Surgical outcome of anterior versus posterior surgical approach for thoracic and lumbar Pott's disease

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Objectives

This retrospective study aimed to determine the surgical outcome of anterior versus posterior approach by comparing the operative duration, blood loss, intraoperative complications, postoperative complications, neurological status, bony fusion, and kyphotic angle for Pott's disease of the spine.

Patients and methods

We retrospectively reviewed 42 patients with Pott's disease of the thoracic and lumbar region who underwent surgery following the anterior approach (group A, 23 patients) or the posterior approach (group B, 19 patients) in Cairo University Hospitals between August 2007 and October 2010. The indication for surgery in all patients was instability or neurological deficits. All patients underwent surgical intervention by either approach and had decompression, debridement, fixation, and placement of an interbody bone autograft.

Results

The anterior approach was used in 23 patients, whereas the posterior approach was used in 19 patients. All patients were followed up with plain radiographs and computed tomography scans immediately after surgery and at 3, 6, and 12 months postoperatively. Two complicated cases were followed up for 2 months inside the hospital. All patients operated upon established immediate stability, except one who developed complete stability a year later. None of the cases developed new neurological deficits after surgery. Excellent clinical outcomes were achieved in both groups. Only one case of mortality took place 7 months after surgery because of pulmonary embolism following deep venous thrombosis. Superficial wound infection occurred in three cases.

Conclusion

We conclude that operative intervention through either the anterior or the posterior approach allows adequate debridement of tuberculous granulation tissue and cold abscess. Debridement with fixation of the diseased segment of the spine offers better chances for success of postoperative medical therapy. Both anterior and posterior approaches allow early decompression, control of pain, and adequate control of kyphosis.

Keywords:
anterior approach, posterior approach, Pott's disease

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Introduction

Pott's disease, described by Sir Percival Pott, is one of the oldest demonstrated diseases affecting humans [1,2]. Tuberculosis is common in developing countries, with 50–60% of skeletal affections occurring in the spine [3]. Isoniazid and rifampin given for 9 months (with streptomycin added for the first 3 months for resistant strains) is now the standard medical treatment [4]. The thoracolumbar spine is the most commonly affected, with less frequent involvement of the cervical and sacral spine [4]. When the anterior and lateral portions of the vertebral body are affected, vertebral collapse occurs, resulting in kyphosis and gibbus deformity [5]. Involvement of the posterior vertebral body results in cavitations and an extradural mass. The disc space is eventually destroyed, but at a slower rate than pyogenic infection [5]. Tuberculous spondylitis is diagnosed in the second, third, or fourth decade of life in developing nations, with a male-to-female ratio ranging from 1.3 : 1 to 1.7 : 1 [2,4,6–8]. Neurologic deficits with or without kyphotic deformities are a frequent sequelae of serious disease [9].

Advancement of computed tomography (CT) scanning and MRI has enabled early diagnosis of spinal tuberculosis [10–16]. In addition, more effective regimens for antituberculous chemotherapy have become available [17,18]. Therefore, the treatment strategy for this disease entity has been revised and has become more conservative in recent years [12,17–21].

Surgical treatment is recommended for failure to respond to antibiotics after 3–6 months, no improvement, or deterioration, in neurological function after a trial of antibiotics, posterior spinal involvement, spinal instability, recurrent disease, or

recurrent neurological deficit [22]. The advantages of radical excision and fusion include a shortened recovery time and a smaller degree of deformity, including improved vertebral body height [2,6,22]. Modern transpedicular instrumentation can provide effective rigid short-segment stabilization of the thoracolumbar and lumbar spine [23–28]. Despite the fact that the majority of published papers favor the anterior approach combined with radical debridement and anterior fusion because the tuberculous infection usually involves the anterior column, the posterior approach reported by other authors has in recent times gained popularity with remarkable clinical success [13–16,29–31]. In our study, we compared the anterior and posterior approaches combined with debridement, interbody autografting, and instrumentation with special attention to operative duration, blood loss, bony fusion, intraoperative and postoperative complications, clinical improvement of neurological status, and angle of kyphosis.

