

Surgical Management of Spinal Tuberculosis in Children, Our Experience

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Abstract

Study Design: Retrospective Descriptive study

Purpose: The goal of this study was to assess the outcome of surgical management of 10 pediatric Pott's spine cases.

Overview of Literature: Spinal tuberculosis represents 50% of skeletal tuberculosis cases and 0.5-1% of all cases. Children are affected in 5-15% of cases. Antituberculous chemotherapy remains the mainstay of treatment of the tubercular spine with very good response in paediatric patients. However, children are more prone to kyphotic deformity of the spine.

Methods: All cases were followed-up for an average of 23.1 months (range 14–48 months). Ages ranged from 7 to 17 years. There were 8 male and 2 female children. All patients were treated with antituberculous chemotherapy which was continued after the surgical intervention also. The anatomical distribution was: Fifty per cent thoracic, 30% thoracolumbar, and 20% lumbar. Indications for surgery included: deformity (60%), neurological compromise (30%), and pain (10%). The majority of the fusions were anterior (7) the others were posterior (3).

Results: All patients were relieved of pain post operatively (evaluated by VAS, visual analog scale). Only 3 patients had neurological deficits, all of them improved post operatively (evaluated by Frankel classification grading system). The kyphotic angle improved from an average of 27.5° to 11.7° in the immediate post-operative period. Average kyphotic angle in the final follow up was 13.7° with an average 2° loss of correction.

Conclusions: Even though spinal tuberculosis is a curable medical condition, surgery in carefully selected patients by either anterior or posterior approach with instrumentation is a feasible and effective way of achieving and maintaining good correction of deformity and disease control.

Key words : Pediatric spine; Tuberculous spondylitis; Surgical Management

Introduction

Spinal tuberculosis, known as Pott's disease, is still prevalent in many parts of the world and is an important orthopaedic problem [1]. It is known that spinal tuberculosis is the most dangerous form of skeletal tuberculosis because of its potential to cause bone destruction, deformity, and paraplegia [2], and particularly is more severe, dangerous and disabling in children

than it is in adults [3]. Back pain, fever, weakness, weight loss, fatigue, and malaise in addition to the varying neurological manifestations and paraparesis of varying severity depending upon the location are the usual symptoms of the disease [4]. Regardless of the approach, the goals of treatment should be to eradicate the disease, prevent neurological deficit or recover existing deficit and to correct or prevent unacceptable deformity. Surgery is indicated for complications such as deformity, neurological deficit, instability, huge abscess, diagnostic dilemma and in suspected drug resistance to mycobacterium tuberculosis [5].

We report here a group of 10 children with spinal tuberculosis treated by surgical debridement, grafting and instrumentation.

Materials and Methods

From January 2012 to December 2015, 10 children with spinal tuberculosis who underwent surgical treatment were enrolled in this descriptive, retrospective analytic study. Treatment consisted of surgical debridement, instrumentation and fusion through, either anterior or posterior approach in combination with antituberculous chemotherapy. The mean age at the time of diagnosis and treatment initiation was 12.7 years (range 7–18

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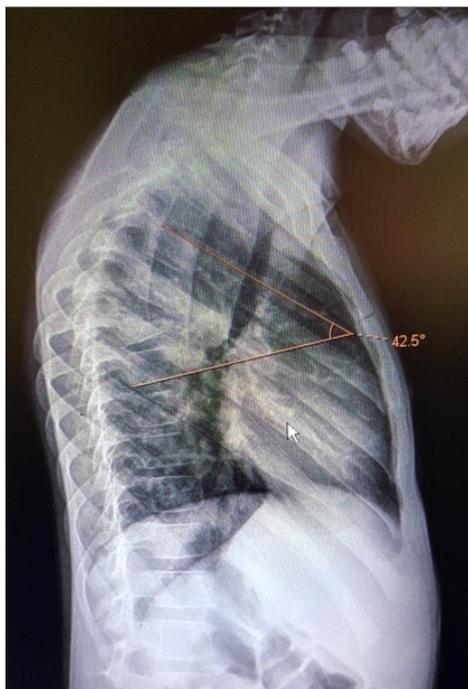


Figure 1: Lateral radiograph showing the kyphosis angle (angle between the lines along the upper and lower border of the first normal vertebra cranial and caudal to the level of the lesion respectively.)

years). Seven were male and 3 were female (Table 1). Most of the children exhibited tuberculosis symptoms including fatigue, night sweats, low fever and weight loss, with a mean symptom duration of 6 months. The patients were admitted to the hospital for severe backache with or without radiculopathy or with difficulty in walking. The thoracic spine was involved in 5 patients, the thoracolumbar spine (T10-L2) in 3 and the lower lumbar spine in 2. None of the children had skip and multifocal lesions. Neurological involvement was classified according to the classification of Frankel et al. [6] 3 patients had neurological deficits (Frankel C, D) (Table 2).

