

Case Report

Type II old odontoid fractures in the ankylosing spondylitis patient: successful surgical treatment by O-arm navigation: a case report

Kai Tang*, Xiao-Qiang Cheng*, Hui-Lin Yang, Feng Zhou

*Department of Orthopedic Surgery, The First Affiliated Hospital of Soochow University, Suzhou 215006, Jiangsu, China. *Equal contributors.*

Received September 28, 2018; Accepted February 11, 2019; Epub June 15, 2019; Published June 30, 2019

Abstract: Background: Ankylosing spondylitis (AS) is a chronic inflammatory disease that mainly affects the axial bone. Because of the poor blood supply, conservative treatment for type II old odontoid fractures is not effective. It often requires surgery. However, cases of odontoid fracture complicated with ankylosing spondylitis are very rare in the clinic. Case presentation: A case of a 60-year-old male patient is described who felt neck pain after he fell down on the ground two months before. The patient had a history of ankylosing spondylitis and did not undergo regular treatment. The X-ray and computed tomography (CT) showed a type II odontoid fracture and fusion of all spinal segments below C2. MR found included interruption of bony continuity of odontoid process basilar part. This patient was diagnosed with an old type II odontoid fracture complicated with ankylosing spondylitis. Posterior bone graft fusion screw-rod fixation assisted by O-arm navigation surgery was performed for the patient. After surgery, the patient's neck pain completely disappeared. Conclusions: Cases of odontoid fracture complicated with ankylosing spondylitis are very rare in clinic. This is a very important case of providing spine surgeons with a treatment plan for treating patients with old type II odontoid fractures complicated with AS. It also requires us to discuss that what treatments are more suitable for patients.

Keywords: Type II old odontoid fractures, ankylosing spondylitis, old fracture, posterior fusion screw-rod fixation, O-arm navigation

Introduction

Ankylosing spondylitis (AS) is a systemic inflammatory disease that mainly affects the spine, ankle joints, and ambient joints [1, 2]. It eventually leads to severe spinal deformity, spinal fusion, and ankylosis. The patients are at high risk of spine fractures. The odontoid fracture is very common in cervical vertebrae fracture, accounting for 10% to 15% of cervical fractures [2, 3]. Most odontoid fractures are not complicated with spinal cord injury, namely without obvious symptoms. As a result, the rate of missed diagnosis is high. After more than three weeks, fresh fractures evolved into old fractures. In the literature, the probability of type II odontoid fracture is 26%-76% [4]. However, cases of odontoid fracture complicated with AS are rare in clinic. According to our review there have been few reports on type II old odontoid

fractures complicated with AS. In this article, a rare case of a patient with type II old odontoid fractures complicated with AS is reported. Posterior bone graft fusion and screw-rod fixation assisted by O-arm navigation surgery was chosen for the patient, and the patient recovered well after the surgery.

Case presentation

The 60-year-old patient man came to our hospital because he fell down on the ground and he felt neck pain for two months. The patient was diagnosed as ankylosing spondylitis when he was 30 and he did not undergo regular treatment. The patient was given cervical fixation treatment. Physical examination showed tenderness on the cervical spine. The patient's thoracic and lumbar vertebrae were supported by rigid belt. His extremities muscle force and



Figure 1. Cervical X-ray (A, B) showed the change of physiological curvature of cervical spine, old type II odontoid fracture and fusion of all spinal segments below C2. Calcified cervical anterior longitudinal ligament can also be seen.

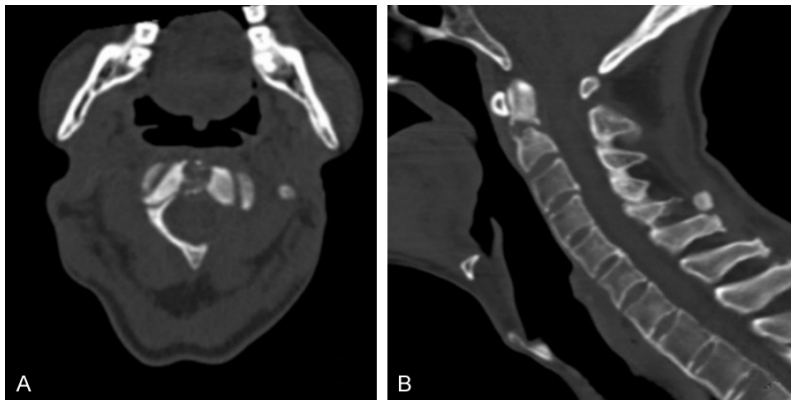


Figure 2. CT of the cervical spine (A, B) showed that old type II dens fracture, the right cortical bone destruction was discontinuous, the CT appearances were hyperostosis of the anterior and posterior margins of vertebral body, ossification of the anterior and posterior longitudinal ligaments, and formation of the ossify bridge. The classic bamboo appearance of the spine from the CT scan can be observed.

tension are normal, and the patient had normal sensation. The pathological reflex was negative.