Patients and methods

Surgery was performed in 42 consecutive patients with Pott's disease of the spine following the posterior or anterior approach, combined with debridement, interbody autografting, and instrumentation, from August 2007 to October 2010 in this approved study conducted at the Cairo University Hospitals. Twenty-two male and 20 female patients were enrolled in this study. The age of the patients ranged from 19 to 64 years (mean 36.3 years). The mean preoperative duration of symptoms was 11 months (range 2–41 months). The reason for admission to the hospital was the presence of axial spinal pain (dorsal or low back pain or both) or the presence of neurological deficits. On admission, all patients were submitted to a thorough clinical examination and all patients underwent plain radiology, CT scan, and MRI with contrast. Patients were assessed using the Frankel grading system at discharge and after 3, 6, and 12 months postoperatively in the outpatient clinic. The instability was shown in stress radiograph views. In addition to the tuberculosis symptoms (e.g. fatigue, night sweats, low-grade fever, and weight loss), all patients had severe pain preoperatively measured using the Visual Analogue Pain (VAP) scale with an average score preoperatively of 7.5. The neurological status preoperatively is shown in Figure 1. The distribution of spinal level involvement among the 42 patients is shown in Figure 2.

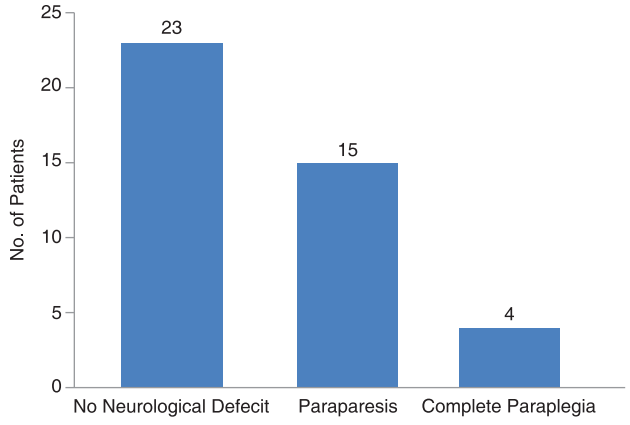
All patients underwent a trial of conservative medical antituberculous treatment before surgery (rifampicin + isoniazid+ethambutol + streptomycin) for a period varying between 2 and 3 weeks preoperatively.

The indications of surgery were either one of the following:

(1) Development of neurological complications during the conservative treatment.
(2) Presence of neurological complications with failure of remarkable recovery despite a good trial of conservative treatment.
(3) Deterioration of neurological complications while patients were under antituberculous drugs and bed rest.
(4) Recurrence of neurological complications.
(5) Evidence of instability.
(6) Presence of epidural abscess compressing the dura or paravertebral abscess or granulation tissue or disc fragments compressing either the dura or nerve roots.

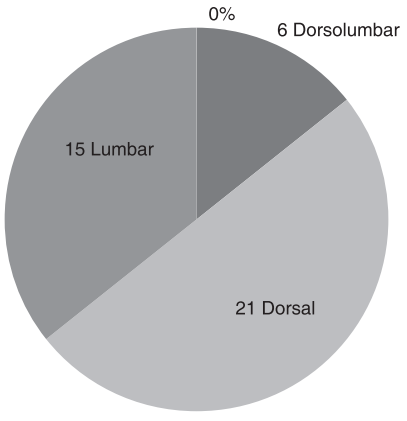
Twenty-six (61.9%) cases had evidence of instability and variable degrees of kyphosis. Sixteen (38.1%) patients had variable degrees of neurological deficits.

Figure 1



Preoperative neurological status.

Figure 2



Number of patients with pathological evidence at each spinal level.

The anterior approach was favored in 23 patients meeting the following criteria:

(a) kyphotic angle more than 30°;
(b) Degree of collapse of the vertebral body by more than 50%;
(c) Lesion existing in the anterior and middle columns.

The posterior approach was favored in 19 patients meeting the following criteria:

(a) Kyphotic angle less than 30°;
(b) Degree of collapse of the vertebral body by less than 50%;
(c) Lesion existing in the anterior, middle, and posterior columns.

Surgical procedures

The main concern during surgery was correction of deformity, decompression, and establishment of stability to allow for solid fusion.

Anterolateral approach

In the lumbar region, the anterior approach is performed from the left side with the patient in the lateral position. The operating table is tilted between 20 and 40° toward the surgeon, who stands facing the back of the patient. The gibbus level is projected onto the skin level by lateral fluoroscopy.

