up for 8 months and had returned to his normal daily activities and was free of neck pain.

3. Discussion

The treatment of odontoid fractures remains controversial, and is evolving with the advent of new fixation methods [3,4]. Many clinicians have recommended halo vest immobilization. However, the nonunion rate of patients after halo vest immobilization is significant in a number of series, ranging from 26% to 80% [1]. Some authors have recommended posterior C1–C2

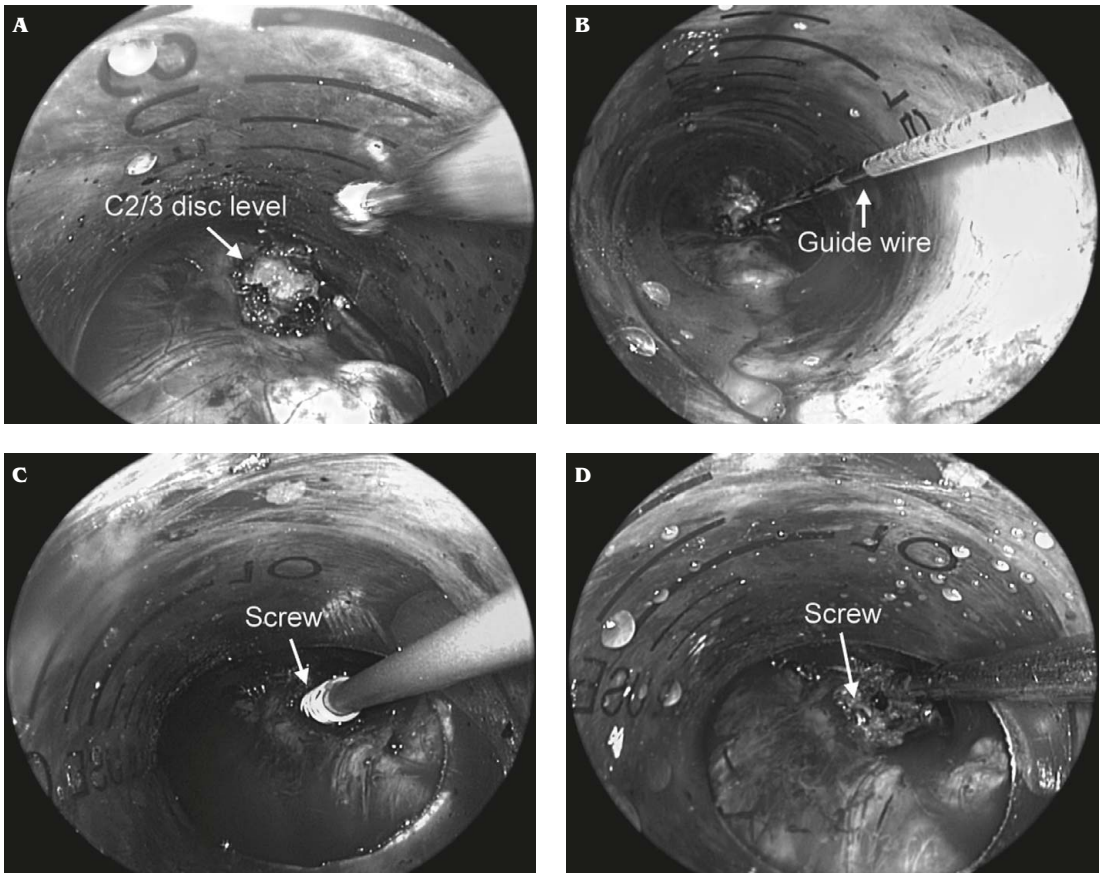

Fig. 2 — The surgical field seen through the endoscope, via a video monitor. (A, B) The guide wire was inserted at the anterior-superior portion of the C3 body. (C, D) The cannulated cancellous screw was inserted.

arthrodesis. Despite the overall union rate of approximately 95% [2], posterior C1–C2 arthrodesis compromises axial rotation by 45–50° and reduces cervical spine flexion-extension by 15° [1,3,5]. Since its introduction by Nakanishi et al in 1978 [6], anterior screw fixation has become the most widely used procedure for stabilization of type II odontoid fractures because it can be used to avoid the loss of neck motion. There are several advantages such as high union rate of 80–100% [1–3,7,8], less trauma and spared C1–C2 motion.

