Combined anterior and posterior surgery for treatment of cervical fracture-dislocation in patients with ankylosing spondylitis

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Objective: To discuss the pathological characteristics of cervical spinal fracture complicating ankylosing spondylitis (AS) and the effect of combined anterior and posterior operation.

Methods: Eighteen AS patients with traumatic cervical fracture-dislocation were treated operatively from January 2000 to January 2006. The symptom duration of AS was 14.5 years on average. Three cases had undergone osteotomy in lumbar spine. There were 4 cases of Grade A, 3 cases of Grade B, 9 cases of Grade C and 2 cases of Grade D according to Frankel's score. There were 15 cases of Grade III dislocation and 3 cases of Grade II. All patients underwent surgical procedures by combined anterior and posterior approach.

Results: There were 4 anterior-posterior procedures, 8 anterior-posterior-anterior procedures and 6 posterior-anterior procedures. Seven patients had one stage operation and 11 cases underwent two stage surgeries. There was certain extent of neurological improvement in 14 incomplete paraplegic patients, but no improvement in 4 complete paraplegic patients. The follow-up period was 21.2 months on average and the time for bone fusion was 3.6 months. There were 4 complications during operation and a long-term complication in follow-up.

Conclusions: The study suggests that anterior combined with posterior approach makes the spine stable and relieves the pressure immediately. It is a reasonable surgical strategy for treatment of cervical spinal fracture-dislocation with AS.

Key words: ***Spondylitis, ankylosing; Cervical vertebrae; Fractures, bone; Dislocations; Surgical procedures, operative***

Chin J Traumatol 2009; 12(3):148-152

The cervical spine is the most common fracture site in patients with ankylosing spondylitis for its special anatomy and biomechanical characteristics, making the treatment different from other types of cervical fractures.[1] We retrospectively analyzed 18 cervical fracture patients who had ankylosing spondylitis and were admitted to our department from January 2000 to January 2006 to investigate the therapeutic value of combined anterior and posterior surgery.

General data

All 18 patients were male, from 35 to 60 years old (mean 45). Three patients had a history of lumbar spinal osteotomy. The cervical spines of the patients were fixed to anteflexion position before injury (Fig.1). All the cervical fractures were fresh, in which 5 cases were slightly injured by anterior force, and the other 13 were injured by posterior force. X-ray and MRI showed all the fractures were accompanied by osteoporosis and dislocation. Cervical disc dislocation was found in 8 cases (Figs.2, 3), and vertebral dislocation in10 cases (Fig.4). C_4-C_5 dislocation was confirmed in 3 cases, C_6-C_7 in 10 cases, and C_5-C_6 in 5 cases. One of them was associated with odontoid fracture. There were 4 cases of Frankel A, 3 cases of Frankel B, 9 cases of Frankel C, and 2 cases of Frankel D according to Frankel's score.

Treatment

All patients underwent skull traction before operation (10 kg). If X-ray showed partial reduction, anterior decompression and fixation were performed, then posterior surgery was followed (anterior-posterior procedure,

DOI: 10.3760/cma.j.issn.1008-1275.2009.03.005

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A-P). If reduction of dislocation could not be achieved by anterior surgery, posterior reduction and fusion was adopted, then anterior fixation was performed (anterior-posterior-anterior procedure, A-P-A). If reduction of dislocation could not be achieved by skull traction, posterior surgery should be performed prior to anterior fusion (posterior-anterior procedure, P-A). The internal fixation was selected by the position and range of the fracture.

Technique

Anterior surgery was performed as the common procedure including subtotal resection of the fracture vertebra, decompression and reduction of the spine. Internal fixation was placed after fusion. If dislocation was rigid and irreducible, posterior reduction and fixation should be adopted without hesitation. Remove the twisted parts of zygapophyseal joints and ligamentum flava, and then reduce the spine by lifting the spinous process. Wires and U-rod or screws were assembled into two segments above and below the fracture site respectively. After fixation of screws, outer cortex of the lamina was removed and interlaminal fusion was made. Turn the patient to supine position, remove the fracture fragment and decompress the spinal cord. If there was no obvious vertebral fracture, curette the discs and lamina terminalis on the dislocation site and fuse the spine with bone graft. Anterior fixation could be added to non-osteoporotic patients. If the internal fixation was difficult on the site of cervical-thoracic site, simple bone graft fusion without fixation could be performed.

