The single transoral approach for Os odontoideum with irreducible atlantoaxial dislocation

Xiang Wang · Cun-Yi Fan · Zhen-Hua Liu

Received: 12 March 2009 / Revised: 8 April 2009 / Accepted: 17 June 2009 / Published online: 14 July 2009
© Springer-Verlag 2009

Abstract We report a 52-year-old female patient with a 2-year history of local neck pain, decreased cervical spine rotation, progressive numbness and weakness of both arms. Preoperative, dynamic X-rays, computed tomography, three-dimensional computed tomography demonstrated a displaced Os odontoideum with irreducible Subluxation of C1/2. We used a single transoral approach release, reduction using an assistance of skull traction, bone fusion and stabilization in the treatment of Os odontoideum with irreducible atlantoaxial dislocation. Postoperative, the patient was free of all symptoms and X-rays taken showed a stable fusion of C1/2 at 6th postoperative month. This technique in the treatment of Os odontoideum with irreducible atlantoaxial dislocation is atraumatic and effective. And preoperative dynamic X-rays, computed tomography, three-dimensional computed tomography and MRI scans provided an invaluable aid to select this operative procedure.

Keywords Os odontoideum · Irreducible atlantoaxial dislocation · Transoral approach · Skull traction

Introduction

The odontoid is a relative common site for malformations. In the past years, several bone fusion and instrumentation procedures have been developed for the posterior operative stabilization of Os odontoideum with irreducible atlantoaxial dislocation. However, in the preview literature to date, there is paucity of existing data with regard to single transoral approach bone fusion and stabilization of Os odontoideum with irreducible atlantoaxial dislocation. We report a congenital anomalies case of Os odontoideum with irreducible atlantoaxial dislocation, which is treated by single transoral approach release, reduction using an assistance of skull traction, bone fusion and stabilization.

Case report

Here, we report a 52-year-old female patient with a 2-year history of local neck pain, decreased cervical spine rotation, progressive numbness and weakness of both arms. Preoperative, dynamic X-rays, computed tomography, three-dimensional computed tomography demonstrated a displaced Os odontoideum with irreducible atlantoaxial dislocation (Figs. 1, 2). And MRI scans revealed the subluxation of C1/2 which decreased the spinal canal due to the compression of the posterior arch of the C1 and the increased spinal cord signals at posterior of C1 levels on T2-weighted images (Fig. 3). The patient underwent skull traction (4 kg for 2 weeks) preoperative and the subluxation of C1/2 could not be reduced. The patient was treated by single transoral approach release, reduction using an assistance of skull traction, bone fusion and stabilization. Moreover, to reduce the risk of infection, convenient for

X. Wang · C.-Y. Fan
Department of Orthopaedic Surgery, School of Medicine,
The Sixth Hospital of Shanghai Jiaotong University,
Shanghai, China

Z.-H. Liu (✉)
Department of Orthopaedic Surgery,
The First Affiliated Hospital of Bengbu Medical College,
287 ChangHuai Road, Bengbu, Anhui, China
e-mail: liuzhenh@yahoo.com.cn

Fig. 1 Dynamic X-rays of the cervical spine in neutral position (a), flexion (b) and extension (c). Ventral subluxation of C1 over C2 in flexion (b), which cannot reduce on extension (c)

Fig. 2 Computed tomography and three-dimensional computed tomography scans reveal displaced Os odontoideum and subluxation of C1 over C2 with narrowing of the spinal canal

possible assistant respiration postoperative and to introduce the endotracheal tube for general anesthesia, a tracheotomy was performed on the patient and endotracheal airway was established the day before the operative day. The patient was placed on the table in a supine position. The transoral approach was performed with the use of adjustable retractor support, which elevated the soft palate into the nasopharynx and depressed the tongue inferiorly. A vertical posterior pharyngeal wall incision was made from the anterior tubercle of C1 to the vertebral body of C3 and extended through the submucosa, the pharyngeal constrictor and longus colli muscles. The muscular and ligamentous attachments to the anterior arch of the C1 and the vertebral body of C2 were undermined and retracted with retractor. Protecting the vertebral artery, the upper cervical spine was carefully exposed and the soft tissues were extensively released. And the capsules of both sides of the lateral atlantoaxial joint were completely released and the surfaces of both sides of the lateral atlantoaxial joint were resected. Both sides of the lateral mass of atlas and the anterior vertebral body of C2 were exposed. And then the subluxation of C1/2 was reduced using an assistance of