The approach started with a 10 cm skin incision centered above this projection in an oblique direction. The retroperitoneal space was exposed by blunt splitting of the muscle fibers of the lateral abdominal wall (external oblique, internal oblique, and transverse abdominal muscle). The retroperitoneal space was entered through the transverse abdominal muscle far lateral to avoid penetration of the peritoneum, which is less adherent to the abdominal wall. Blunt dissection was performed with cottonoids and modified Langenbeck hooks to expose the psoas muscle. The spine was exposed, following the anteromedial 'slope' of the psoas muscle. The genitofemoral nerve, which passes along this part of the psoas muscle, was preserved. The anterolateral attachments of the psoas muscle are sharply dissected from the vertebrae. At L4–L5, the left common iliac vein may obstruct the anterior medial angle of the surgical field and, although risky, was mobilized bluntly.

The thoracotomy performed for spinal surgery is variable and must be based on the spinal level and the side of the pathological site. Because the rib slopes downward, entering the chest one level above the pathologic level was preferable in the upper dorsal region, and entering two levels above the pathologic level is often necessary when the lower dorsal spine is being exposed. We performed these operations without the assistance of a thoracic surgeon. However, a thoracic surgeon had been needed when the thorax had been opened before (two cases) or when there had been pathologic evidence in the lung (three cases) as well as in higher dorsal levels above D6 (four cases).

The thoracolumbar junction was approached through the bed of the 10th or 11th rib and required partial division of the diaphragm. After exposure of the spinal segments to be instrumented, the gibbus was removed totally and the spinal cord was decompressed. The disc space above and below was removed. The endplates were curetted to prepare them for the bone graft.

Once the corpectomy was completed, the coronal diameter of the vertebral body was measured using the anterior depth gauge.

In patients presenting with kyphosis, reduction was performed at this time. The reduction maneuver recommended was application of manual pressure over the dorsal spine at the apex of the kyphosis. A large laminar spreader was placed between the vertebral endplates within the corpectomy defect to assist in the reduction. The majority of reduction was obtained with these two maneuvers. The Z-plate distractor was used to hold the reduction. This distractor was placed against the exposed threads of the vertebral body bolts. Once the reduction was completed, the laminar spreader was removed from the corpectomy defect and the reduction was held with the Z-plate distractor. The length of the bone graft required was then measured. The bone graft was then harvested and fixed in place, securing the reduced position. The plate was then placed and spiral nuts were secured to the bolt. Finally, the screws in the other two holes of the Z-plate were inserted.

Posterior approach

The patient was positioned prone as for a standard posterior midline approach. A subperiosteal muscle dissection was undertaken to expose the spinous processes, lamina, facets, and the transverse processes. By the aid of the drill, pediculotomy was performed bilaterally at the affected vertebral level. The next step was removal of pathologically infected tissues, pus, sequestrae, and necrotic disc fragments. The dissection was performed at the level of Pott's disease and the levels above and below. The transverse

processes were decorticated. The starting point for placement of the pedicle screw was identified by locating the intersection of two lines, one dividing the transverse process horizontally and the other vertically through the adjacent superior facet. An awl or burr was used to pierce the outer cortex, after which the tap was passed down the pedicle. A probe was used to feel the inner boundaries of the pedicle to ensure that the pedicle wall was circumferentially intact before placing the screw. The depth of screw penetration should be more than 50% of the vertebral body but not exceeding the anterior boundary on a lateral projection radiograph. Intervertebral bone autograft or a titanium cage with a cancellous bone from the iliac crest was used. The bone chips were placed along the decorticated transverse processes after securing the longitudinal members of the screws. In cases where the screws could not be introduced into the affected vertebra, or into the thoracolumbar junction region, two vertebrae above and one or two vertebrae below the pathological vertebra were introduced to correct the kyphosis. Antibiotics were given for 7 days postoperatively and antituberculous drugs were given for 12–18 months postoperatively.

Patients were followed up at regular intervals through clinical, laboratory (ESR and C-reactive proteins), and radiological [radiographs (anteroposterior–lateral views)/CT scans with bone window cuts] examinations immediately after surgery, and plain radiographs and stress views were taken after 2 weeks and at 3, 6, and 12 months postoperatively. Two complicated cases, one with evidence of immediate postoperative instability and the other with wound infection, were followed up for 2 months inside the hospital.

