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Surgical Treatment of Lower Cervical Tuberculosis With Kyphosis Deformity

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The objective of this paper was to investigate the outcome of the patients with lower cervical tuberculosis with kyphosis deformity who underwent 1-stage anterior debridement, autograft fusion combined anterior or posterior fixation. From January 2007 to December 2012, 10 cases were enrolled in this retrospective study. There were 7 patients with cervical deformity and 3 with cervicothoracic kyphosis. Seven patients underwent anterior debridement and reconstruction, using iliac crest or cage with autograft, while 3 patients with cervicothoracic kyphosis received single-stage kyphosis correction and posterior fixation combined anterior debridement and autograft fusion. Neurologic function of all the patients was evaluated by JOA score and visual analogue scale (VAS) score. Patients were followed up for 26 months on average. The mean preoperative focal kyphotic angle was 49.1° (range, 25–90°), reducing to –4.9° (range, –15 to 13°) postoperatively at the last follow-up visit. Neurologic assessment of all the patients using the JOA and VAS score was improved significantly after surgery. All patients had solid fusion and no major complications were observed in the follow-up. One-stage anterior debridement, autograft fusion combined anterior or posterior fixation was demonstrated to be a safe and effective method to achieve spinal decompression and kyphosis correction in patients with lower cervical tuberculosis.

Key words: Cervical tuberculosis – kyphosis deformity – Internal fixation – Anterior – Posterior

As the most common extrapulmonary form of tuberculosis (TB), spinal tuberculosis is a growing hazard worldwide and has an aggressive behavior of profound vertebral destruction and severe complications.[1] Patients with spinal tuberculosis often suffer from severe spinal cord damage and kyphosis deformity requiring surgical treatment. In the cervical or upper thoracic spine, the spinal cord is prone to be compressed.[2] Paravertebral disease can cause pathologic subluxation or

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dislocation of the spine and the resultant instability can damage the cord.[3] Pedicle involvement is also part of the disease process and usually associated with relatively severe vertebral body and disc destruction, wide prevertebral abscess, and severe kyphosis.[4]

In our study, the clinical and radiographic results of 10 patients of lower cervical tuberculosis with kyphosis deformity were evaluated. We propose that a 1-stage procedure, with an anterior approach for cervical kyphosis and a posterior approach for cervico-thoracic kyphosis, supplemented with chemotherapy and nutritional support can achieve a satisfactory outcome.

Materials and Methods

Patient data

From January 2007 to December 2012, 10 patients of lower cervical tuberculosis with kyphosis deformity formed the study group. There were 7 males and 3 females with an average age of 37.5 years (range, 25–47 years). The indications for surgery were radiologic demonstration of a cervical or cervico-thoracic vertebral lesion, presence of acid-fast bacilli detected on direct examination, bone destruction with progressive kyphosis deformity, poor response to medical treatment, deterioration in neurologic, status and mechanical instability.

The number of vertebrae involved in the fusion mass ranged from 3 to 8. On the lateral plain X-ray films as suggested by Rajasekaran,[5] kyphosis was measured before and after the operation and also at the final follow-up. According to the criteria described by Lee *et al*, postoperative radiographs were examined to assess the level of bony fusion.[6] Magnetic resonance imaging (MRI) was performed to evaluate the site of compression and status of the cord. The Japanese Orthopaedic Association (JOA) scores[7] were 8 in 7 patients, 9 in 1 patient and 6 in 2. The mean visual analogue scale (VAS) score was 4.3 (range, 3–7).

Surgical technique

Before the operation day, all patients were treated with antituberculous therapy until the erythrocyte sedimentation rate (ESR) decreased to 20 mm/h. The surgical procedure for the 7 cervical kyphosis patients comprised of anterior debridement, corpectomy, and fixation with iliac crest grafts or titanium cage, and anterior cervical plate. This was the standard practice for the treatment of this series of cases. In these patients, a corpectomy and discectomy were performed, and all necrotic and devitalized tissues were removed as far as possible until normal bleeding bone was reached. The spinal cord was then decompressed carefully. With the destruction of focal vertebrae, 1 healthy vertebra above and 1 below were incorporated for spinal instrumentation. Bone graft taken from iliac crest were used to fill in the defect after the debridement of the diseased vertebrae, or inserted into the cage then placed into the resected vertebra body. Before the bone graft was wedged into the defect, a Caspar distractor was used to correct the kyphosis deformity. Intraoperative anteroposterior and lateral fluoroscopic images were taken to confirm the correction of deformities and graft position.