skull traction. In order to lessen the traumatic, the Os odontoideum was not removed in the operation. The surfaces of the anterior arch of the C1 and the vertebral body of C2 were drilled for stimulation of bone fusion. An autologous cancellous bone graft from the iliac crest was placed between the anterior arch of the C1 and the vertebral body of C2 and both sides of the lateral atlantoaxial joint. C1/2 fusion was performed with two dynamic compression plates because a universal anterior plate–screw fixation C1/2 is deficient in clinical use to date. The screws were placed in the lateral mass of atlas and the vertebral body of C2 under the assistance of continual skull traction. The plates provided the stabilization of C1/2 and maintained the reduction of subluxation of C1/2, and then the incision was closed. Cervical immobilization was maintained for 3 months postoperative with a collar. X-rays, computed tomography, and magnetic resonance imaging taken within the second postoperative week demonstrated reduction of the Os odontoideum and the subluxation of C1/2 and the decompression of the posterior spinal canal of C1 level (Figs. 4, 5). X-rays taken at 6th postoperative month showed a stable fusion of C1/2 (Fig. 6). The patient

Fig. 3 The spinal canal decreased due to the compression of the posterior arch of the C1 and the spinal cord signals increased at the posterior of C1 levels on T2-weighted images

was free of all symptoms and returned to the previous work and presented social activities the 4th postoperative month.

Discussion

Surgical stabilization of the atlantoaxial instability and dislocation have been proposed for intractable local neck

pain, transient or progressive neurological deficit and worsening instability of C1/2 [1–3]. The operation procedure for malformation of the upper cervical spine should be designed to decompress the spinal cord involved and get solid bone fusion for long-term stabilization. There are several variations of posterior approaches bone fusion and stabilization [4–8] or the transoral approach release combined with the posterior approaches bone fusion and stabilization for the malformation of the upper cervical spine [9–12].

Os odontoideum can lead to reducible or irreducible atlantoaxial dislocation. Reducible atlantoaxial dislocation can be managed by direct posterior bone fusion using different fixation techniques. Although single posterior approach to the upper cervical spine produces extensive and traumatic soft-tissue stripping, posterior approaches bone fusion and stabilization have been used to atlantoaxial instability and dislocation for many years. Behari reported 109 patients who underwent posterior stabilization with congenital, reducible atlantoaxial dislocation. Brooks' procedures or Goel's C1/2 fusion, Ransford's contoured rod fusion, Jain's occipitocervical fusion, and transoral decompression and Jain's occipitocervical fusion were included. 79 of these 86 patients showed solid bone fusion on dynamic intrathecal CT scan at the follow-up of 6 months [13]. On the contrary, 15% of patients underwent unsuccessful bone fusion using wire and external bracing, bone fusion and stabilization using internal screw fixation techniques resulted in 100% fusion in 87 patients with Os odontoideum [14]. Gluf reported transarticular C1/2 screws or C1 lateral mass screws/C2 pedicle screws, plates and posterior bone grafts were superior to the rates after a Gallie fusion [15].

Fig. 4 Postoperative X-rays, stable atlantoaxial fusion performed using two dynamic compression plates in ap (**a**) and lateral (**b**) view

Fig. 5 Computed tomography and MRI scans showing the position of the cervical spine was corrected and the spinal cord was decompressed (a, b). And the screws were well placed in both side of lateral mass of atlas (c)

Fig. 6 X-rays taken at 6th postoperative month showed solid bone fusion of C1/C2 in ap (a) and lateral (b) view