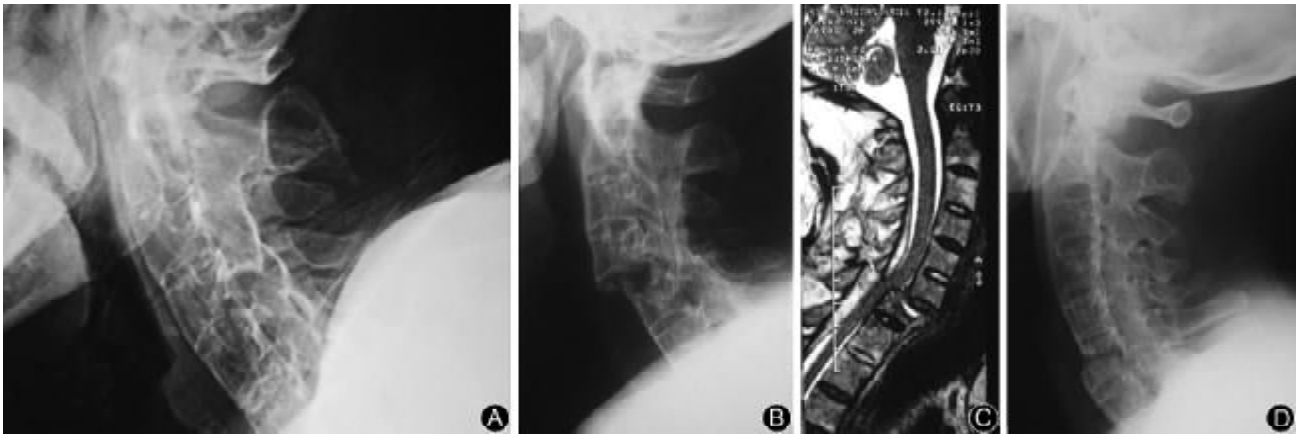

Fig.1. The distance between the head and shoulder was shorten in a patient with ankylosing spondylitis and osteoporosis. **Fig.2.** C_{4-5} fracture-dislocation with twisted joints. **Fig.3.** MRI showed dislocation in C_{6-7} disc and C_7 compressive fracture. **Fig.4.** C_6 vertebral fracture with odontoid fracture.

RESULTS

Therapeutic effects

All surgeries were implemented successfully. The average blood loss was 2 100 ml (1 700-2 350 ml). Average operation time was 8.1 hours (6.5-9.0 hours). There were 4 cases of A-P procedure, 8 cases of A-P-A procedure, and 6 cases of P-A procedure. Seven cases underwent one-stage surgery, and 11 two-stage surgery. In the early 4 cases, dislocation failed to be reduced by anterior surgery, so the following vertebral resection, decompression, fusion and internal fixation were performed. But 3 to 7 days later, X-ray showed mobilization of internal fixation, posterior reconstruction surgery was then performed. U-rod and wire fixation was used in 2 cases, and the others used lateral mass screw fixation and interlaminal fusion. All cases were followed up for 10 months-6 years (mean 21.2 months). After half a year to two years' follow-up, four Frankel A patients did not show improvement. One of the Frankel B patients improved to Frankel D. One of the Frankel C patients improved to Frankel E. Two Frankel D patients improved to Frankel E (Table 1). After 3.6 months (2.8 to 4.5 months), bony fusions were achieved in all 18 cases without fixation failure (Fig. 5).

Complications

Perioperative complication occurred in 4 cases including two cases of pneumonia in which 1 case was recovered by antibiotic treatment, while another died. There was 1 case of hoarseness that induced by traction injury to retropharyngeal nerve, and was recovered 3 months later. There was 1 case of cerebrospinal fluid leakage. After 7 days of administration of acetazolamide, the leakage volume was less than 50 ml/day, and the drainage was stopped. There was 1 case of long-term

Chinese Journal of Traumatology 2009; 12(3):148-152

complication of esophageal fistula that happened one year after the operation. The anterior internal fixation was then removed and the fistula was repaired. The patient was recovered after 2 weeks' gastrointestinal nutrition.