Three patients with severe deformity, with a kyphosis magnitude over 60°, underwent skeleton traction using a modified halo-vest for about 1 week before surgery. The patients received single-stage posterior and anterior combined operation and a standard chemotherapy. After the single-stage kyphosis correction and posterior fixation, the diseased vertebrae and abscess were removed by anterior approach and autograft was placed in site. The posterior fixation was operated with lateral mass screws in lower cervical spine and with pedicle screw in C7 and the thoracic spine.

Postoperative care

The patients were told to sit up in bed with cervical collar protection for 1 week after surgery and allowed out of bed with continuous cervical collar stabilization for a further 3 to 4 weeks. In addition to the antituberculous chemotherapy, intravenous antibiotic drugs were administered to all patients after surgery for 5 to 8 days until the patient was discharged from our hospital. All patients were asked to take nutritional support after surgery.

Results

All procedures were performed by one senior doctor. Average operating time was 120 minutes (range, 90–180 minutes) with blood loss of 300 mL (range, 100–600). The number of vertebrae affected in individual patients ranged from 1 to 4, and a mean of 4.35 levels were fused (range, 3–8).

The mean follow-up time was 26 months (range, 15–52 months). The focal kyphosis at the infected level before surgery averaged 49.1° (range, 25–90°), and was corrected to a mean postoperative angle of

Table 1 Clinical data of patients

Case no.	Gender/age	Diseased segments	VAS score			JOA score			Angle of kyphosis			Correction
			Pre	Post	Final	Pre	Post	Final	Pre	Post	Final	
1	F/41	C4–C5	4	2	2	6	11	12	50	−10	−12	62
2	M/39	C5–C6	3	2	1	8	11	12	40	−12	−15	55
3	M/29	C6–C7	3	2	0	8	10	11	25	−12	−13	38
4	M/36	C3–C4	4	3	2	8	9	12	32	−10	−10	42
5	F/42	C4–C6	3	1	2	9	11	11	37	−13	−11	48
6	M/40	C3–C4	4	1	0	8	11	11	30	−10	−10	40
7	F/47	C3–C4	3	1	1	8	12	12	35	−13	−15	50
8	M/31	C6–T2	6	2	1	8	11	12	90	9	10	80
9	F/45	C7–T2	7	3	2	6	11	12	70	11	12	58
10	M/25	C6–T3	6	3	2	8	10	11	82	12	13	69
Mean	37.5		4.3	2	1.3	7.7	10.7	11.6	49.1	−4.8	−4.9	54.2

–4.8° (range, –13 to 12°). The pre-operative motor deficits improved significantly after surgery. No patient developed a pseudarthrosis or proximal junction kyphosis. All patients received an appropriate course of antibiotics as recommended by the infectious disease consultants after the surgery. All patients experienced complete healing of their spinal infections.

The postoperative JOA score was 12 in one patient, 11 in 6 patients, 10 in 2 patients and 9 in 1, improving from pre-operative 7.7 to 10.7 points on average. The pain level decreased gradually throughout the follow-up period in all 10 patients. The mean pre-operative VAS was 4.3 (range, 3–7). This decreased significantly to 1.3 (range, 0–2) at the last follow-up (Table 1).

The wounds were healed without chronic infection or sinus formation. Fusion was evaluated by flexion-extension radiographs. All patients achieved fusion at the last follow-up (Figs. 1 and 2). There was no recurrence of disease in any of the patients at the last follow-up.

