Original Article

Outcome of minimally invasive surgery in the management of tuberculous spondylitis

Pankaj Kandwal, Bhavuk Garg, Upendra BN, Budhadev Chowdhury, A Jayaswal

Abstract

Introduction: With the advancement of instrumentation and minimally access techniques in the field of spine surgery, good surgical decompression and instrumentation can be done for tuberculous spondylitis with known advantage of MIS (minimally invasive surgery). The aim of this study was to assess the outcome of the minimally invasive techniques in the surgical treatment of patients with tuberculous spondylodiscitis.

Materials and Methods: 23 patients (Group A) with a mean age 38.2 years with single-level spondylodiscitis between T4-T11 treated with video-assisted thoracoscopic surgery (VATS) involving anterior debridement and fusion and 15 patients (Group B) with a mean age of 32.5 years who underwent minimally invasive posterior pedicle screw instrumentation and mini open posterolateral debridement and fusion were included in study. The study was conducted from Mar 2003 to Dec 2009 duration. The indication of surgery was progressive neurological deficit and/or instability. The patients were evaluated for blood loss, duration of surgery, VAS scores, improvement in kyphosis, and fusion status. Improvement in neurology was documented and functional outcome was judged by oswestry disability index (ODI).

Results: The mean blood loss in Group A (VATS category) was 780 ml (330-1180 ml) and the operative time averaged was 228 min (102-330 min). The average preoperative kyphosis in Group A was 38° which was corrected to 30°. Twenty-two patients who underwent VATS had good fusion (Grade I and Grade II) with failure of fusion in one. Complications occurred in seven patients who underwent VATS. The mean blood loss was 625 ml (350-800 ml) with an average duration of surgery of 255 min (180-345 min) in the percutaneous posterior instrumentation group (Group B). The average preoperative segmental (kyphosis) Cobb's angle of three patients with thoracic TB in Group B was 41.25° (28-48°), improved to 14.5°(11°- 21°) in the immediate postoperative period (71.8% correction). The average preoperative segmental kyphosis in another 12 patients in Group B with lumbar tuberculosis of 20.25° improved to –12.08° of lordosis with 32.33° average correction of deformity. Good fusion (Grade I and Grade II) was achieved in 14 patients and Grade III fusion in 1 patient in Group B. One patient suffered with pseudoarthrosis/doubtful fusion with screw loosening in the percutaneous group.

Conclusion: Good fusion rate with encouraging functional results can be obtained in caries spine with minimally invasive techniques with all the major advantages of a minimally invasive procedures including reduction in approach-related morbidity.

Key words: Minimally invasive spine surgery, tuberculous spondylodiscitis, video-assisted thoracoscopic surgery

Introduction

Minimally invasive techniques in the discipline of spinal surgery have been gradually gaining popularity in the last decade and most of the open procedures can now be done by minimally invasive technique. The goals of minimally invasive spine surgery (MISS) is to achieve spinal decompression and stabilization matching that of its open counterpart while reducing iatrogenic muscle injury to the back thus reducing the blood loss, narcotic use in postoperative period, and the hospital stay.

Tuberculosis of spine is one of the major causes of spinal deformity and paraplegia. Treatment of tuberculous infection of spine is essentially medical and operative intervention is indicated for complications.[1,2] Surgical decompression and stabilization is contemplated in few patients to prevent/treat complications arising as a result of the disease or where conservative treatment fails.

While MISS has established itself as an efficient procedure

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for degenerative disorder and other pathology, its use in spinal infection is relatively new and still in evolution.[3] The purpose of this study is to analyse the outcome of the various minimally invasive procedures done for spinal infections. With appropriate adaptation, these minimally invasive techniques can be used safely in spinal infections in cervical, thoracic, and lumbar spine.

Materials and Methods

This is a retrospective analysis of 38 patients with tuberculosis of dorsal and lumbar spine who were treated by minimally invasive techniques for the management of TB spondylodiscitis between March 2003 and December 2009.

Group A: 23 patients (13 males, 10 females), with a mean age of 38.2 years with single-level spondylodiscitis between T4-T11 were treated with video-assisted thoracoscopic surgery (VATS) with anterior debridement and fusion, Group B: 15 patients (9 males, 6 females) with a mean age of 32.5 years (21-45 years) underwent percutaneous posterior pedicle screw instrumentation with posterolateral debridement and fusion using mini open expanding retractors.

