Original Article

The role of debridement and reconstruction of sagittal balance in tuberculous spondylitis

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Abstract

Background: An accepted comprehensive clinical approach to the deformed spine with tuberculous infection is still lacking. We aimed to determine the usage of a staged algorithm in the treatment of kyphotic spine with tuberculous infection and to present the clinical results of the patients treated with the help of this protocol.

Materials and Methods: 54 patients (28 females, 26 males) with a mean age of 39.2 (22-76) years. Preoperative, early postoperative, and followup clinical and radiologic results were evaluated retrospectively. The patients were classified into Kaplan A (kyphotic deformity <30°), Kaplan B (kyphotic deformity 30°-60°) and Kaplan C (kyphotic deformity >60°). They were operated by posterior instrument with anterior debridment (Kaplan A), debridment with anterior bone grafting (Kaplan B) and anterior column resection and bone grafting in Kaplan C.

Results: Tuberculous involvement were seen at more than one level in 40 patients and paraspinal abscess were detected in 31. Preoperative focal kyphotic deformity was reconstructed with an average of 19 (9-38) degrees. Twenty-six patients had neurologic compromise with different severities and 12 of them improved after the surgical intervention. Improvement in work ability and pain status was detected in 52% and 61% of the patients, respectively. Wound complications responding to medical care were detected in nine patients. Initial kyphotic deformity was found as an important parameter in selecting the surgical procedure.

Conclusion: Regarding resected amount of infected osseous material, as planned preoperatively, have resulted with better concordance between anterior and posterior column heights and better sagittal alignment. We could correct kyphosis and improve sagittal balance with staged algorithm as used by us.

Key words: Debridement, kyphosis in tuberculous spondylitis, tuberculous spondylitis

Introduction

Tuberculosis of the spine is a dangerous form of skeletal tuberculosis and it constitutes 50-60% of all osteoarticular involvements.[1] The lesion is a combination of a form of tuberculous osteomyelitis and arthritis that usually affects more than one vertebrae and may spread to the adjacent intervertebral discs.[2] Mechanical support capability of the spine may decrease parallel to the severity of the disease and the extension of the involved spinal structures. The weakened spinal units have the potential to cause serious morbidity, including permanent neurologic deficits and severe deformities, usually in the sagittal plane. Diminished bony support may be eventuated from the tubercuolus affection itself or as a result of surgical debridement. In spite of the successfull treatment results on kyphosis correction with instrumentation, grafting, and spinal osteotomies,[3-5] an accepted comprehensive clinical approach to the deformed spine with tuberculous infection is still lacking. We hypothesized that the Kaplan's severity grading system[6] may be used as a surgical algorithm in tuberculous spondylitis surgery. According to our preoperative planning approach the patients with less than 30° of kyphosis (Kaplan A) underwent debridement, posterior instrumentation, and fusion. For Kaplan B patients with moderate kyphosis (between 30° and 60°) the bone grafting was added to support anterior column. Spinal wedge osteotomy were performed in patients with more than 60° of kyphosis (Kaplan C).

The aim of this study is to present the clinical results of the patients who have kyphotic spine with tuberculous infection and treated by our protocol.

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Materials and Methods

After approval of the institutional review board, the patients who underwent a surgical procedure because of tuberculous spondylitis between 2004 and 2009 who has completed antitubercular therapy and were reviewed with minimum 24 months of followup. Sixty seven patients were operated out of which thirteen patients with inadequate data and/or who did not come to the followup evaluation were excluded from the study.

Fifty-four patients (28 females, 26 males) with a mean age of 39.2 (22-76) years were included in our study. Mean followup time since surgical treatment was 42 months (range, 24-80 months). Four drug regimen (RCin, INH, PZA, ETB) chemoterapy was started minimally 2 months before the operation and given for 9-12 months to all of the patients.[7,8] The ATT was stopped on observing clinicoradiological healing and normal acute phase reactants.

The patients were allocated into three groups according to Kaplan's classification.[6] Group A consisted of patients, whose kyphotic angles were measured to be less than 30°. The kyphosis angles of group B patients ranged from 30° to 60° and Group C patients had severe kyphosis more than 60°.

Neurologic status or patient's immune state was not taken into consideration during grouping. There were 20, 25, and 9 patients in groups A, B, and C, respectively [Table 1].

Tuberculous involvement were seen in four patients at pedicles, and transvers processes and laminae were infected in three patients. These patients have only posterior complex disease or associated with vertebral body disease. All patients had vertebral body infection and the levels were documented [Table 2]. Tuberculous involvement was limited to one vertebral body in 14 patients, two vertebral body infection associated with adjacent soft tissues was seen in 34 patients, three vertebral body infection was seen only in 6 patients. Paraspinal abscess was also detected in 31 patients and in the remaining 23 patients any markable abscess was not detected. There were not any patient affected more than three levels of infection.