Discussion

For active spinal tuberculosis, anterior debridement is imperative. Anterior debridement, strut grafting fusion and fixation, has become the standard for surgical treatment of spinal tuberculosis.[8] The disadvantages of the anterior approach used alone include insufficient kyphosis correction and postoperative loss of correction. For mild kyphosis, it has been associated with long-term loss of deformity correction, although the problem can be alleviated by anterior instrumentation.[9] Most reports focus application of anterior surgery on patients with deformities less than 30°, as it has limited correction capacity on kyphosis of greater severity.[10,11] Furthermore, it is not suited for patients with multiple-level involvement. Other surgeons attempted to address this challenge with single-stage posterior debridement and fixation. This strategy can only be used with localized foci of no more than 3 levels and without extensive formation of abscesses.[12] Additionally, posterior debridement bears the potential risk of tuberculosis spread to the posterior healthy regions, infection, and fistulas.[13]

In all the patients of our study, neurologic recovery after surgery was remarkable. Neurologic improvement started from the postoperative day in 75% of cases. The introduction of antibiotics allowed bacterial control of the disease and healing.[14] A postoperative regimen of antituberculous drugs can effectively enter pathologic sites and recover the bone lesions.[15] Current antitubercular drugs reach pus, granulation tissue, caseous tissue, bone and cavities in concentrations well above the minimum inhibitory concentration and the lesion can be sterilized.[16,17] Serious complications with posterior vertebral column resection in thoracic and lumbar spinal TB were reported by Suk *et al*, including 6 serious hematomas, 5 implant failures that needed revision, and 2 complete cord injuries.[18] The 3 patients who underwent posterior and anterior combined surgery had no major neurologic complications due to preservation of spinal column. Our patients completed an appropriate course of antibiotics, and all of the patients experienced complete healing of their spinal infections. There were no major complications like spinal cord or root lesions.

In 10 patients with tuberculous spondylitis treated by a 2-stage operation (posterior and anterior) using posterior spinal instrumentation reported by Hirakawa *et al*, the average correction