Cervical X-ray (**Figure 1A, 1B**) revealed change of physiological curvature of cervical spine, old type II odontoid fracture, and fusion of all spinal segments below C2. Calcified cervical anterior longitudinal ligament was also observed. Computerized tomography (**Figure 2A, 2B**) showed that old type II odontoid fracture, ossification of

the anterior and posterior longitudinal ligaments, and formation of the ossify bridge. Typical bamboo appearance of the spine from the CT scan was found. MR (**Figure 3A-C**) revealed that the interruption of bony continuity of the base of odontoid process basilar part. From the MR, the posterior displacement of the fracture site and soft tissue swelling of the cervical spine could be seen. At the fracture site, there was a stripy hypo-intense on T1-W1, and a patchy hyper-intense was seen on the short time inversion recovery (STIR). The spinal cord of C1-2 spinal cord was compressed. There was no obvious abnormal signal in the spinal cord. According to the patient's medical history and radiology examinations, the patient was diagnosed as type II old odontoid fractures with AS.

Due to the history of AS, the cervical vertebra activity degree was basically lost, and the anterior flexion and posterior extension of the cervical vertebrae was very poor. Therefore, anterior cervical operative position was not an option. Considering various aspects (activity, surgical position, anesthesia intubation, etc.)

factors, it was decided to perform posterior bone graft fusion and screw-rod fixation assisted by O-arm navigation surgery (C1-2). After the operation, the patient got pain relieve. The postoperative X-ray (**Figure 4A, 4B**) showed the internal fixation was in good position. The patient was able to get up out of bed 7 days and was discharged 10 days after operation and continued to be protected by neck collar for four weeks more. Five months after operation, X-rays of the cervical spine

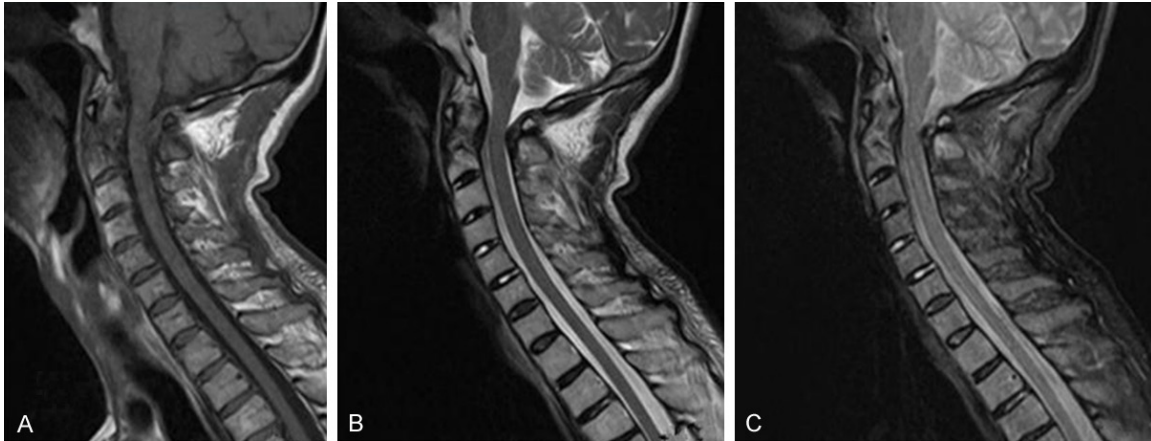


Figure 3. MR (A-C) showed that the change of physiological curvature of cervical spine, and the interruption of bony continuity of the base of odontoid process basilar part. From the MR, the posterior displacement of the fracture site and soft tissue swelling of the cervical spine can be seen. At the fracture site, there was a stripy low signal on T1W1, and a patchy hyper-intense signal was seen on the short time inversion recovery (STIR). The spinal cord of C1-2 spinal cord was under compression. There was no obvious abnormal signal in the spinal cord.



Figure 4. Three days after the surgery, the X-ray (A, B) reexamination showed that the internal fixation position was good.

ine (Figure 5Aa, 5Ab) and CT (Figure 5Ba, 5Bb) showed good internal fixation and bone callus was observed at the bone graft site. The patient's neck pain completely disappeared and the patient was still followed up.