Table 1: Kyphosis angle measurements

Patient groups	Number of patients	Kyphosis angle (°)		
		Preoperative	Postoperative	Followup
A:<30	20	23.2	11.4	13.6
B:30-60	25	54.5	32.7	35.3
C:>60	9	76.3	41.7	45.2
Mean		51.01	28.9	31.8

Table 2: Affected spinal levels

Levels	T4	T5	T6	T7	T8	T9	T10	T11	T12	L1	L2	L3	L4	L5
Number of patients	1	0	1	2	3	3	5	7	8	9	4	4	3	4

Preoperative, early postoperative, and followup clinical and radiological data of the patients were evaluated. Clinical examinations and laboratory test results, radiologic examination findings (including standing orthoroentgenograms and magnetic resonance imaging (MRI)), affected levels, presence of abcess, general condition, medical treatment history, and comorbidities were recorded. Kyphosis angles were measured on lateral radiographs by using Cobb method.[9] Preoperative planning of reconstruction of the sagittal contour was performed with the help of a correction simulation program on PC, considering the resection. Based on MRI pictures, bony resection amounts during debridement were defined and marked on lateral X-rays for simulation of realignment with "virtual cut" of this area.

Operative procedure

All patients were operated by the same surgical team via the anterior and posterior approach only. Pedicle screws with double rod fixation was used for posterior instrumentation. Instrumentation extended from one healthy vertebrae proximal and distal to the lesion. The surgical procedure of group A patients was posterolateral decompression of the disease focus and posterior instrumentation via midline posterior incision [Figure 1]. Anterior grafting was added to the surgical procedure in group B patients to support the anterior column, during the same operation session [Figure 2].[10] Spinal osteotomy (resection of the planned anterior column) was combined to the above-mentioned procedures according to the degree of kyphotic deformity to the patients in group C.[11]

The vertebrae, which was in contact to the lesion was skipped and the screws were inserted in to the healthy vertebras above or below, in all groups [Figure 3].

The thoracolumbosacral orthoses were given to all patients for a period of 3 months and were mobilized in the orthoses in the early postoperative days. The patients were discharged after the wounds were healed and were called for followup visit at third month and then every sixth month of periods. Followup examinations included clinical examination and the neurologic status assessment according to the ASIA scale.[12] Work ability impairment were questionned according to Denis[13] and pain status were assessed with the visual analog scale.[14] All patient were called for a last visit at the time of the study. Blood analyses, and X-ray examinations were performed at preoperative, early postoperative and at the last visit. Osseous union of the bones and consolidation of the grafts were evaluated on the followup X-rays.

The statistical analysis was done using SPSS 18. Pearson correlation and *t*-test were used in statistical analysis.

Results

The amount of preoperative focal kyphotic deformity was reconstructed to an average of 28.9° (6°-56°) and could be sustained with a minimum loss of 3.1° on an average. The mean correction amount of kyphosis was 19.2° (9°-38°) at the latest followup [Table 1]. Twelve out of 26 with neurologic compromise showed neural improvement [Table 3]. The mean improvement in the work ability and pain status of all patients was detected as 52% and 61%, respectively [Table 4]. Wound dehiscence due to superficial infection were detected in nine patients, and all healed with secondary medical interventions.

Figure 1: Preoperative radiograph (a) and MRI (b) of a patient in group A showing a paradiscal destruction with kyphosis and postoperative 5th year follow-up radiograph (c), after debridement and posterior instrumentation, showing correction

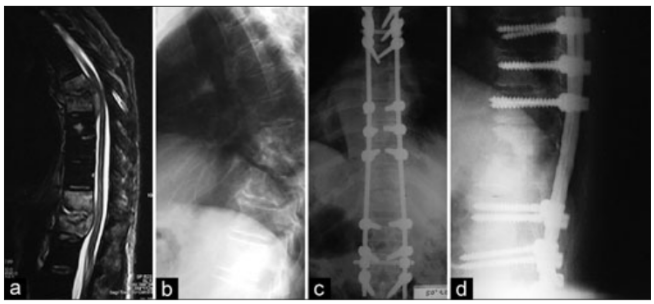

Figure 2: Preoperative MRI (a), lateral graph (b) of a patient in group C showing kyphosis in a multilevel effected patient and postoperative 3rd year follow-up radiograph (c,d), after anterior column resection and posterior instrumentation, showing correction

Figure 3: Preoperative radiograph (a) and MRI (b) of a patient in group B showing para spinal abscess and postoperative 6th year follow-up radiograph (c), after debridement, anterior grafting and posterior instrumentation, showing correction

All patients had a statistically significant decrease in focal kyphotic angles postoperatively ($P<0.05$). There was a high correlation between neurologic impairment with the patients in group C (r=0.51) and in group B (r=0.27). No patients had neurologic impairment in group A. There was a weak correlation between improvement of pain status (r=0.13) and work ability (r=0.26) with correction degrees of kyphosis. There was no significant correlation between the presence of abcess and healing and affected levels either. Initial kyphotic deformity were measured with considering preserved bone stock, which was found as an important parameter in selecting surgical procedure.