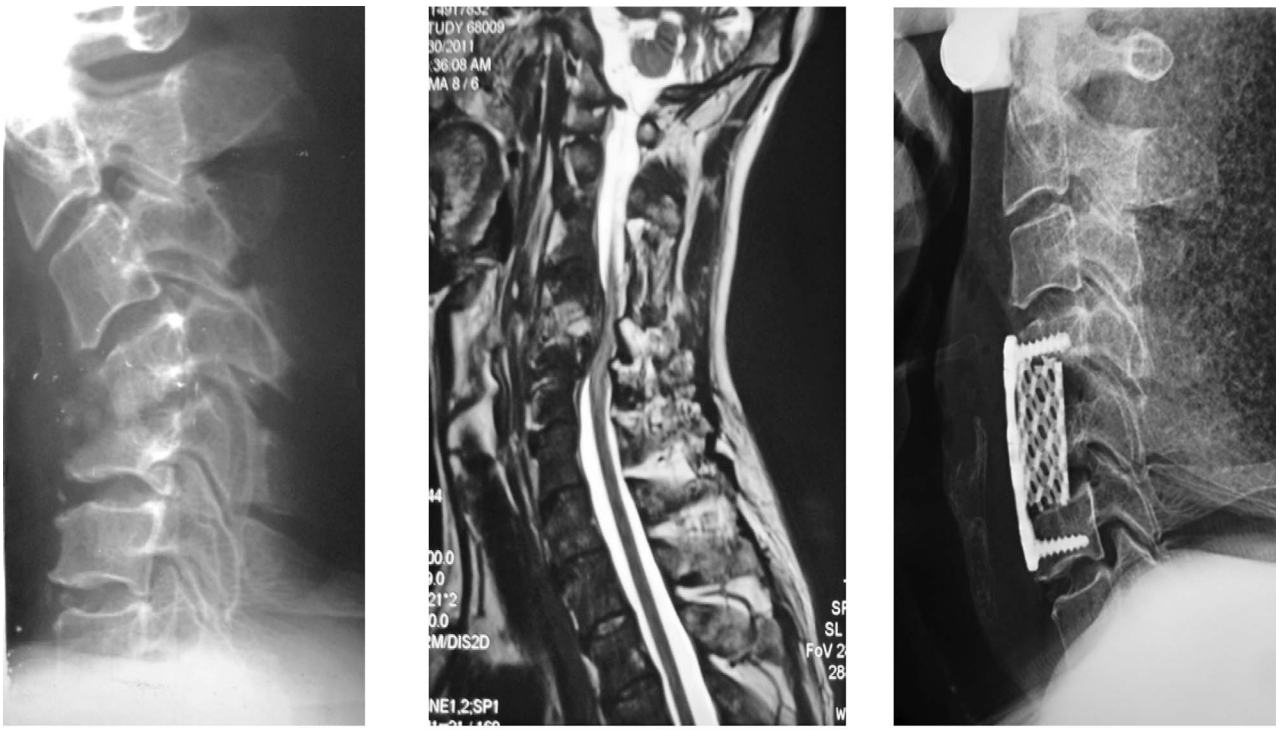

Fig. 1 A 41-year-old woman with cervical tuberculosis related to C4∼C5. After removal of diseased vertebrae and completed debridement by anterior approach, a titanium mesh-associated autograft was placed in the site followed by anterior plate stabilization. (A) Lateral X-ray before operation showed the bone in vertebral body of C4 and C5 was destructive, accompanied with kyphosis deformity of cervical column. (B) MRI before operation showed the spinal cord was compressed by tuberculosis lesion. (C) Lateral X-ray witnessed solid fusion and good sagittal alignment of cervical spine was restored at the end of follow-up period.

angle of kyphosis was relatively small.[19] In a study reported by Louw,[20] through a combined anterior/posterior approach, thoracic or thoraco-lumbar spinal tuberculosis kyphosis deformity was corrected by 50%; however, kyphosis angles remained at an average of 30° after surgery. Unlike thoracic or thoraco-lumbar kyphosis correction, the correction of cervical and cervico-thoracic kyphosis is much better, by more than 100%. In our study, the mean kyphotic angles of 7 patients with cervical kyphosis improved from 35.6° to ∼11.4° postoperatively, and at final follow-up to −12.3°; and the other 3 patients with cervico-thoracic kyphosis improved from 80.7° to 10.7° postoperatively, and at final follow-up to 11.7°. Solid fusion was achieved in all 10 cases. Neurologic conditions in all patients were improved significantly after surgery.

Thoracic transdiscal osteotomy is a safe surgical treatment of thoracic discitis with vertebral body involvement and collapse,[21] which can resect the infected disc material, achieve neurologic decompression, stabilize the spine, and correct the kyphotic deformity through a single approach in the thoracic spine. In a study of 39 adults with tuberculosis of the cervical spine described by Moon *et al*,[22] intercorporeal bony fusion has been attributed to good bony contact of the 2 involved vertebral bodies adjacent to the destruction of the disc and the end-plate cartilage at the involved level. For patients with cervical kyphosis, the anterior procedure is easy to perform and exposes the diseased segments. Removal of involved vertebra, decompression of spinal cord and correction of deformities is a safe and effective way of surgical treatment. For patients with cervico-thoracic kyphotic deformities, the single-stage posterior and anterior combined operation with correction, fixation, decompression, debridement, and fusion is practical with a satisfactory clinical outcome.

Our experience in treating lower cervical spine tuberculosis using 1-stage anterior debridement, fusion, and fixation or single-stage posterior and anterior combined operation followed by chemotherapy is feasible and safe to correct kyphosis