All the patients had regular laboratory tests comprising complete blood count, erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP) initially as diagnostic, and subsequently, as monitors of treatment response. Clinical presentation, investigations

Table 1. Table showing demography, affected level and ESR, CRP values on follow	
Patients	10
Sex (male/female)	8:2
Age (average, range)	12.6 years (07–17 years)
Duration of follow-up(average, range)	23 months (14–48 months)
Affected Level:	
1. Thoracic(T1-T10)	5 (50%)
2. Thoracolumbar(D10-L2)	3 (30%)
3. Lumbosacral(L2-S1)	2(10%)
Erythrocyte Sedimentation Rate (mm/h) (average, range)	
Preoperative	47.80±6.88(17–89)
At 6 months	6.90±0.86(02–10)
CRP(mg/L) (average)	
Preoperative	36.4±0.42(21–67)
At 6 months	2.7±0.09(01–03)

including bloodwork and radiology helped in initial diagnosis and confirmation of the diagnosis was by histopathology and microbiology after surgery.

The kyphosis angle measured on lateral radiographs by drawing a line on the upper surface of the first normal vertebra above the lesion and one through the lower surface of the first normal vertebra below the lesion [7], was on average 27.5° (range 10–51°) (Table 2, Fig. 1).

All children were given antituberculous chemotherapy. Isoniazid (H), rifampicin (R), ethambutol (E), or pyrazinamide (Z) for 12–18 months was used. No second line and newer drugs were used. Regular liver function tests were done to watch out for side effects.

Surgical indications were neurological deficit, kyphosis and recalcitrant pain. Anterior or posterior surgical intervention was surgeon dependent. Out of the 10 patients 7 underwent surgery by anterior approach (6 were transthoracic transpleural approach and one was retroperitoneal approach) and remaining 3 by posterior approach (Fig. 2). All received perioperative

prophylactic antibiotics. The average hospitalization time was 20 days (range 14–30 days). A follow-up examination was performed at 1,3, 6, and 12 months. Subsequent follow-ups were conducted at 12-month intervals. Pain, kyphotic deformity, neurological function, ESR, and CRP was assessed preoperatively and post operatively (Fig.

3).

Statistical analysis of the data was done using descriptive statistics and statistical significance of laboratory and radiological parameters, before and after the surgery, was evaluated using the paired t-test. A p-value <0.05 was considered statistically significant.

Results

All patients were relieved of pain at final review (evaluated by VAS, visual analog scale). Signs of radiographic consolidation were observed by the end of the third month of treatment in all cases. Three patients with neurological deficit improved post operatively in 3 months to Frankel E. All patients regained ambulation without any aid after a median duration of 2 months. The average pre-operative ESR and CRP were 47.80±6.88 mm/h (range, 17–89 mm/h) and 36.4±0.42 mg/L (range, 10–67 mg/L) respectively, which returned to normal levels by 6 months in all patients (Table 1). There was no recurrent infection and no multidrug-resistant bacillus types in this series.

The kyphotic angle improved from an average of 27.5°±4.25° to 11.7°±2.39° in

the immediate post-operative period. Average kyphotic angle in the final follow up was $13.7^{\circ} \pm 2.34^{\circ}$, with an average 2° loss of correction (Table 2).

Discussion

Described in 1779 by Percival Pott [2], spinal tuberculosis is the most frequent osteoarticular affliction of mycobacterium tuberculosis [8]. Pott's disease is the most dangerous form of skeletal tuberculosis [2] because of its

inherent destructive nature leading to significant potential morbidity and mortality due to several complications. Early diagnosis and treatment is the key to avoiding long-term morbidity, because of the nonspecific and wide spectrum of clinical presentations of spinal tuberculosis delaying the diagnosis[9].