The indications of surgery in both the groups were neurological deficit not responding to antituberculous chemotherapy for 4-6 weeks or instability (anteroposterior or lateral translation; kyphosis). The operating surgeon was the same for all the procedures in both the groups. All the patients received anti tuberculous treatment (ATT) for minimum 3-4 weeks before surgery and then postoperatively. The total duration of ATT was 12 months. The usual regimen followed was four-drug chemotherapy (rifampicin 10 mg/kg, isoniazid 6 mg/kg, ethambutol 15 mg/kg, and pyrazinamide 25 mg/kg) for 3 months followed by three drugs (rifampicin, isoniazid, and ethambutol) for 3 months and two drugs (rifampicin and isoniazid) for the rest of the period (6 months). Liver functions and sedimentation rates were monitored carefully at regular intervals. Patients were followed up every 3 months in first year and every 6 months thereafter. Routine radiographs were done and fusion was assessed by CT scan using Eck *et al.* criteria [Table 1].[4]

Group A: Anterior debridement and fusion through VATS

Preoperative neurological status was Frankel grade A in four, B in six, C in five, D in three, and grade E in five patients. Depending on the various procedures used patient fell into 4 groups.

Group I (n=4): Debridement and drainage of abscess.

Group II (n=8): Debridement, decompression, and reconstruction with rib graft.

Group III (n=5: Debridement, decompression, anterior titanium mesh cage, and posterior pedicle screw instrumentation.

Group IV (n=6): Debridement, decompression, and anterior instrumentation.

Operative procedure

Standard three portal techniques were used for simple abscess drainage and decompression. The first portal for the thoracoscope was made at seventh intercostal space along the anterior axillary line and two working channels made, under thoracoscopic vision, slightly posterior to the posterior axillary line. The intercostals levels are chosen depending on the site of the lesion. The working portals were enlarged to 2.5-3 cm and used as extended manipulating channels, which facilitated the use of conventional spinal instruments for adequate decompression of the cord. Anterior Rib grafts were harvested by subcutaneous dissection of the ribs and used for anterior column support after debridement. With experience anterior instrumentation with a screw, single rod construct can be undertaken.

Group B: Percutaneous posterior instrumentation and posterolateral debridement using mini-open expanding retractor system

Ten of the 15 patients had lumbosacral tuberculosis who underwent two level instrumentation (Medtronic *Sextant*), while 5 of the patients underwent multilevel percutaneous posterior fixation (Medtronic *Longitude*). All the 15 patients had a mini-open posterolateral decompression using expanding tubular retractors and fusion with cages filled with local autologous bone. Most of the patients who underwent two-level fixation had tuberculosis of either L4-L5 (n=3) or L5-S1 (n=7). The distribution of disease in patients who underwent multilevel percutaneous stabilization was dorsal spine in three and lumbar spine in two patients [Figure 1].

Table 1: Eck and Bridwell criteria[4]

Anterior fusion grades	
Grade 1	Fused with remodeling and trabeculae
Grade 2	Graft intact, not fully remodeled or incorporated, though no lucencies
Grade 3	Graft intact, but definite lucency at the top or bottom of the graft
Grade 4	Definitely not fused with resorption of the graft and with collapse
Posterior fusion grades	
Grade1	Solid trabeculated transverse process and facet fusion bilaterally
Grade 2	Thick fusion mass on one side, difficult to visualize on other side
Grade 3	Suspected lucency or defect in fusion mass
Grade 4	Definite resorption of graft with fatigue of instrumentation

Operative procedure

The placement of percutaneous pedicle screw was aided by cannulated instruments with accurately placed guide wires in the pedicle and checking repeatedly by Image intensifier. Debridement and decompression was done by MIS-(transforaminal lumbar interbody fusion) TLIF type approach using unilateral paramedian incision followed by muscle splitting to reach the facet joint. Further surgical procedure is performed through the expanding tubular retractor system with its endoscopic light source [Figure 2].

Decompression of spinal canal and debridement of involved disc space and adjacent paradiscal region was done after unilateral facetectomy (like in the TLIF approach). After debridement, the space is filled with PEEK/Titanium cage filled with autologous bone graft from the local area (resected facet and surrounding bone) with the screw rod fixation locked in place.

The functional outcome was judged by Oswestry disability index (ODI).