For the statistical analysis, the χ^2-test and *t*-tests were used, and a *P*-value less than 0.05 was considered statistically significant.

Results

Demographic characteristics

No statistical difference was observed between patients operated upon using the anterior approach and those operated upon using the posterior approach with respect to age and sex distribution ($P > 0.05$).

Operative duration, blood loss, hospital stay

The mean operative duration was 275 min (range 185–470 min). Blood loss during the surgery was 1070 ml on average. The mean hospital stay was 12 days (range 8–61 days). None of these aspects were statistically significant ($P > 0.05$). Details are shown in Table 1.

Table 1 Comparison between groups A and B regarding the operative duration, blood loss, and hospital stay

	Anterior approach (group A)	Posterior approach (group B)	*P*-value
Mean operative duration (min)	281	258	>0.05 (0.6452)
Average blood loss during surgery (ml)	1120	1025	>0.05 (0.0736)
Mean duration of hospital stay (days)	14	10	>0.05 (0.65472)

Biopsy sample results

Biopsy samples obtained from the pathologically affected tissues were found to be positive for acid fast bacilli and 84% had granulomas on examination.

Stability

Twenty-six (61.9%) patients had evidence of instability preoperatively; 12 (46.2%) patients underwent surgery through the anterior approach and 14 (52.8%) patients had a posterior approach surgery. Stability was assessed by radiograph stress views preoperatively and on follow-up. Twenty-five (96.1%) patients operated upon either by the anterior or by the posterior approach achieved adequate stability immediately postoperatively as well as in the 3- and 6-month follow-up periods after surgery. Only one patient operated upon by the posterior approach showed evidence of instability in the first set of stress views taken 2 weeks postoperatively, and established stability 11 months from the operative date. No statistical difference was observed between the patients operated upon through the anterior approach and those operated upon through the posterior approach with respect to stability ($P > 0.05$). The preoperatively stable patients developed no signs of instability after surgery in either group.

Kyphosis

Kyphosis was present in 26 cases. The kyphotic angles were measured by Cobb's method [17]. In the 12 patients operated upon through the anterior approach, the kyphotic angle preoperatively ranged between 18 and 35° with an average of 28°, whereas the immediate postoperative angle improved to 16°. In the 14 patients operated upon through the posterior approach, the kyphotic angle preoperatively ranged between 12 and 26° with an average of 15° and improved in the immediate postoperative period to 11°. It is noteworthy that after 6 months from surgery we noticed loss of kyphotic correction of 7° in the group of patients operated upon through the anterior approach, but only 4° loss of kyphotic correction in the group of patients operated upon through the posterior approach. The comparison between preoperative/postoperative

average kyphotic angle between patients operated upon by the anterior and those operated upon by the posterior approach is shown in Figure 3.

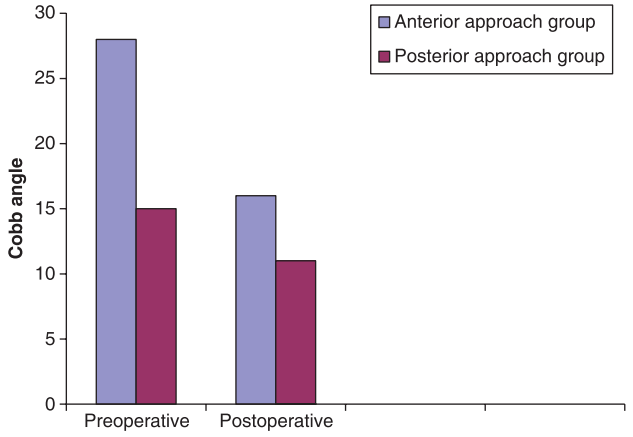
Neurological outcome

Clear improvement in the clinical neurological status was observed postoperatively compared with the preoperative clinical status. There were no newly recorded permanent neurological deficits. Figure 4 shows the improvement in the preoperative clinical status compared with the postoperative clinical status according to the Frankel classification system. No statistical difference was observed between the patients operated upon through the anterior approach and those operated upon through the posterior approach with regard to the improvement in clinical status ($P > 0.05$) (Figs 5 and 6).