There is universal consensus about antituberculosis chemotherapy is the cornerstone of treatment to achieve cure from the disease and prevent recurrence and surgery alone cannot replace chemotherapy in managing spinal tuberculosis[10].

The controversy in the literature is about the necessity of additional surgical intervention and the approach and instrumentation in spinal tuberculosis treatments.

Jutte PC in a Cochrane review of randomised controlled trials comparing the chemotherapy plus surgery with chemotherapy alone for treating active tuberculosis of the spine with at least one year follow up concluded no statistically significant difference for any of the outcome measures[11].

Surgical debridement does help in removing necrotic tissue thereby reducing local bacterial burden, improve local circulation allowing better delivery of chemotherapy[12,13] and decompressing the spinal cord favoring neurological recovery even in delayed cases[14]. Surgery also aids in diagnostic confirmation by biopsy in patients unresponsive to anti tubercular chemotherapy.

Grafting and instrumentation adds in stability, corrects deformity and prevents progression of kyphosis thereby restoring spinal balance [15,16], early pain relief and early rehabilitation of the patients.

With advance in surgical techniques and instrumentation and patient's outcome expectations about early return to activity with negligible tolerance for

Table 2: showing involved level, neurology on follow up and kyphotic angle on serial follow up

A_qc number	? ec-Gender	Dnijm - up (months)	Bgg_qcb segment	Surgery Ant/Post	I wnfmg_a_ejc &'			Dp_l i_ej grade	
					Npcm	Nnqrm	Dg_j follow-up	Npcm	Dg_j follow-up
/	/5-K	26	R/. -T11	?1r	05	/4	0.	B	C
0	5-K	15	R2-T5	?1r	21	/5	/6	A	C
1	/4-K	/5	J2-L5	?1r	/.	5	5	C	C
2	// -D	/4	R7-T10	?1r	01	//	/1	C	C
3	/2-D	/6	R5-T9	?1r	3/	0/	0/	B	C
4	/.-K	05	R/0-L1	?1r	16	/3	/6	C	C
5	6-K	/3	R4-T7	Nnqr	06	/.	/2	C	C
6	/4-K	/5	R// -T12	?1r	/2	.	.	C	C
7	// -K	00	R3-T6	Nnqr	06	0.	0/	C	C
/.	/4-K	/2	J1-L4	Nnqr	/1	.	3	C	C