In a previous study to determine the results of direct anterior screw fixation, Apfelbaum et al reported successful positioning of the odontoid screw in 125 (97%) of 129 patients with recent odontoid fracture (within 6 months post injury) [8]. Four of 125 patients had imprecise screw placement. In each of these four patients, only one of the two anterior fixed screws was found to be incorrectly placed. Two of these patients were placed in a halo orthosis, and satisfactory fusion was eventually achieved. The other two patients developed nonunion and underwent successful posterior C1–C2 fusion several months after the injury. Fountas et al reported that only one of 38 patients had intraoperative complications of anterior screw fixation for type II and rostral type III odontoid fractures [7]. The one case had a broken K-wire fragment left in the vertebral body of C2, and a cannulated screw was positioned without any further problems.

Surgery-related complications of direct anterior screw fixation for recent odontoid fracture occurred in 10 of 117 patients [8]. The most common hardware-related failure was screw pullout of the body of C2 (5 cases), and the second most common was screw backout (4 cases). Among these 10 cases, only one patient became quadriplegic and died of respiratory causes.

Anterior screw fixation using the endoscopically-assisted system was first reported by Hashizume et al in 2003 [3]. The entry point was monitored by endoscopy to avoid soft tissue involvement. Radiographs taken immediately after surgery showed that the screw was inserted at a point 2 mm above the anterior caudal margin of the body of C2. However, at the examination 80 weeks after surgery, the radiographs showed nonunion of the odontoid fracture. They attributed