The average followup was 36 mth (range 16 mth-97 mth).

Results

Group A

The average operative time was 228 min (102-330 min). The wide range of operative time was due to the difference in the procedures performed. The abscess drainage group took less time than the debridement and anterior fixation group. The mean blood loss was 780 ml (range 330-1180 ml), the blood loss along with operative time increased with an addition of anterior instrumentation.

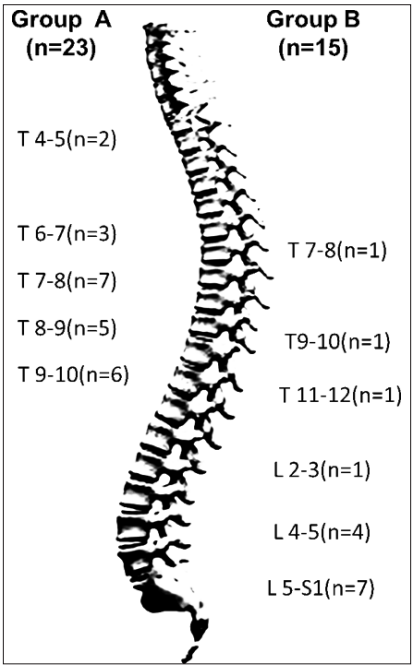

Figure 1: Regional distribution of TB spine in the study

The average preoperative kyphosis was 38° (range 22°-58°) which improved to 27° (20°-34°) in immediate postoperative period and the average postoperative kyphosis at final followup was 30° (range 22-42°) [*P* value 0.001]. Postoperatively, 17 of the 18 patients with preoperative neurological deficit attained ambulatory status and all the patients showed improvement on the Frankel scale, Grade C in 1 patient, Grade D in 10 and Grade E in 12 patients.

The mean preoperative ODI of 41.185 (range 30-50) improved to 22.22 (range 28-15) at the end of 1 year followup [Figure 3] which was statistically significant ($P<0.05$).

The most common complication was conversion to open thoracotomy, seen in three patients. Two had prolonged (5 days) intercostal drainage tube *in situ* due to persistent air leak. One patient had superficial wound infection.

Group B

While the mean blood loss was 625 ml (range: 350-800 ml), the average duration of surgery was 255 min (180-345 min. The duration and blood loss was more in the multilevel percutaneous group and decreased with every subsequent case.

The average preoperative kyphosis angle of three patients with Thoracic TB [Figure 4] was 41.25° (28°-48°), improved to 14.5°(11°-21°) in the immediate postoperative period and maintained at 15.25° at final followup (63.03% correction) with loss of 1°.

The preoperative segmental kyphosis in 12 patients with lumbar tuberculosis [Figure 5] was 20.25° (range: 08°-26°) which improved to -12.08° (range: 08°-16°) with 32.33° average correction of deformity, the correction was maintained at -10.58° (range: 06°-14°) at final followup with loss of reduction of 1.5° (*P* value 0.001).

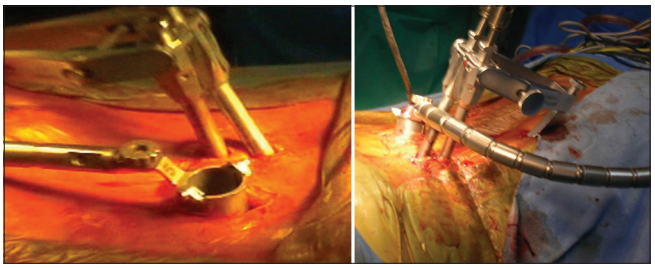

Figure 2: Preoperative photograph showing MIS posterolateral decompression debridement and anterior column support with cage through expandable retractor X-tube