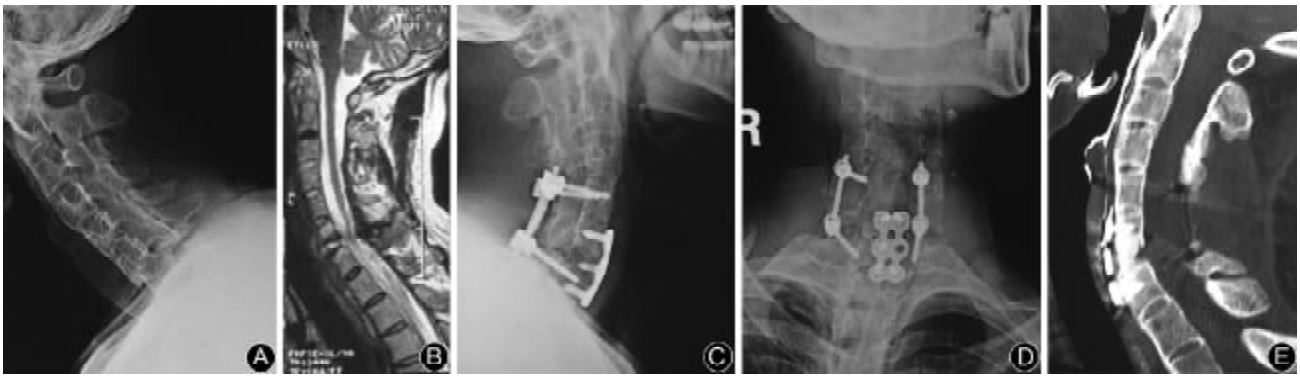

Fig.5. A 38 years old male patient with C_{6-7} fracture-dislocation and ankylosing spondylitis underwent posterior decompression, pedicle screw fixation (C_{5-7}), anterior resection of C_6 vertebra with iliac implant and fixation. **A:** Preoperative X-ray showed C_6 fracture with C_{6-7} anterior dislocation and twisted joint. **B:** MRI showed spinal cord compression. **C** and **D:** Postoperative X-ray showed satisfactory reduction and internal fixation. **E:** CT showed bony fusion 4 months later.

Table 1. The neurological function of cervical fracture-dislocation in 18 patients with ankylosing spondylitis

Preoperative Frankel's score	Cases	Postoperative Frankel's score	Cases	Death
A	4	A	3	1
B	3	B	0	0
C	9	C	2	0
D	2	D	9	0
E	0	E	3	0

DISCUSSION

Features of cervical spinal fracture with ankylosing spondylitis and its treatment

Low energy trauma, high neurological and respiratory complication rates are typical features of cervical spinal fracture with ankylosing spondylitis. If without effective treatment, its early mortality would be up to 20%-57%, twice the number of normal cervical fractures.[2] The flexibility of the cervical spine with ankylosing spondylitis is reduced prominently. The trabecula of the vertebra is sparse and small. The contact area of the non-fused zygapophyseal joints reduces. The biomechanical weaknesses make the cervical spine vulnerable to injury. The lower cervical spine, cervical-thoracic junction, and the discs are vulnerable points to fracture. The fractures are divided into compressive, hyper-extensive and shearing types by different forces exerted. The fracture-dislocation caused by shearing force is commonly seen, constituting 73% of all fractures.[3] In this series, 72% were anterior dislocation with unilateral or bilateral twisted joints (13/18), which is attributed to the fragile anteversive spine.[4]

Since the great distinction in biomechanics and pathology, the treatment of the cervical spine fracture concurrent ankylosing spondylitis is substantially different from the normal cervical fractures. Ankylosing spondylitis is a systemic disease in which multiple organs involved and great risks exist in surgery. In the past, patients with ankylosing spondylitis suffering from cervical fractures were treated conservatively consisting of skull traction, Halo-vest or head and chest cast. In this series, only 22% dislocations were reduced (4/18) after skull traction. Articles showed that skull traction could not satisfactorily reduce or stabilize the cervical spine due to the stiff spine and its irreducible surrounding soft tissues. Dilemma is confronted when low traction force is difficult to reduce the twisted joints, but over-traction may aggravate spinal trauma. Simple external fixation cannot exterminate the mobilization between the fracture sites, leading to pseudoarthrosis.[5] The rates of complication and pseudoarthrosis of skull traction are high.[6] Therefore, surgical treatment is an effective way to stabilize the vulnerable spine because it can offer direct decompression, avoid complications caused by long-time traction and external fixation.