Discussion and conclusion

Ankylosing spondylitis (AS) is an unexplained systemic inflammatory disease that mainly affects the spine and sacroiliac joint. The pre-

valence in China is about 0.26% [5, 6]. During the development of the disease, spontaneous bone fusion occurs in patients with AS, and the patients usually have osteoporosis. The biomechanical properties of the spine have changed, and spinal fractures can occur at any time if the patients with AS are not careful. It is reported that the probability of spinal fractures in AS patients is nearly 5 times higher than that in the normal population, and the probability of combining with other types of fracture is increased by 35% almost [3]. Cervical vertebrae is a common site of fracture in patients with AS.

Due to the biomechanical property changes of AS, there are some characteristics of cervical vertebrae fractures in the patients with AS. First, there can be low-energy injuries even when there is no definite trauma that could result in fracture. Second, the fracture site is unstable, accompanied by fracture dislocation, which can easily lead to spinal cord injury. Old odontoid fractures are not common in clinical practice and are easily missed diagnosed. There are many reasons for missed diagnosis [1, 5, 6].



Figure 5. (A, B) Five months after operation, the X-rays of the cervical spine (Aa, Ab) and CT (Ba, Bb) showed good internal fixation and bone callus was observed at the bone graft site.

First of all, due to insufficient understanding of the disease, there is a large space for buffering because of a wide diameter of cervical spinal canal. Therefore, some fresh odontoid fractures may be missed because there are no symptoms and signs of spinal cord injury. Second, because of complicated with other body parts injury, with insufficient experience, some doctors are focused on the major injuries that affect vital signs and ignore the odontoid fracture. Moreover, some serious trauma can-

not be treated at the same time. Various reasons lead to unreasonable treatment and patients' condition will probably be concealed from multiple injury. In this case, the patient was diagnosed with a type II old odontoid fracture associated with AS. Studies have shown that the odontoid blood supply mainly comes from the anterior ascending artery, the posterior ascending artery, and the cleft perforators artery. Type II odontoid fractures can easily damage blood supply and lead to odontoid fractures nonunion.

According to investigation, the odontoid fracture can occur in all age groups. Older people may have this type of fracture because of a low-energy fall, while younger patients' odontoid are more vulnerable to fracture after motor vehicle accidents [6-8]. Dr. Anderson and Dr. D'Alonzo put forward a classification system in 1974 and there are 3 types of the odontoid fractures. Type I fractures, described as avulsion fracture, near the tip of the odontoid process, accounting for 1% to 5% and were considered stable. Type II fractures, accounting for 38% to 80%, are usually trans-

verse fractures that occur at the base of the odontoid and above the axis [3, 9]. At the same time, this type of fractures usually occur between the transverse ligament and the vertebral body. Type III fractures, extend into the vertebral body, involving the superior articular process of the axis, one side articular process or bilateral facet fractures, accounting for 15% to 40%. The type II fractures are the most common type, and the probability of nonunion of type II odontoid fractures is 26%-76% accord-

ing to other literatures due to the unstable structure [4]. Most of the type I and type III odontoid fractures can be cured by conservative treatment. However, the fracture line of type II odontoid fracture is located at the odontoid waist, and the blood supply is very poor, and thus conservative treatment is not effective and most patients require surgery [3, 10, 11]. At the same time, according to the fracture time, it is divided into fresh fracture and old fracture. The former refers to fracture within 3 weeks and the latter refers to fracture over 3 weeks. Obviously, old odontoid fractures are not common in clinical practice.

Treatment options for a type II OF remain controversial. Conservative treatment, such as prolonged cervical immobilization may be a risk for the patient, resulting in bone nonunion. Furthermore, operation intervention may pose a risk for the patient. For the fresh type II odontoid fractures, conservative treatment has poor effect. The anterior cancellous bone screw fixation is the first choice in clinical. The operative method can retain the rotation function of atlanto-axial vertebral. Considering the patient has a long history of ankylosing spondylitis, activity degree of cervical vertebra is very small, the significance of anterior surgery for the patient is not great. Furthermore, for the old type II odontoid fractures, the fracture interspace may be partially filled with soft tissue scars. If the anterior dentate lag screw fixation or posterior non-fusion screw fixation is chosen, there is still a risk of bone nonunion. Therefore, the posterior atlanto-axial fixation [8, 12-14] assisted by O-arm navigation was more inclined to be chosen.

According to the literature, it has been revealed that a higher median placement accuracy with a CT-based navigation system, and the CT-based navigation system may provide higher accuracy of pedicle screw placement than conventional non-navigated techniques. Our initial experience with the O-arm navigated spinal surgery allowed us to anticipate that this system may significantly increase the precision of spinal instrumented procedures and shorten the operation time [6, 10-12, 15]. It allows intra-operative control and immediate correction of misplaced spinal implants that can eventually result in lower incidence of redo surgery. Therefore the patient was received surgical assisted by O-arm navigation [3, 16].