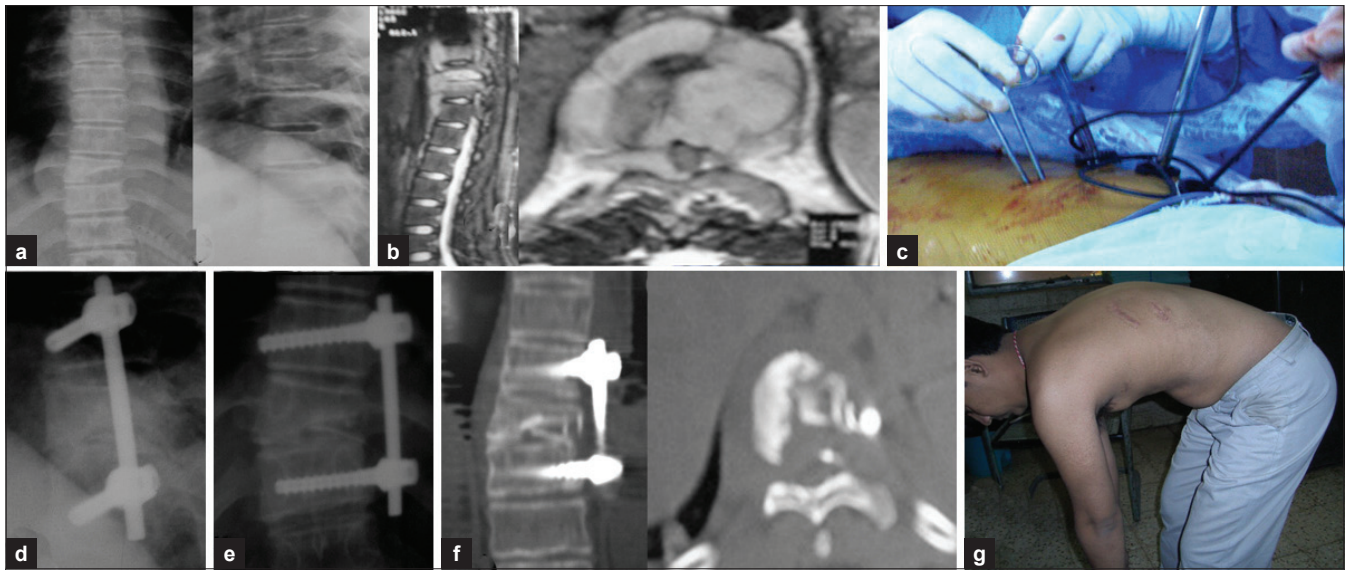

Figure 3: A 22 year old male with Potts paraplegia (Frankle B) at D9-10, Preoperative anteroposterior and lateral view of X-rays (a) showing decreased disc space between D9-D10 with partial destruction of D9. (b) Preoperative MRI saggital STIR image and T2 axial showing epidural, pre and para-spinal abcsess. (c) Peroperative description of thoracoscopic portals. (d, e) postoperative X-rays (anteroposterior and lateral) following video-assisted thoracoscopic decompression, anterior instrumentation, and bone grafting. (f) Postoperative CT scan saggital recon showing good fusion and axial image showing adequate decompression. (g) Clinical/neurological improvement to Frankel E