Some of the literatures reported that irreducible atlantoaxial dislocation required posterior decompression and occipitocervical fixation or posterior bone fusion and fixation and an additional transoral decompression [9, 16]. However, those procedures do not correct the swan neck deformity. And surgical fixation of atlantoaxial joint in a hyperlordotic position could precipitate the degenerative changes in the lower cervical spine [12, 17]. Because of the irreducible subluxation of C1/2, single posterior approach bone fusion and fixation procedure may not be optimal for the patient. Wang found most of the irreducible atlantoaxial dislocation could become reducible after anterior release without odontoid resection. And then irreducible atlantoaxial dislocation might be reduced and the additional posterior atlantoaxial or occipitocervical bone fusion and fixation could provide immediate and long-term stabilization [12]. To reduce the potential morbidity of the transoral approach, the endonasal endoscopic anterior decompression of the cervicomedullary junction combined with the posterior approaches occipitocervical fusion was performed in a 50-year-old woman with Os odontoides [18]. The posterior approach bone fusion and fixation combined transoral approach release were thought to be appropriate to Os odontoides with irreducible atlantoaxial

dislocation. However, this operative procedure to the upper cervical spine produced too much traumatic.

In comparison, anterior internal fixation through a single transoral approach for treating irreducible atlantoaxial dislocation is an atraumatic technique when compared with the above-operative procedure. Ai [19] reported applied anatomy of transoral approach is suitable for anterior screw–plate fixation. Yin [20] designed transoral atlantoaxial reduction plate fixation for irreducible atlantoaxial dislocation and the postoperative effect was satisfactory. Oropharynx is a contamination situation, however. Therefore, prevention of surgical infection is very important. Plenty of blood supply of posterior pharyngeal wall and careful preoperative prepare, such as oral hygiene and prophylactic antibiotic therapy, the transoral approach has a low risk of infection. Menezes [21] reported only one case of retropharyngeal infection among the 280 patients who were treated by transoral–transpalatopharyngeal approach to the craniocervical junction. To our experience, preoperative dynamic X-rays, computed tomography, three-dimensional computed tomography and MRI scans provided an invaluable aid to preoperative planning. According to the imaging studies and the patient's clinical symptoms, we think the patient had symptoms secondary to

the compression of the posterior arch of the C1. Therefore, reduction of subluxation of C1/2 and stabilization of the C1/2 decompress the spinal cord, and then all symptoms relieved postoperatively. And perioperative, the reduction of subluxation of C1/2 trended to redislocation after the single anterior release. Therefore, assistance of skull traction is very important to maintain the reduction of subluxation of C1/2 and it offers a favorable condition to place the screws and plates. And two dynamic compression plates were used to provide immediately and long-term stabilization to maintain the reduction of subluxation of C1/2. Postoperative, the patient was free of all symptoms and the reduction of subluxation of C1/2 got solid bone fusion the 6th postoperative month.

Our technique provides an atraumatic and effective operative procedure in the treatment of Os odontoideum with irreducible atlantoaxial dislocation. We think it is suitable for Os odontoideum with irreducible atlantoaxial dislocation which causes the symptoms secondary to the compression of the posterior arch of the C1. Moreover, it is helpful in the reduction of subluxation of C1/2, which decompresses the spinal cord.

Conclusion

Single transoral approach release, reduction using an assistance of skull traction, bone fusion and stabilization in the treatment of Os odontoideum with irreducible atlantoaxial dislocation is an atraumatic and effective operative procedure. In addition, preoperative dynamic X-rays, computed tomography, three-dimensional computed tomography and MRI scans provided an invaluable aid to select this operative procedure.

Conflict of interest statement None of the authors has any potential conflict of interest.