Back pain

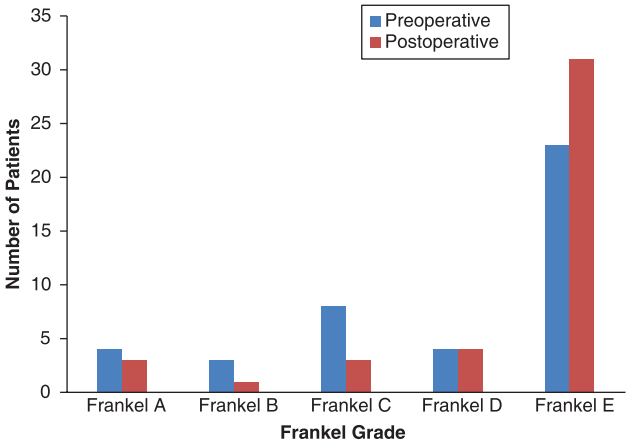
Back pain was present in 42 cases preoperatively. The average pain score preoperatively was 9 on the VAP

Figure 3



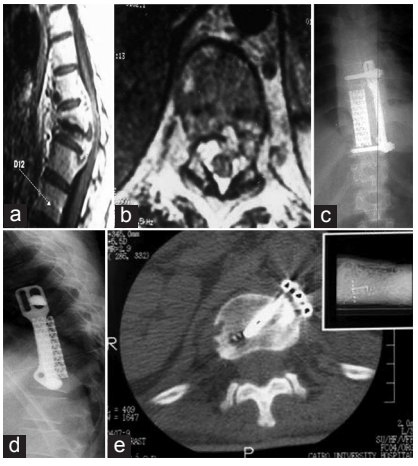
Comparison of preoperative and postoperative average kyphotic angle between patients operated upon by the anterior approach and those operated on by the posterior approach.

Figure 4



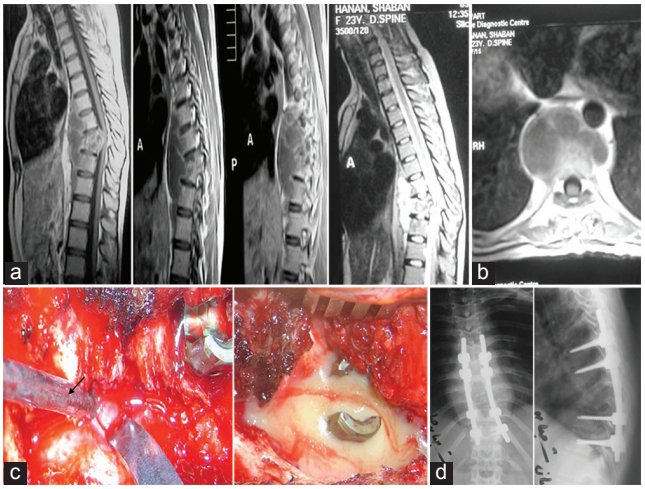
The difference between preoperative/postoperative clinical conditions measured by the Frankel classification system.

Figure 5



A 34-year-old female patient presented with kyphosis deformity due to destructive Pott's spondylodiscitis at D9–D10. (a) MRI sagittal cuts showing destruction of D9–D10 with encroachment on the spinal cord. (b) MRI T2 axial cuts showing destruction of the vertebral body with a compressive tuberculous mass reaching the spinal canal. (c,d) Plain postoperative radiographs in anteroposterior and lateral views after anterior debridement, and sagittal profile reconstruction using Z-plate and a titanium cage and autologous bone graft. (e) Computed tomography axial cuts – bone window – with the Z-plate in place and the screws reaching proper direction in the vertebral body.

Figure 6



A 23-year-old female patient presented with kyphotic deformity, paraparesis, and severe back pain due to destructive Pott's spondylodiscitis at D8. (a) MRI sagittal cuts showing destruction of D8 with encroachment on the spinal cord and large paraspinal collection. (b) MRI T2 axial cuts showing destruction of the vertebral body with a compressive paraspinal tuberculous mass reaching the spinal canal. (c) Intraoperative microscopic pictures before opening of the pointing tuberculous abscess (black arrow) and after opening of the abscess filled with caseating material. (d) Plain postoperative radiographs in anteroposterior and lateral views after posterior debridement, and sagittal profile reconstruction using long segment pedicular screws/rod instrumentation and autologous bone graft.

scale and postoperatively was 2. This decrease in back pain was statistically significant (0.05153, $P > 0.05$). The cases operated upon by means of the anterior approach evidenced more reduction in the VAP scale compared with those operated upon by the posterior approach, but the difference was statistically insignificant (Fig. 7).