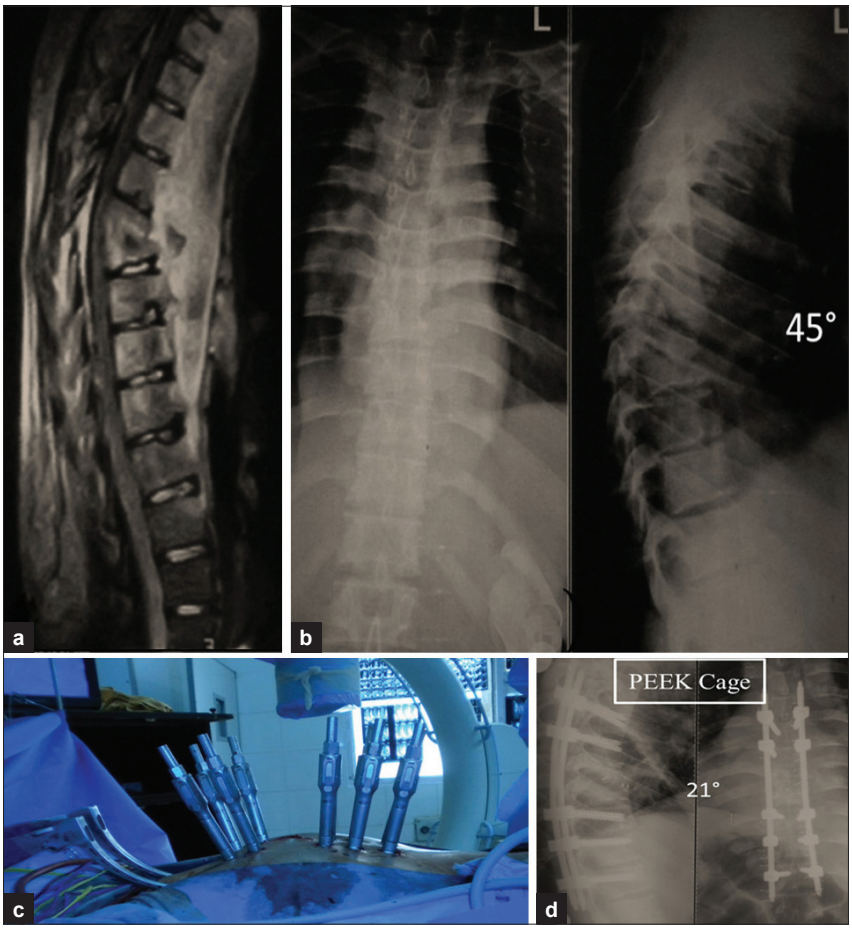

Figure 4: A 21 year old male with Potts paraplegia (Frankel B) at D7-8 vertebra. (a) MRI T2 saggital coronal and axial images showing destruction of D7-8 with large pre and paravertebral abscess extending from D2- D12 anteriorly. (b) Pre-op X-rays (AP and Lat) showing decreased disc space between D7-8 with fuzzy endplates. (c) Per-op illustration of percutaneous screws and tubular retractor system. (d) postoperative X-rays (AP and Lat) of the same patient shows multilevel percutaneous posterior instrumentation and anterior support with PEEK cage and graft

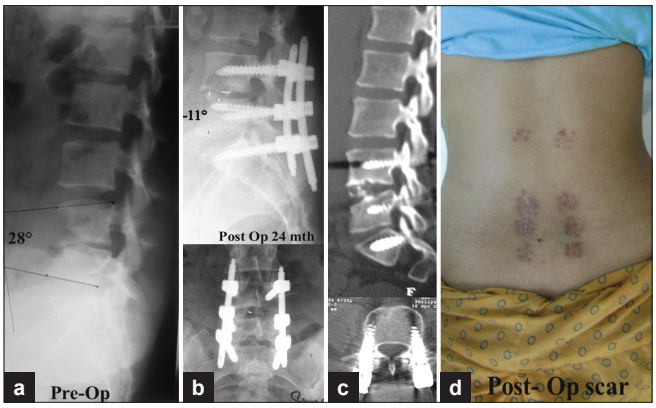

Figure 5: A 24 year old female with TB spine L4-L5 with progressive kyphosis and left L4 and L5 radiculopathy. (a) Preoperative lateral X-ray showing decreased disc space L4-5 with segmental kyphosis. (b) postoperative X-rays (AP and Lat) shows restoration of lumbar lordosis. (c) CT scan saggital and axial cuts showing good placement of screws with inter-body fusion. (d) Clinical photograph displaying the scars

The average preoperative VAS score of 7 improved to 5.6 on the seventh postoperative day and further improved to 3.5 at the end of 2 weeks (P value<0.05). There was significant improvement in the functional outcome at the end of 1 year which was reflected by the ODI. All the three patients with thoracic TB improved neurologically at least by one grade. The patient with lumbar TB in Group B had considerable improvement in radicular pain and weakness.

One patient had pseudarthrosis/doubtful fusion with screw loosening in the percutaneous group at 6 mth followup. However, there was no worsening of neurology or backing out of the screws. The patient had multifocal tuberculosis with pulmonary tuberculosis and was diagnosed to have MDR tuberculosis on sputum cultures. The patient responded to second line ATT and at the end of 1 year, good fusion was appreciated. No other complication was seen in any of the patients.

Sixteen of the 23 patients who underwent VATS (Group A) had definite (Grade 1) fusion, 6 had Grade II and failure of fusion was seen in 1, on the other hand in Group B patients undergoing percutaneous pedicular screw fixation, Grade I (definite) fusion was seen in 60% (n=9), Grade II fusion (probably) in 33.33% (n=5) and Grade III fusion (probably not) in one patient [Table 2].

Discussion

Minimally invasive surgery (MIS) procedures by far have been popularized and extensively used for degenerative spine pathologies and trauma; however, the literature is scarce regarding its use in tuberculosis of the spine. Minimally invasive spine procedures are challenging, require expertise, and have a long and steep learning curve.