In conclusion, for the old type II odontoid fractures, the appropriate surgical treatment should be selected based on different individual conditions, such as the type of odontoid fracture, displacement degree, reduction status, as well as the technical skills in clinical. In this way the best clinical treatment can be chosen.

The patient gained good recovery after the surgery. Three days later, the X-rays were reviewed (**Figure 4A, 4B**). The fracture internal fixation was good and the fracture site was completely repositioned. The X-ray (**Figure 5Aa, 5Ab**) and CT scan of the cervical vertebrae (**Figure 5Ba, 5Bb**) showed good internal fixation after 5 months. Bone callus can be seen at the bone graft site.

Disclosure of conflict of interest

None.

Address correspondence to: Dr. Feng Zhou, Department of Orthopaedic Surgery, The First Affiliated Hospital of Soochow University, 188 Pinghai Road, Suzhou 215006, Jiangsu, China. Tel: +86-512-67-780111; Fax: +86-512-67780999; E-mail: liw72@126.com

References

- [1] Josten C, Jarvers JS, Glasmacher S, Heyde CE, Spiegl UJ. Anterior transarticular atlantoaxial screw fixation in combination with dens screw fixation for type II odontoid fractures with associated atlanto-odontoid osteoarthritis. *Eur Spine J* 2016; 25: 2210-2217.
- [2] Ozgocmen S, Ardicoglu O. Odontoid fracture complicating ankylosing spondylitis. *Spinal Cord* 2000; 38: 117-119.
- [3] Bhattacharyya S, Kim M. Cervical spine fracture associated with ankylosing spondylitis. *Neurology* 2014; 83: 1297.
- [4] Vaccaro AR, Kepler CK, Kopjar B, Chapman J, Shaffrey C, Arnold P, Gokaslan Z, Brodke D, France J, Dekutoski M. Functional and quality-of-life outcomes in geriatric patients with type-II dens fracture. *J Bone Joint Surg Am* 2013; 95: 729-735.
- [5] Meyer C, Oppermann J, Meermeyer I, Eysel P, Muller LP, Stein G. [Management and outcome of type II fractures of the odontoid process]. *Der Unfallchirurg* 2018; 121: 397-402.
- [6] Pal D, Sell P, Grevitt M. Type II odontoid fractures in the elderly: an evidence-based narrative review of management. *Eur Spine J* 2011; 20: 195-204.

- [7] Clark S, Nash A, Shasti M, Brown L, Jauregui JJ, Mistretta K, Koh E, Banagan K, Ludwig S, Gelb D. Mortality rates after posterior C1-2 fusion for displaced type II odontoid fractures in octogenarians. *Spine* 2018; 43: e1077-e1081.
- [8] Hadjicostas PT, Tsirogianni AK, Soucacos PN, Thielemann FW. Odontoid fracture in severe ankylosing spondylitic patient. *Injury* 2010; 41: 231-234.
- [9] Nugent M, Berney MJ, Morris S. Clinical outcomes following spinal fracture in patients with ankylosing spondylitis. *Ir J Med Sci* 2017; 186: 677-681.
- [10] Vosse D, van der Heijde D, Landewe R, Geusens P, Mielants H, Dougados M, van der Linden S. Determinants of hyperkyphosis in patients with ankylosing spondylitis. *Ann Rheum Dis* 2006; 65: 770-774.
- [11] Alaranta H, Luoto S, Kontinen YT. Traumatic spinal cord injury as a complication to ankylosing spondylitis. An extended report. *Clin Exp Dermatol* 2002; 20: 66-68.
- [12] Konieczny MR, Gstrein A, Muller EJ. Treatment algorithm for dens fractures: non-halo immobilization, anterior screw fixation, or posterior transarticular C1-C2 fixation. *J Bone Joint Surg Am* 2012; 94: e144, 141-146.
- [13] Thumbikat P, Hariharan RP, Ravichandran G, McClelland MR, Mathew KM. Spinal cord injury in patients with ankylosing spondylitis: a 10-year review. *Spine* 2007; 32: 2989-2995.
- [14] Pavlu J, Jan-Mohamed R, Kaczmariski R. Pathological odontoid fracture. *Lancet Oncol* 2006; 7: 96.
- [15] Liu H, Chen W, Liu T, Meng B, Yang H. Accuracy of pedicle screw placement based on preoperative computed tomography versus intraoperative data set acquisition for spinal navigation system. *J Orthop Surg (Hong Kong)* 2017; 25: 2309499017718901.
- [16] Fu Z, Zhang X, Shi Y, Dong Q. Comparison of surgical outcomes between short-segment open and percutaneous pedicle screw fixation techniques for thoracolumbar fractures. *Med Sci Monitor* 2016; 22: 3177-3185.