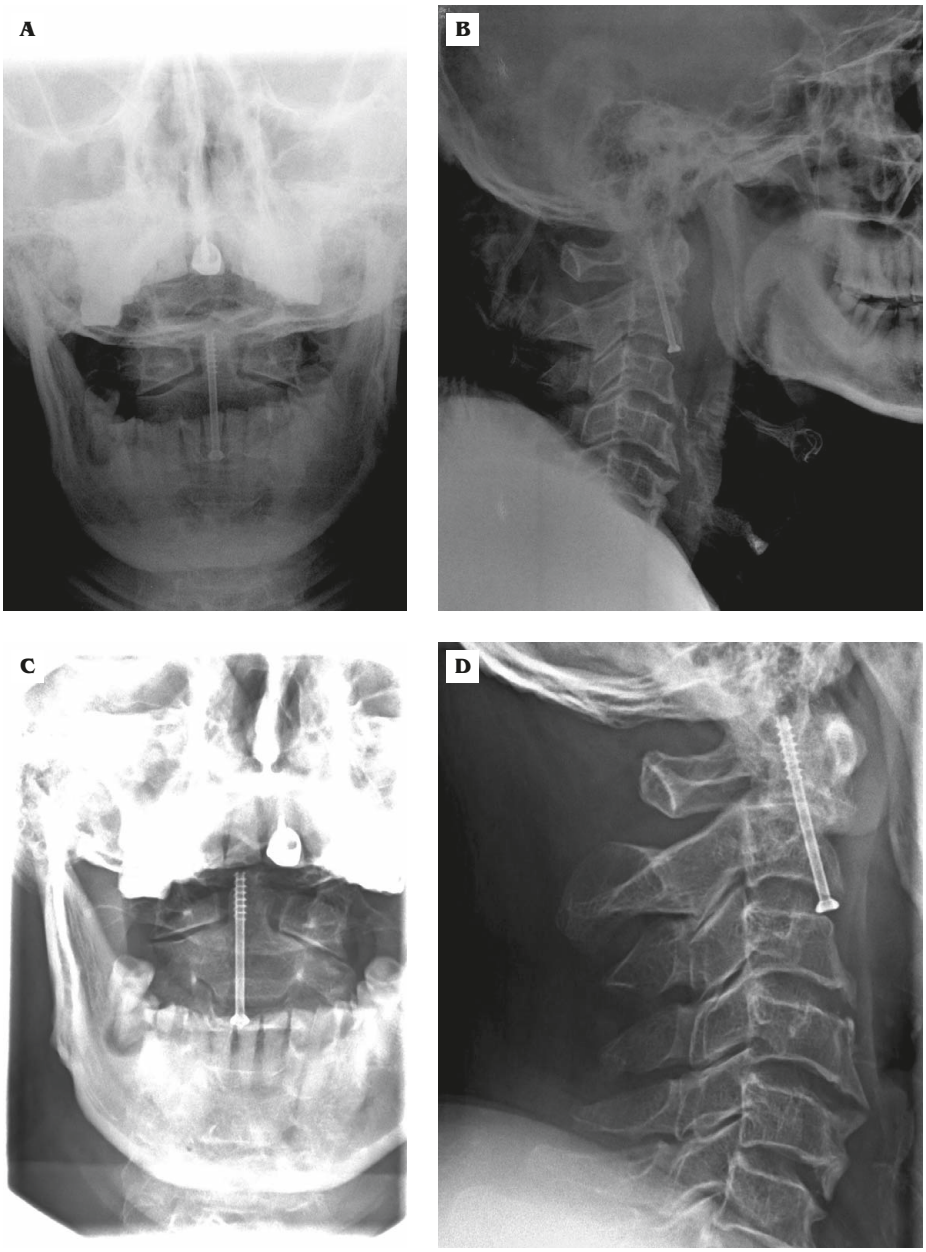

Fig. 3 — (A, B) Radiograph immediately after the operation. (C, D) Radiograph 90 days after the operation.

the nonunion of the odontoid fracture to the screw entry point, which was located 2 mm above the anterior caudal margin of the C2 body. Clinically, the patient is being followed-up conservatively because he is free of neck pain and has resumed his activities of daily living independently.

In our case, the postoperative images also showed precise positioning of the odontoid screw. Our patient did not have any complications during his admission. He had a 3-cm horizontal skin incision, compared with the traditional skin incision which is 6–7 cm in length (9).

There are several advantages to endoscopically-assisted surgery. First, it is less invasive, with reduced incision lines and blood loss. Second, the postoperative pain is decreased. Third, it allows direct access to the target site that is as good as with the open technique. Moreover, the use of a tubular retractor may reduce the incidence of injury to the surrounding soft tissue, such as the esophagus, trachea, laryngeal nerve, and carotid artery (3).

In conclusion, endoscopically-assisted surgery for anterior screw fixation of odontoid fractures has the dual benefits of greater safety and less invasiveness

compared to the open approach. Long-term follow-up studies of patients as well as more case studies are needed.

References

1. Maak TG, Grauer JN. The contemporary treatment of odontoid injuries. *Spine* 2006;31(11 Suppl):53–60.
2. Sasso RC. C2 dens fractures: treatment options. *J Spinal Disord* 2001;14:455–63.
3. Hashizume H, Kawakami M, Kawai M, Tamaki T. A clinical case of endoscopically assisted anterior screw fixation for the type II odontoid fracture. *Spine* 2003;28: E102–5.
4. Chi YL, Wang XY, Xu HZ, et al. Management of odontoid fractures with percutaneous anterior odontoid screw fixation. *Eur Spine J* 2007;16:1157–64.
5. White AA III, Panjabi MM. *Clinical Biomechanics of the Spine*, 2nd edition. Philadelphia: JB Lippincott, 1990:610–1.
6. Nakanishi T, Sasaki T, Tokita N, et al. Internal fixation for the odontoid fracture. *Orthop Trans* 1982;6:176–83.
7. Fountas KN, Kapsalaki EZ, Karampelas I, et al. Results of long-term follow-up in patients undergoing anterior screw fixation for type II and rostral type III odontoid fractures. *Spine* 2005;30:661–9.
8. Apfelbaum RI, Lonser RR, Veres R, Casey A. Direct anterior screw fixation for recent and remote odontoid fractures. *J Neurosurg* 2000;93(2 Suppl):227–36.
9. Etter C, Coscia M, Jaberg H, Aebi M. Direct anterior fixation of dens fractures with a cannulated screw system. *Spine* 1991;16(3 Suppl):S25–32.