Table 2: Fusion assessment using Eck *et al.* criteria

	Group A (VATS)	Group B (percutaneous posterior instrumentation)	Total
Grade I (definite) fusion	16	9	25
Grade II probable	6	5	11
Grade III probably no	1	1	2
Grade IV no fusion	-	-	-

VATS has been explored in tuberculous spondylitis of thoracic spine with satisfying results. Hunang *et al.*[5] reported their successful results in 10 patients of tuberculous spine. He used VATS debridement with iliac crest reconstruction without anterior or posterior instrumented stabilization. There was no case of recurrence at 2-year followup with improvement of at least one Frankel grade. They reported conversion of one patient to open procedure due to excessive pleural fibrosis and increased kyphosis with use of rib grafts.

Subsequently, Kapoor *et al.*[6] showed comparable results of VATS abscess drainage and debridement with open thoracotomy for single level recent onset paradiscal dorsal tuberculosis failing conservative therapy in 16 patients. Fourteen patients had neurological recovery with one case requiring open conversion due to excessive bleeding. Authors recommend careful digital separation of lung from thoracic wall after the stab incision before inserting the first trocar to prevent complications.

We have been selectively using diverse thoracoscopic procedures like abscess drainage, anterior decompression with/without instrumentation for the management of single-level thoracic tuberculosis extending from D4-D11 with results comparable to open procedure and those reported earlier.[7]

Good fusion rate along with adequate decompression and neurological recovery in 17/18 patients was reported. No implant related complication was noted. The major complication noted was conversion to open procedure as reported before for bleeding and pleural adhesion.

Foley *et al.* introduced the MISTLIF procedure to reduce the approach related muscle damage.[8] MISS is established on several basic principles like using known anatomic neurovascular and muscle compartment planes and not disrupting tendon attachment sites of key muscles, particularly the origin of the multifidus muscle at the spinous process. It also avoids muscle crush injury by self-retaining retractors thus minimizing collateral soft tissue injury by limiting the width of the surgical corridor.[9]

Traditional open posterior spinal procedures require extensive soft tissue dissection to expose the anatomic

landmarks and perform neural decompression and intertransverse fusion. Open instrumented fusion procedures are associated with lengthy hospital stays and significant costs. Additionally, the morbidity associated with these procedures has become an increasing concern for many surgeons. In part, this morbidity is related to the significant iatrogenic muscle and soft tissue injury that occurs during routine exposure.[10] The damage to the lumbar musculature was directly related to the time of retraction during surgery. Furthermore, the incidence of low back pain was significantly increased in patients who had long muscle retraction time.[11] Retractor blades may actually increase intramuscular pressure to levels of ischemia.[12] Mayer *et al*.,[13] demonstrated long term radiographic atrophy of the operated muscle segment on CT scanning after cases requiring extensive posterior surgical exposure. Very encouraging results of minimally invasive posterior instrumentation have been reported in various studies especially for the management of low grade listhesis and other degenerative pathologies of spine.[3,14,15] In an isolated case series, Ito *et al*. demonstrated good pain relief in three patients with tuberculous spondylodiscitis who underwent endoscopic debridement and irrigation of abscess.[16] Minimally invasive posterior instrumentation, either single level or multilevel with decompression and interbody fusion using tubular retractor system in cases of tuberculosis of the spine, is a relatively newer concept and no similar studies are yet described in the literature.

Percutaneous posterior instruments to stabilize the involved spine posteriorly and using the MIS-TLIF approach for the diseased disc space/paradiscal region was used in 15 cases in thoracic and lumbar regions in this study. Significant improvement of kyphosis was noticed with percutaneous posterior instrumentation with blood loss and duration comparable to studies involving MIS done for other degenerative etiologies of lumbar spine. However, we would like to emphasize upon the fact that the minimally invasive technique should be reserved only for lesser degree of kyphosis (Group A, VATS 36° and Group B, MISS percutaneous posterior instrumentation 41.25°). Good surgical decompression and interbody fusion was achieved by both the minimally invasive techniques. Postoperative improvement in the ODI and VAS scores was significantly achieved. One patient reported with screw loosening and clincoradiological evidence of persistent disease; she later improved clinically with second line of antitubercular chemotherapy with good fusion status.

Conclusion

Good fusion rate with encouraging functional results can be obtained in caries spine with minimally invasive techniques with all the major advantages of a minimally invasive procedures including reduction in approach related morbidity.

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