References

- Klimo P Jr, Rao G, Brockmeyer D (2007) Congenital anomalies of the cervical spine. *Neurosurg Clin N Am* 18:463–478
- Stulik J, Vyskocil T, Sebesta P, Kryl J (2007) Atlantoaxial fixation using the polyaxial screw-rod system. *Eur Spine J* 16:479–484
- Acosta FL Jr, Quinones-Hinojosa A, Gadkary CA, Schmidt MH, Chin CT, Ames CP, Rosenberg WS, Weinstein P (2005) Frameless stereotactic image-guided C1–C2 transarticular screw fixation for atlantoaxial instability: review of 20 patients. *J Spinal Disord Tech* 18:385–391
- Brecknell JE, Malham GM (2008) Os odontoideum: report of three cases. *J Clin Neurosci* 15:295–301
- Dai L, Yuan W, Ni B, Jia L (2000) Os odontoideum: etiology, diagnosis, and management. *Surg Neurol* 53(106–108):108–109
- Gluf WM, Schmidt MH, Apfelbaum RI (2005) Atlantoaxial transarticular screw fixation: a review of surgical indications, fusion rate, complications, and lessons learned in 191 adult patients. *J Neurosurg Spine* 2:155–163
- Matsumoto M, Chiba K, Tsuji T, Maruiwa H, Toyama Y, Ogawa J (2002) Use of a titanium mesh cage for posterior atlantoaxial arthrodesis. Technical note. *J Neurosurg* 96:127–130
- Reilly CW, Choit RL (2006) Transarticular screws in the management of C1–C2 instability in children. *J Pediatr Orthop* 26:582–588
- Salunke P, Behari S, Kirankumar MV, Sharma MS, Jaiswal AK, Jain VK (2006) Pediatric congenital atlantoaxial dislocation: differences between the irreducible and reducible varieties. *J Neurosurg* 104:115–122
- Subin B, Liu JF, Marshall GJ, Huang HY, Ou JH, Xu GZ (1995) Transoral anterior decompression and fusion of chronic irreducible atlantoaxial dislocation with spinal cord compression. *Spine* 20:1233–1240
- Osti M, Philipp H, Meusburger B, Benedetto KP (2006) Os odontoideum with bipartite atlas and segmental instability: a case report. *Eur Spine J* 15(Suppl 5):564–567
- Wang C, Yan M, Zhou HT, Wang SL, Dang GT (2006) Open reduction of irreducible atlantoaxial dislocation by transoral anterior atlantoaxial release and posterior internal fixation. *Spine* 31:306–313
- Behari S, Bhargava V, Nayak S, Kiran KM, Banerji D, Chhabra DK, Jain VK (2002) Congenital reducible atlantoaxial dislocation: classification and surgical considerations. *Acta Neurochir (Wien)* 144(116):5–1177
- Klimo P Jr, Kan P, Rao G, Apfelbaum R, Brockmeyer D (2008) Os odontoideum: presentation, diagnosis, and treatment in a series of 78 patients. *J Neurosurg Spine* 9:332–342
- El MM, El AW, Sadek FZ, Salah H (2007) Two methods of atlantoaxial stabilisation for atlantoaxial instability. *Acta Orthop Belg* 73:741–746
- Qureshi MA, Afzal W, Malik AS, Ullah JS, Aebi M (2008) Os odontoideum leading to atlanto-axial instability—report of surgery in four cases. *J Pak Med Assoc* 58:640–642
- Yoshimoto H, Ito M, Abumi K, Kotani Y, Shono Y, Takada T, Minami A (2004) A retrospective radiographic analysis of subaxial sagittal alignment after posterior C1–C2 fusion. *Spine* 29:175–181
- Leng LZ, Anand VK, Hartl R, Schwartz TH (2009) Endonasal endoscopic resection of an os odontoideum to decompress the cervicomedullary junction: a minimal access surgical technique. *Spine* 34:139–143
- Ai F, Yin Q, Wang Z, Xia H, Chang Y, Wu Z, Liu J (2006) Applied anatomy of transoral atlantoaxial reduction plate internal fixation. *Spine* 31:128–132
- Yin QS, Ai FZ, Zhang K, Chang YB, Xia H, Wu ZH, Quan R, Mai XH, Liu JF (2006) Transoral atlantoaxial reduction plate fixation for irreducible atlantoaxial dislocation. *Chin J Traumatol* 9:14–20
- Menezes AH (2008) Surgical approaches: postoperative care and complications “transoral-transpalatopharyngeal approach to the craniocervical junction”. *Childs Nerv Syst* 24:1187–1193