Traditional surgical treatment of cervical fractures with ankylosing spondylitis

The purpose of surgical treatment is to decompress the spinal cord, reduce dislocation and exterminate vertebral mobilization. Cervical fractures of ankylosing spondylitis are unstable ones involved in three columns of the spine. Solid internal fusion cannot be achieved by simple anterior or posterior surgery. Einsiedel et al[3] reported the failure rate of anterior internal fixation being 50%. In our study, four cases of Grade II dislocation were treated by simple anterior surgery. Instant reduction was successful during the operation. But screw loosening and implant mobilization occurred in all cases during follow-up period. We found that anterior implant is unable to resist or absorb the tension from the posterior spinal column in three-column spinal injury. The rigid spine above and below the fracture makes the interface of vertebra and implant become a confluence point of stress. The factor for implant failure attributes to that the interface of the vertebra and the superior part of the implant is the fulcrum of load bearing. So the posterior fusion is adopted.

Though simple posterior fusion is successful in some cases, Cooper et al[6] proved that single posterior fusion was prone to fail because there was too much stress on the posterior internal fixation without the anterior support. Moreover, discs are the most common location of dislocation in cervical fractures with ankylosing spondylitis. Spontaneous fusion is impossible due to the interference of nucleus tissue. Single posterior operation cannot decompress the spinal cord by removing the fragment of bone, discs or epidural hematoma from the anterior part. Therefore, the combined anterior and posterior surgery is an effective way to decompress the spinal cord with low failure rate of internal fixation.[7]

Combined anterior and posterior surgery

We believe that the combined anterior and posterior surgery is an effective means because of its high spinal recovery and low implant failure. In a multicenter study, Einsiedel et al[3] found that all the 13 cases of combined anterior and posterior surgery were successful. Olerud et al[7] also proved the effectiveness of combined anterior and posterior surgery. In our study, all patients who underwent combined anterior and posterior operation had varied degrees of neurological improvement. The average time for bony fusion was 3.6 months. There was no implant failure. Anterior reduction, however, failed in 8 cases of Grade III dislocation with bilateral joint twist. It is attributed to improper selection of patients. All 8 cases were satisfactorily reduced in combined surgeries. The rates of infection, mortality and complication in cervical fracture concurrent ankylosing spondylitis were higher than single cervical fractures. Therefore, it is important to note that, excessive exposure and bleeding in combined anterior and posterior surgery makes patients intolerable because of their poor general conditions. These patients should be operated by stages. Though the two-stage surgery prolongs hospital stays, the infection caused by longtime surgery is reduced.

Rigid kyphotic cervical spine, especially the cervical-thoracic part, is difficult to expose in operation. Overtraction of the trachea and esophagus may lead to retropharyngeal injury or postoperative hypostatic pneumonia. In our series, there was one case of retropharyngeal injury and two cases of pneumonia. Proper selection of anterior surgery is a major measure for avoiding the complications. In the operation of cervical-thoracic fracture and dislocation at the disc, if the range of defect is small after thorough decompression, anterior fusion and posterior fixation are enough. The biomechanical tests by Kotani et al[8] have proved that the stability of pedicle screws is higher than single anterior or posterior fixation, making the early exercises possible. But the application of pedicle screw in cervical fractures concurrent ankylosing spondylitis is limited by the small diameter of the pedicle and complicated anatomy. In our cases, there was one spinal artery injury caused by insufficient inclination of screw, or because of penetration of the thin external wall of the pedicle. Probing the pedicle and screwing under direct vision is favourable to reducing vertebral artery injury.

As has been mentioned, the distinction in pathology and biomechanics lead to different surgical treatments in cervical fracture with ankylosing spondylitis. The combined anterior and posterior surgery is an effective way to decompress the spinal cord with three dimensional stability and low implant failure. The proper selection of patients, suitable management of the whole body condition, reliable fixation and fusion are essential to achieve a satisfactory effect.

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(Received November 27, 2008)
Edited by SONG Shuang-ming