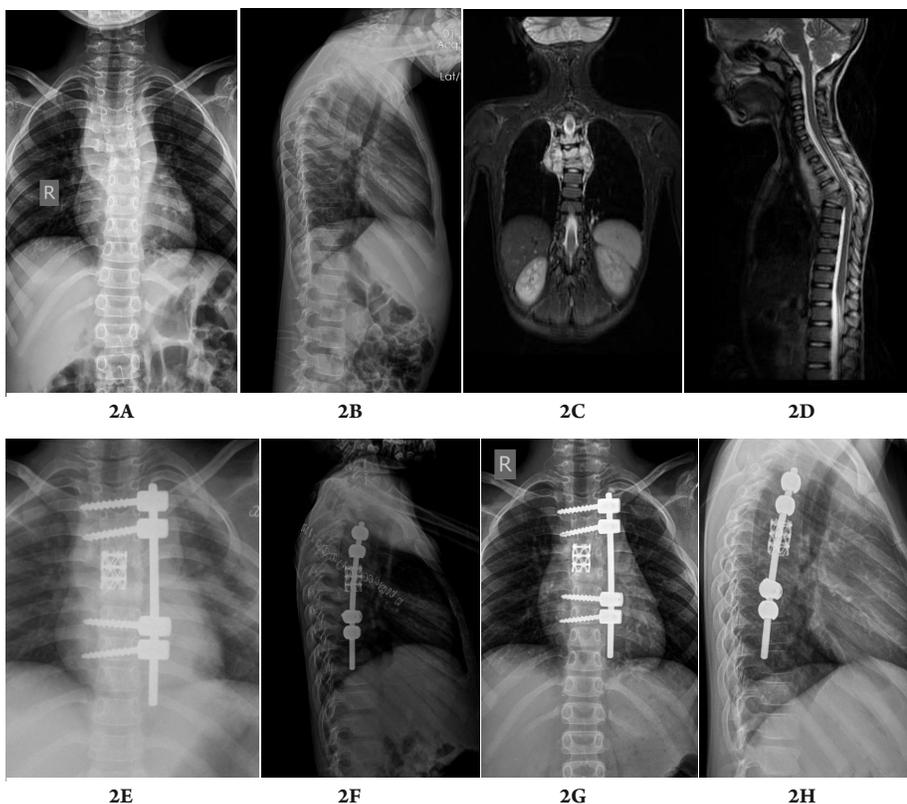


Figure 2: Images of a 7-year-old boy with dorsal tuberculosis (D4-D5) treated with anterior surgery. Anteroposterior (A) and lateral (B) radiographs, T2-weighted (C) coronal and midsagittal T2-W1 (D)magnetic resonance images of the spine showing D4-D5 involvement with destruction of D5 vertebra with prevertebral abscess and cord compression. Postoperative anteroposterior (E) and lateral (F) radiographs and anteroposterior (G) and lateral (H) radiographs at final follow-up showing solid fusion and maintained kyphosis angle.

