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Single anterior approach for cervical spine fractures at C5-T1 complicating ankylosing spondylitis

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ABSTRACT

Objectives: To evaluate the outcomes of anterior approach for cervical spine fractures at C5-T1 in patients with ankylosing spondylitis (AS) and study the problems encountered in diagnosis and treatment.
Patients and methods: Ten patients with AS (all males; mean age 43.7 ± 9.4 years) underwent anterior surgeries to treat fractures at C5-T1. Skull tractions were performed on patients with fracture dislocation preoperatively. After operation, all the patients wore a cervical collar for 3 months. Plain radiographs at follow-up were reviewed. If bone fusion could not be confirmed on plain radiograph, CT scan was employed. The pre- and postoperative neurological statuses were evaluated according to the Frankel grading system. Problems encountered in diagnosis and treatments were analyzed.
Results: The mean follow-up was 41.2 ± 22.7 months. After operation, the displacements of fractures were significantly reduced($P < 0.05$). Bone fusions were observed in 9 patients at final follow-up. Frankel grades improved by 1.0 ± 0.7 grade ($P > 0.05$). Posterior complications occurred in four patients, including implants failure (n = 1), subsidence of cage (n = 1), hoarse voice (n = 1) and pneumonias (n = 2). The patient with implants failure required revision surgery and anterior–posterior fixation. Patient with subsidence of the titanium cage achieved bone fusion with prolonged cervical collar immobilization.
Conclusion: The diagnosis and treatment of cervical spine fractures at C5-T1 in AS patients are challenging, with high risk of neurological compromise and postoperative complications. The single anterior approach followed by postoperative immobilization with a cervical collar can yield acceptable results if the cases are properly selected.

1. Introduction

Ankylosing spondylitis (AS) is a chronic inflammatory disease predominantly affecting the axial skeleton and sacroiliac joints; it is characterized by ossification of the spinal ligaments, annulus fibrosus and joints, leading to progressive rigidity and altered biomechanics of the spine [1–6]. Additionally, diffuse osteoporosis can develop at the early stage of AS, decreasing the strength of bone [7,8]. The ankylosed and fragile spine is then susceptible to fracture with minor or unknown trauma [1,2,9]. The morbidity of spine fracture in AS is 3.5 times higher than that in the normal population [10,11]; about 75% of these fractures occur in the cervical spine, mostly at C5-C7 [1,6,12–14].

Cervical spine fractures in AS often affect all three columns and are prone to displacement, which is associated with neurological deficits and fatal complications [2,13,15–17]. Fractures at C5-T1 in AS patients are easily missed due to osteoporosis, kyphotic deformity, minor trauma, and overlap of shoulders [4,6,12,14,18–20]. The treatment of these fractures is challenging due to marked instability, osteoporosis, and kyphotic deformity [6,10,17,21,22]. At present, successful treatments using the posterior approach or combined anterior–posterior approaches have been largely described, while there are few reports on the single anterior approach [6,23–26]. However, combined anterior–posterior approaches or the posterior approach are not always indicated, and there are some complications associated with these two methods [6,22,27–30]. Therefore, this study aimed to evaluate the outcomes of the anterior approach for treating C5-T1 fractures in AS patients, and investigate the problems encountered in diagnosis and treatment.

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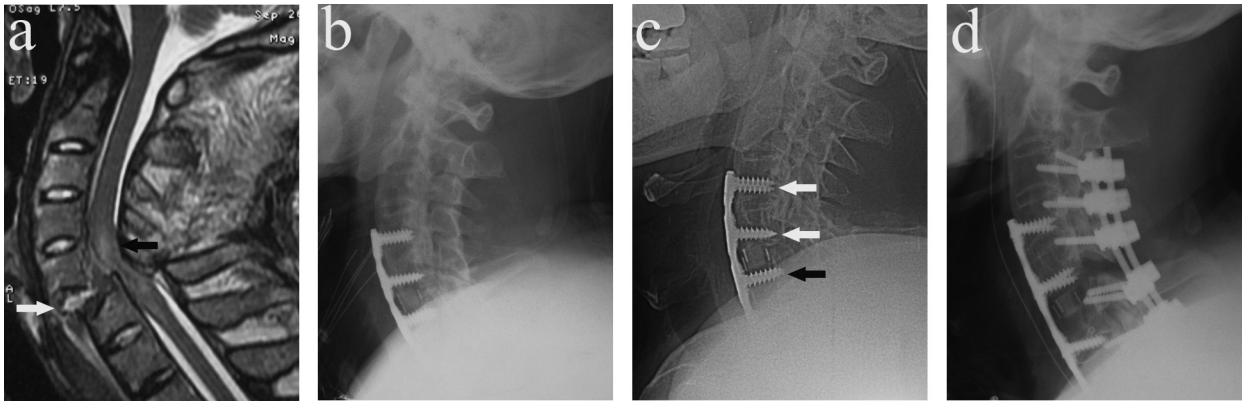

Fig. 1. a Preoperative MRI on T2WI showed severe C5/6 fracture and dislocation (white arrow) with intramedullary hyperintensity (black arrow). b Postoperative X-ray failed to reveal the caudal screws due to overlap of shoulders. **c** Postoperative X-ray at day 10 showed screw loosening (white arrows) and screw misplacement into the intervertebral space (black arrow). d X-ray after revision surgery.