Control of infection

After surgery all patients showed adequate local control of infection. The control of infection was evidenced by the cessation of the bone destructing process on imaging modalities, by improvement in pain and the general condition of the patient, and drop in ESR and C-reactive protein.

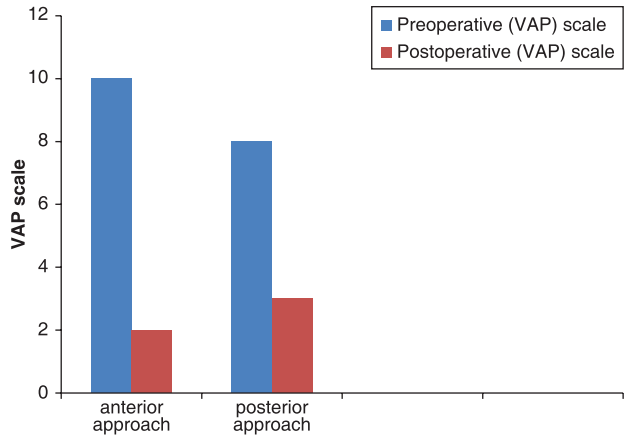
Complications

Three patients developed superficial wound infection, which was managed successfully by repeated dressing and administration of antibiotics. One of them stayed in the hospital for 2 months postoperatively. All the patients with wound infection underwent strict antibiotic therapy for 3–5 weeks according to the results of culture and sensitivity. The three patients were promptly cured at the end of the antibiotic therapy. One patient died 7 months later from deep venous thrombosis following surgery complicated by pulmonary embolism.

Discussion

Surgery whether through the anterior or the posterior approach plays an important role in managing carefully selected cases with spinal tuberculosis. The goals of the surgery are to debride the necrotic tissue, control the infection, decompress the nervous elements, achieve spinal stability, decrease the pain, and correct the kyphus deformity. The majority of surgeons favor the anterior approach because it provides more direct access to the pathological site as well as because of concerns over the safety of the posterior approach [31].

Figure 7



Comparison between preoperative and postoperative Visual Analogue Pain (VAP) scale using different approaches.

In early phases the clinical presentation and radiographic imaging results are frequently nonspecific. Infections (pyogenic, fungal of the vertebrae) and malignant affection appear to have very close presentations and radiological characteristics. Nussbaum and colleagues reviewed 29 patients with Pott's disease and found that 41% were initially misdiagnosed; similar results were also obtained by other authors [32–35]. This is why we ensured that a biopsy sample was obtained to confirm the diagnosis from each patient in our study. In our series, all biopsy samples obtained from the pathologically affected tissues were found to be positive for acid fast bacilli and 84% had granulomas on examination, compared with the results of Omari *et al.* [36] who found only 50% of biopsy samples to be positive for acid fast bacilli and 64% to have tuberculus granulomas on microscopic examination.

In recently published papers, authors have tended to emphasize the importance of tailoring management options to the individual needs of the patients with spinal tuberculosis. Nussbaum *et al.* [32] treated patients with spinal tuberculosis according to the degree of bone destruction. In their series, aggressive debridement and fusion were performed only in patients in whom advanced vertebral body involvement resulted in kyphosis. Rezai *et al.* [29] have reported that radical operative management was required only when the extent of vertebral body destruction exceeded 50%. Boachie-Adjei and Squillante [19] have suggested that neurological function as well as bone involvement should be carefully evaluated before making surgery-related decisions for the treatment of patients with spinal tuberculosis. They recommended that patients with Frankel grade A or B lesions undergo rapid decompressive surgery, whereas those with grade C or D lesions may be treated expectantly with chemotherapy alone. Our indications for surgical intervention had a clear concept in choosing surgical candidates.