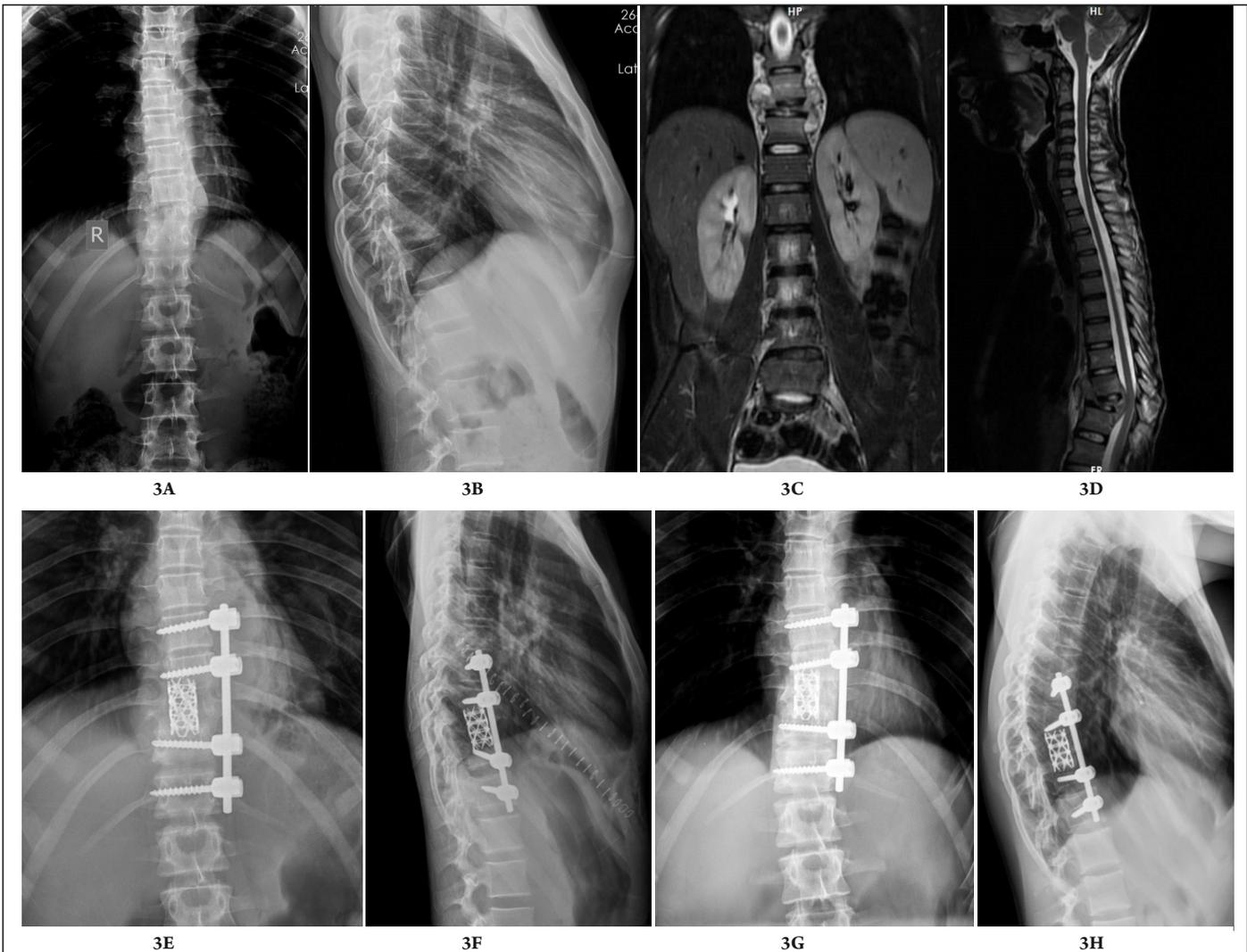


Figure 3: Images of a 17-year-old boy with destructive tubercular spondylodiscitis at D10-D11 treated with anterior surgery. Anteroposterior (A) and lateral (B) radiographs, T2-weighted (C) sagittal and coronal (D) magnetic resonance images showing D10-D11 involvement with destruction of D10 vertebra with prevertebral abscess and compression on cord. Postoperative anteroposterior (E) and lateral (F) radiographs, anteroposterior (G) and lateral (H) radiographs at final follow-up showing solid anterior fusion, a well-maintained kyphosis angle.

deformity and disability Surgical procedures are beginning to have wider role in treating spinal tuberculosis in selected indications.

Ferrer et al systematic review of 37 articles with a total of 1,997 patients found in 75% of the evaluated studies the patients received both chemotherapy and surgical treatment, and in more than half of the studies, the percentage of surgically treated patients was higher than 56%. The indications for the surgical interventions varied across the studies[17]. Currently the

trend in managing spinal tuberculosis is by combining surgery with chemotherapy. Surgical indications are changing from curative and rehabilitative to preventive. Surgery can be performed by anterior or posterior single approach, or a combination of both. Recent data associates the best outcomes with the posterior or combined surgical approaches[18-20]. The role of clinical evaluation including ESR and CRP as markers of disease activity has been well established. The

average ESR was 47.80 ± 6.88 mm/h preoperatively, which dropped to 6.90 ± 0.86 mm/h (p-value=0.0002) at 6 months. The average CRP was 36.4 ± 0.42 mg/L preoperatively, which declined to 2.7 ± 0.09 mg/L (p-value=0.0001) (Table 1). Moon et al[21] in their follow up of 124 children had ESR drop from pretreatment level of 41 mm/h to 14 mm/h at 3 months' post-chemotherapy. Sun L et al [22] in their series of 14 patients with lumbosacral tuberculosis treated surgically reported that ESR

normalized within 3 months in 6 patients and within 6 months in 8 patients postoperatively, and CRP returned to normal levels for all patients within 3 months postoperatively. Significant differences were found in ESR and CRP levels between the preoperative and final follow-up values.

Neurology:

Neurological complications are the most feared in spinal tuberculosis[23]. Prompt treatment can reverse paralysis and minimise the potential disability. Three of our patients who had deficits had complete recovery in 3 months post operatively regaining independent unaided ambulation (Table 2).

Sai Kiran et al[14] in their retrospective review of 48 patients with a minimum of 3 months of follow up found the degree of improvement exhibited by patients with a Frankel Grade A/B spinal cord injury was comparable to that shown by patients with Frankel Grade C status. They concluded that surgery should be considered even in suffering from paraplegia of considerable duration.

Reid et al[24] operated on 20 patients for neurological compromise; 18 of them had a pre-operative Frankel grading of C or worse. Patients managed surgically had either anterior debridement and strut grafting (Hong Kong procedure) or anterior debridement alone. None had any neurological deterioration post operatively and only 2 patients remained non ambulant. Of the 4 patients in their series who had a pre-operative Frankel grading of A, 2 started showing some neurological recovery within the first week post-surgery and 3 became ambulant.

Chen WJ et al[25] reported 30 of 32 patients with a neurologic deficit improved and ambulation was regained in 25 patients. The best results were obtained among the 12 patients with

Frankel's grade C neurologic deficits. In none of the patients did the neurological condition deteriorate. Two cases of cauda equina syndrome had complete recovery. Neurologic recovery from admission to the latest follow-up averaged 1.4 (1-3) grades.

Sun L et al[22] had complete recovery of neurological function within 6 months postoperatively in 8 patients with preoperative neurologic deficit. One patient with Frankel Grade A had no recovery. Two other patients with preoperative Frankel Grade C only recovered to Frankel Grade D at final follow-up.