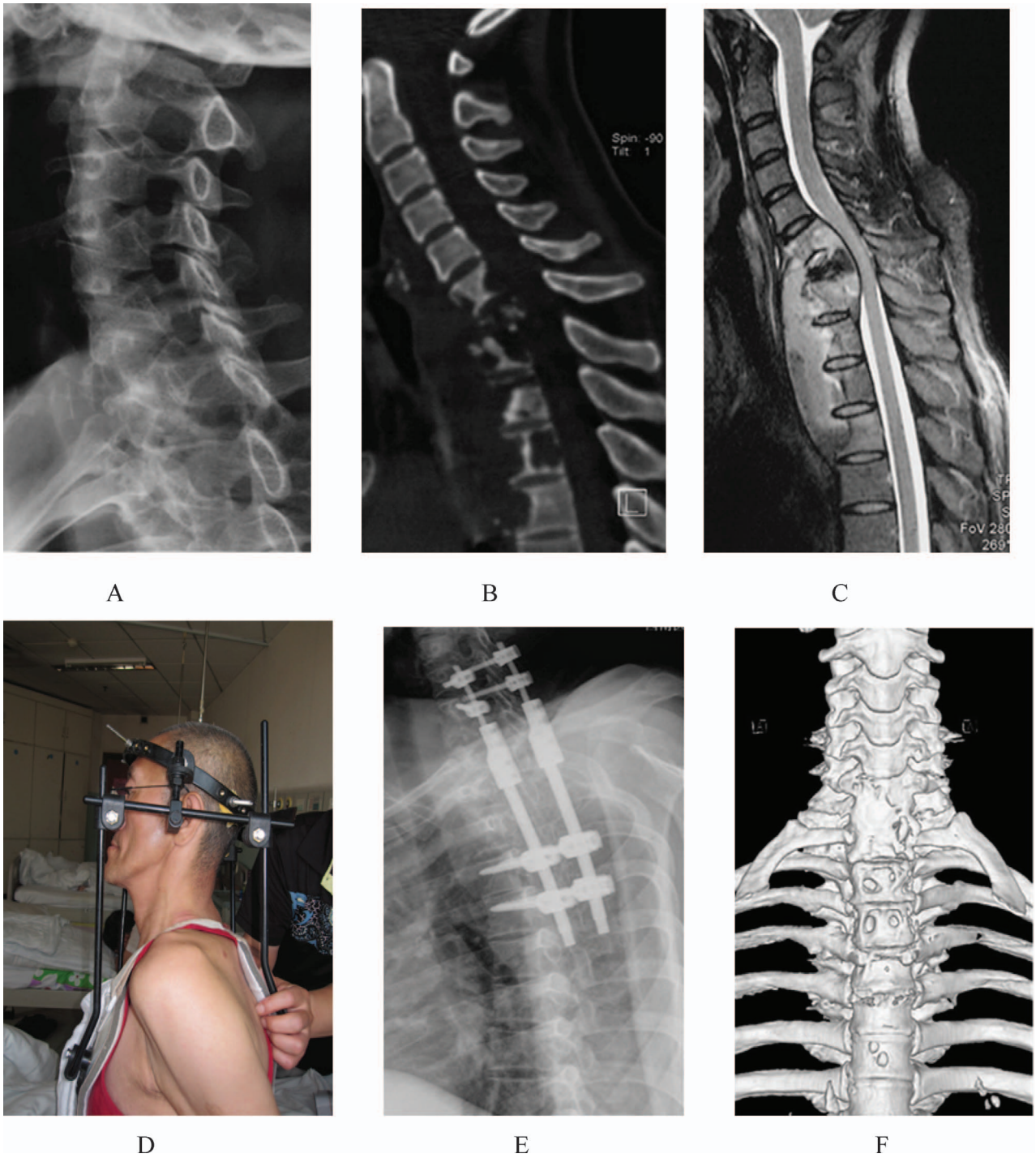

Fig. 2 A 31-year-old man with cervical tuberculosis related to C6∼T2. The patient received single-stage posterior and anterior combined operation and a standard chemotherapy. After the single-stage kyphosis correction and posterior fixation, the diseased vertebrae and abscess were removed by anterior approach and autograft was placed in site. (A, B) Lateral X-ray and CT before operation showed the bone in vertebral body of C6∼T2 was destructive, accompanied with kyphosis deformity of cervical column. (C) MRI before operation showed the spinal cord was compressed by tuberculosis lesion and abscess formed around long vertebral segments. (D) The patient with a kyphosis magnitude over 60° underwent skeleton traction using a modified halo-vest for about 1 week before surgery. (E, F) Lateral X-ray and 3D-CT witnessed solid fusion and good sagittal alignment of cervical spine was restored at the end of follow-up period.

deformity. Anterior spinal decompression and grafting with fixation in the treatment of cervical tuberculosis is safe and efficient, with effective kyphosis correction and minimal complications. For severe kyphosis deformity of the cervicothoracic junction area, pre-operative skeleton traction followed by correction and fixation is a safe process and may achieve satisfied radiographic and clinical outcome.

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