Because 23 (54.7%) patients in our series were neurologically intact and had variable degrees of bone destruction and spinal instability, they could not be expected to have good treatment outcomes by undergoing antituberculous chemotherapy alone, as this conservative method cannot prevent the possible progression of kyphotic deformity and it usually requires long-term rest to achieve relief from severe back pain [18].

According to the literature, a rigid stabilization system provides the best solution, not only to prevent kyphosis but also to achieve relief from pain due to spinal instability [20,23–25,27,28,37]. This concept has been adopted by others and is accepted by us.

We can summarize the advantages of the anterior approach as follows:

(a) Effectively gains direct access to the pathological vertebrae;
(b) Allows for debridement of the infected tissues;
(c) Gives immediate relief from pain;
(d) Helps in reducing the infective mass that chemotherapy has to penetrate;
(e) Effectively reduces kyphotic deformity;
(f) Provides immediate postoperative spinal stability; and
(g) Prevents the possible progression of a kyphotic deformity.

In our opinion, the main disadvantages of the anterior approach are: it is demanding as it needs a steady learning curve; the approach may need the presence of an access surgeon; and the surgeon may have to divide the diaphragm or the segmental vessels, a finding that has been agreed upon by other authors [20].

The posterior approach from our experience with advancement of instrumentation systems has many advantages:

(a) Provides adequate rigid stability;
(b) Allows for debridement of the infected tissues;
(c) Safely corrects angular deformity;
(d) Helps in reducing the infective mass that chemotherapy has to penetrate; and
(e) Gives immediate relief from pain.

Our findings are commensurate with those of Grast [20] and Guven *et al.* [21] who treated vertebral tuberculous infection exclusively using posterior fixation alone and with those of Guzey *et al.* [38] who reported that the posterior approach was sufficient for infection debridement and spinal stabilization in patients with thoracic and lumbar tuberculous spondylitis. However, there are a few authors who believe that the posterior approach may affect the integrity of the posterior spinal column [39,40].

In the literature, there is one report comparing the anterior approach with the posterior approach for spinal tuberculosis [31]. Lee *et al.* [41] reported their experiences with the anterior and posterior approaches combined with internal fixation for thoracolumbar tuberculosis. They concluded that there was no difference in outcomes between groups. We found that both approaches lead to favorable outcome with no statistically significant difference between them as regards operative duration, blood loss, hospital stay, postoperative stability, kyphotic angle correction, and clinical improvement in neurological status. The degree of improvement of back pain postoperatively favored the anterior approach.

The kyphotic angulations preoperatively were 25° for patients operated upon by the anterior approach and 15° for patients operated upon by the posterior approach, corrected to 15 and 11°, respectively. Our results regarding the degree of correction of the kyphotic angle closely match those published by Rezai *et al.* [29] who obtained a correction of the angulation in the anterior approach from an average of 31–24°.

Forty-one cases showed adequate stability in the follow-up period. This was demonstrated by stress views. These were seen in the immediate follow-up period as well as in the follow-up 3–6 months postoperatively. The patient who was unstable after surgery established stability a year after surgery, although the degrees of angulations increased by 5°. Although there was minimal degree of loss of kyphotic angle correction in both groups of patients operated upon by the anterior or posterior approach after initial recorded kyphotic angle correction, it did not affect the stability. This can be attributed to the mild loss of correction of 5° on average.

Postoperatively, one patient died 7 months later from deep venous thrombosis following surgery complicated by pulmonary embolism.

Postoperatively, all patients showed adequate local control of infection. The control of infection was evidenced by the cessation of the bone destructing process, by the improvement in pain and general condition of the patient, and drop in ESR to nearly normal 6 months after surgery. This is slightly better than what was found by Rezai *et al.* [29] who reported normalization of ESR after 1 year from surgery in 13 of 15 cases. The few complications in our study can be attributed to the small sample size.

Conclusion

Operative intervention through the anterior or posterior approach allows adequate debridement of tuberculous granulation tissue and cold abscess. This together with immobilization of the diseased segment of the spine offers better chances for the success of postoperative medical therapy. Both anterior and posterior approaches also allow early decompression, control of pain, and

adequate control of kyphosis. We believe that modern advancements in surgical techniques and improvement in spinal instrumentation have led to similar outcomes from both approaches. The familiarity and experience of the surgeon with the approach will always remain a cornerstone for the success of the procedure.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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