Discussion

The spinal column is an easy target for the tuberculous bacili.[2,10] due to features of Batson plexuses and spinal circulation. The multi drug antitubercular drugs for a long term period is the gold standard in patients with a diagnosis of tuberculosis.[15]

Despite the success of medical treatments on systemic control of the disease, local control may fail in many cases due to osseous lytic process of the disease.[16] Spinal deformity may occur in sagittal plain, where kyphosis or gibbus is a result of the collapsed anterior vertebral support in severe cases.[17] The severity of kyphotic angle deformity was dependent on amount of vertebral height loss.[10]

Moon *et al*. found posterior instrumentation as a first-stage

Table 3: Neurologic status according to ASIA classification

ASIA	Number of patients	
	Preoperative	Postoperative
A	2	-
B	3	1
C	9	3
D	12	8
E	28	42

Table 4: Work ability and pain status

Work ability Number of patients	Degree	Pain Number of patients
-	1	-
4	2	2
7	3	5
13	4	16
30	5	31

procedure to correct or prevent progression of tuberculous kyphosis.[18] They have utilized British Medical Research Council (MRC) grading (mild, moderate, and severe) of dorsolumbar kyphosis.[19,20] Rajasekaran and Shanmugasundaram have described a formula to predict final kyphosis.[21] Kaplan has also classified the kyphotic deformity in three stages as mild (<30°), modarete (30°-60°), and severe (>60°).[6] In order to reconstruct the sagittal alignment and to classify the results of surgical treatment strategies we have chosen the outlines of Kaplan's classification in our study. Our treatment approach also consider the debridement procedure in determining kyphotic angle, which may be more accurate than the estimated vertebral height. Debridement is removal of infected material and accessing for good bone stock. Mild cases less than 30° of deformity angle were candidates of posterior instrumentation and fusion alone. We believe balancing the disproportionality between the anterior and posterior columns can be obtained with supporting anterior column with bone grafts or shortening of the posterior column in severe deformities.

The deteriorations of the kyphotic deformity has led surgeons to restore or prevent kyphosis with surgical treatment alternatives.[3,22] The severity of the deformity is higher in childhood disease and in multilevel affections.[23]

Healed spinal tuberculosis also may require surgical correction of the deformity via instrumented fusion. There is still no consensus in kyphosis reconstruction. Combinations, such as anterior surgical techniques with posterior instrumentations, were succeeded in hands of experienced surgeons.[24] Chunguang *et al*. studied the results of staged surgeries in pediatric groups and concluded that staged and combined anterior and posterior osteotomy, deformity correction, and instrumented fusion halted progression of kyphosis and improved the neurologic symptoms.[24] On the other hand, Zhang *et al*. found no significant loss of correction at followup examinations.[25] Also Moon *et al*. have reported one stage surgery in their series with posterior instrumentation, even in infection healed patients.[18] Similar to their series, our results showed that single stage posterior decompression, interbody grafts, and posterior instrumentation and fusion followed by chemotherapy may be an alternative treatment for patients with spinal tuberculosis to prevent and correct the deformity.

Radiologic assessment including MRI examination is crucial in preoperative evaluation. Dunn *et al*. evaluated the preoperative MRI findings in spinal tuberculosis and found correlation with the neurologic status and outcome.[26] Authors could not found any significant correlation between the ambulatory status and the presence of an epidural abscess, kyphotic angle, or vertebral body destruction. We also could not find any relationship between radiologic findings and healing status. The MRI may be also useful in preoperative planning. In our study the amount of debridement and osteotomy level was planned according to the involved segments on T2-weighted images. In an other study location and selection of fused segments were calculated on orthoroentgenograms with expection of the suboptimal corrections due to tuberculous infection for avoiding complications.[27]

Prevention of neurologic dysfunctions in association with active tuberculosis of the spine was achieved in early diagnosed patients with prompt treatment.[28] Jain reported that prompt treatment including combination of conservative therapy and surgical decompression can reverse paralysis and minimize the potential disability resulting from Pott's paraplegia.[28] Surgical treatment options resulted with improvement in the degree of impairement.[13,29] Badve *et al*. pointed out that early decompression in patients with spinal tuberculosis and complete paraplegia had better prognosis in relation to the neurological recovery and deformity progression.[29] We obtained neurologic improvement in 12 patients out of 26 patients with neurologic involvement of our series. Work ability and pain perception was also improved in the patients with surgical treatment. Considering the preserved bone stock for calculating initial kyphotic deformity we have to notice that it was an important parameter in selecting the surgical procedure for obtaining and sustaining well balanced spinal column.

Regarding resected amount of infected osseous material, as planned preoperatively, have resulted with better concordance between anterior and posterior column heights and better sagittal alignment. We could correct kyphosis and improve sagittal balance with staged algorithm as used by us.

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