Table 1
General information of patients.

Subject	Age (years)	Duration of ankylosing spondylitis (years)	Traumatic event	Segment	Dislocation	Fracture extend	Time to surgery (days)	Cervical alignment
1	33	12	Fall	C6/7	GradeI	3-column	7	Lordosis
2	45	18	No	C7/T1	No	Anterior column	1	Lordosis
3	56	20	Fall	C6/7	GradeI	3-column	0	Lordosis
4	55	22	Motor vehicle accident	C5/6	GradeII	3-column	0	Lordosis
5	58	27	Motor vehicle accident	C6/7	No	3-column	0	Lordosis
6	34	13	Fall	C7/T1	No	Anterior column	2	Lordosis
7	40	10	Fall	C6/7	GradeI	3-column	5	Lordosis
8	37	12	Fall	C5/6	No	Anterior column	0	Lordosis
9	41	14	Fall	C6/7	No	Anterior column	0	Lordosis
10	38	15	Motor vehicle accident	C6/7	GradeI	3-column	0	Lordosis

2. Material and methods

This study was approved by the ethics committee of our hospital. Ten patients with AS (all males; mean age 43.7 ± 9.4 years, range 33–58 years) underwent anterior surgical procedures to treat fractures at C5-T1 between April 2002 and June 2009. The inclusion criteria were: anterior column compression fracture without obvious dislocation; fractures passing intervertebral discs without obvious dislocation; fractures without kyphosis and severe osteoporosis; patients with low level of activity who would spend most of the early postoperative phase in bed or a wheelchair due to factors including neurological deficits, multiple injuries, and ventilation. We defined the dislocation according to the method of lumbar spondylolisthesis. Obvious dislocation often means that there are great stresses at the site of fracture, which may be an important cause of implant failure; therefore, all included cases had no more than grade I dislocation, except for one case with grade II dislocation. Preoperative radiography and computed tomography (CT) were performed to evaluate cervical-thoracic kyphosis, and the relative positions of the fracture level, manubrium sterni and shoulder to ensure the feasibility of the anterior approach. Cases with severe kyphosis requiring additional posterior surgery were excluded from this study.

The general information is summarized in Table 1. All ten cases were positive for HLA-B27 antigens. Clinical symptoms at presentation ranged from neck pain alone to complete loss of function distal to the level of injury. All patients had preoperative plain radiography, CT and magnetic resonance imaging (MRI) performed. Two fractures that were not recognized on plain radiographs were identified as three-column fractures on CT imagery. MRI showed reduced signal intensity on T1-weighted images (T1WI) with increased signal intensity on T2-weighted images (T2WI) in eight cases, and reduced signals on both T1WI and T2WI in two cases. Spinal cord compressions were recognized in nine patients, some of which were complicated by traumatic disc herniation or intramedullary hyperintensity on T2WI. After admission, skull tractions were performed on patients with fracture dislocations while they were conscious. The traction direction was chosen while taking the preexisting cervical-thoracic alignment into consideration, as placing the neck in an extended position may have induced neurological complications. Traction was monitored by repeated clinical evaluations to detect potential neurological worsening including alteration of consciousness. Preoperative planning included blood group examination and cross-matching, and preparation of cell saver and topical hemostatic agents.

All patients underwent anterior decompression, fusion and fixation under general anesthesia by fiber optic intubation. Somatosensory and motor-evoked potentials were used to monitor neurologic function during the intubation and positioning phases, and during surgery. Rigid plates were placed at least one level above and below the injury sites. If it was difficult to reduce the fracture and there were great stresses at the fracture sites, instrumentation was placed two levels above and below the fracture site.

All patients wore a Philadelphia cervical collar at least for 3 months postoperatively. Plain radiographs were taken at 3 and 6 months postoperatively, and at final follow-up. If bone fusion could not be confirmed on plain radiography, CT was used. The pre- and post-operative neurological statuses were evaluated according to the Frankel grading system [31]. Problems encountered during diagnosis and treatments were analyzed.

The values were presented as mean and standard deviation. Paired t test and Mann-Whitney U test were used for statistical analysis. Probability values less than 0.05 were considered statistically significant. Analyses were performed using SPSS (SPSS Inc., Chicago, IL) 17.0.