Kyphosis:

In children, vertebral destruction is more severe because most bone is cartilaginous[26]. Severe kyphosis is more often a complication of childhood spinal tuberculosis than of adult disease, due to disturbance in spinal growth[27,28]. Children are at increased risk of deformity both during the active phase, and progression in the future after the disease has been cured[29]. The therapeutic goal in children is to heal the tuberculosis with restoration of sagittal balance with minimum residual deformity and without neurologic sequelae[30,31].

Rajasekaran and Shanmugasundaram[7,33] reported that, among children treated with ambulatory chemotherapy with 15 years follow up, only 44% experienced improvement of the deformity, while in the remaining patients there was no change (17%) or deterioration (39%); in particular, kyphosis of more than 60° developed in 3–5% of cases. Progression occurred during the active phase of the disease and again after cure when variations in progression were observed.

Kyphosis is not only a cosmetic problem, resultant cardiopulmonary dysfunction and sagittal imbalance can

significantly alter quality of life and survival[33,34]. When greater than 60°, it can lead to delayed paralysis, recovery which is unpredictable even despite the deformity being corrected by surgery[33]. Correction of an established kyphosis is both difficult and hazardous with a high rate of complications, even in experienced hands[35].

Therefore, for active tuberculosis with kyphosis in children, foremost objective should be correction of deformity. Radical debridement with or without strut grafting by anterior approach provides insufficient support anteriorly leading to loss of correction during follow up[31,36]. The advantages and safety of instrumentation in preventing progression of deformity has been well established with surgeons differing in their views about anterior or posterior instrumentation. The increased stability of the spinal column with instrumentation might also help neurological recovery; the immobilisation effect achieved might also be useful in suppressing infection and prevent tuberculosis recurrence [20].

However, the anterior approach in combination with anterior instrumentation only provides partial spinal stability, and some authors have reported that it is necessary to add posterior stabilisation to restore spinal stability and correct kyphotic deformity[37].

In our series, 7 patients who had anterior surgery, had average preoperative kyphosis of $29.43^{\circ} \pm 5.74^{\circ}$, corrected to $12.43^{\circ} \pm 2.67^{\circ}$ postoperatively, with final follow up angle of $13.86^{\circ} \pm 2.94^{\circ}$. 3 patients with posterior surgery, had average kyphosis angle of $23.00^{\circ} \pm 5.00^{\circ}$ before surgery, decreased to $10^{\circ} \pm 5.77^{\circ}$ postoperatively with average loss of correction of $3.33^{\circ} \pm 4.63^{\circ}$ at final follow up. The difference was not statistically

significant (Table 2).

Ma YZ et al [20] in a review of 165 adult patients with mean follow up of 37 months comparing outcomes between anterior and posterior instrumentation concluded both anterior and posterior instrumentation attain good results for correction of the deformity and maintaining correction, foci clearance, spinal cord decompression and pain relief in the treatment of thoracic and lumbar spinal tuberculosis providing that the operative indication is accurately identified. However, they felt the posterior approach may be superior to anterior instrumentation to correct deformity and maintain that correction. Zhang HQ et al [38] reported outcome of 7 children treated by 1-stage posterior decompression, interbody grafts, and transpedicular instrumentation and fusion followed by chemotherapy at an average follow up of 34 months. Average preoperative

kyphosis was 37.9°, which decreased to 5.4° postoperatively with no significant loss of correction at last follow-up. They suggested this as an alternative to anterior surgery for advanced thoracolumbar spinal tuberculosis in children in poor general condition. Many authors tend to emphasise the importance of tailoring management options to the needs of the individual patient [20]. Deciding upon the appropriate surgical procedure should be determined by the position and extent of foci; however, radical debridement remains the key [20]. Posterior instrumentation is being preferred in view of better pedicle purchase and ease of application.

Conclusion

The management of Pott's disease with compromise of spine and neurology should be tailored to each individual

patient. Antituberculous chemotherapy for Pott's disease has been the gold standard and must be instituted in management at the early stages of the disease. Surgical intervention by anterior/posterior approach or combined approach with debridement and appropriate instrumentation should be used judiciously to lessen compression of the cord thereby encouraging neuraxis recovery, correct deformity and prevent its progression allowing better rehabilitation. Children should be monitored till growth completion as deformity may continue to progress during growth even after the disease is healed.

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