



Posterior lumbar interbody fusion and posterior instrumentation in the surgical management of lumbar tuberculous spondylitis

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There are few reports of the treatment of lumbar tuberculous spondylitis using the posterior approach. Between January 1999 and February 2004, 16 patients underwent posterior lumbar interbody fusion with autogenous iliac-bone grafting and pedicle screw instrumentation. Their mean age at surgery was 51 years (28 to 66). The mean follow-up period was 33 months (24 to 48). The clinical outcome was assessed using the Frankel neurological classification and the Kirkaldy-Willis criteria.

On the Frankel classification, one patient improved by two grades (C to E), seven by one grade, and eight showed no change. The Kirkaldy-Willis functional outcome was classified as excellent in eight patients, good in five, fair in two and poor in one. Bony union was achieved within one year in 15 patients. The mean pre-operative lordotic angle was 27.8° (9° to 45°) which improved by the final follow-up to 35.8° (28° to 48°). Post-operative complications occurred in four patients, transient root injury in two, a superficial wound infection in one and a deep wound infection in one, in whom the implant was removed.

Our results show that a posterior lumbar interbody fusion with autogenous iliac-bone grafting and pedicle screw instrumentation for tuberculous spondylitis through the posterior approach can give satisfactory results.

The incidence of tuberculosis is rising. Its most common and most serious skeletal manifestation is as tuberculous spondylitis, which is found in approximately 50% of all affected patients.¹⁻³ Antituberculous chemotherapy remains the mainstay of treatment now that MRI allows early diagnosis before the onset of severe deformity and neurological deficit. This conservative approach cannot, however, prevent the progression of a kyphotic deformity, and long-term rest is usually required to relieve severe back pain.⁴ These problems may be avoided by rigid internal stabilisation of the spine.⁴⁻⁶ Various methods have been described for spinal tuberculosis including anterior fusion, combined anterior and posterior fusion, posterior fusion alone and posterior fusion followed by anterior fusion.³ However, there have been few reports of the use of posterior lumbar interbody fusion and pedicle screw fixation.⁴ The aim of this procedure is to remove the infected material and to achieve sound union, thereby facilitating early mobilisation and speedy rehabilitation. We have evaluated the use of this technique in patients with lumbar tuberculous spondylitis.

Patients and Methods

Between January 1999 and February 2004, 41 patients with lumbar tuberculous spondylitis were treated at the authors' institution. Of these, 22 received antituberculous chemotherapy alone, 16 underwent posterior lumbar interbody fusion with instrumentation and three had both anterior and posterior surgery. This retrospective study concerns the 16 patients treated by posterior lumbar interbody fusion with instrumentation. There were six women and ten men with a mean age at surgery of 51 years (28 to 66). The mean follow-up period was 33 months (24 to 48). All presented with constitutional symptoms including weakness, malaise, night sweats and fever with weight loss. Back pain was a late symptom. The mean duration of symptoms was four months (1 to 8). Initially, ten patients had a neurological deficit of grade C or grade D according to the classification of Frankel et al,⁷ monitored by motor weakness, sensory change, radiating pain to the lower limbs, and urinary symptoms. Concurrent medical problems included diabetes mellitus in three, hypertension in one, chronic renal failure in one and pulmonary tuberculosis in five. Spondylitis

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Table I. The modified criteria of Lee et al⁹ for radiological fusion

Grade	Description
Definitive fusion	Definitive bony trabecular bridging across the graft-host interface, no movement (< 3°) on a flexion-extension radiograph and no gap at the interface
Probable fusion	No definitive bony trabecular crossing, but no detectable movement and no identifiable gap at the interface
Possible pseudarthrosis	No bony trabecular crossing, no movement, but identifiable gap at the interface
Definite pseudarthrosis	No traversing trabecular bone, definitive gap, and movement > 3°

Table II. The modified Frankel classification of neurological deficit⁷

Grade	Description
A	Sensation and voluntary motor function absent
B	Sensation present, motor function absent
C	Sensation present, voluntary motor function present and but not useful (grade 1/5-2/5)
D	Sensation present, motor function present and useful (grade 3/5-4/5)
E	Sensation normal and motor function normal (grade 5/5), reflexes may be abnormal and parasthesiae may be present

Table III. The modified criteria of Kirkaldy-Willis et al¹⁰ for the functional outcome

Grade	Description
Excellent	The patient has returned to his normal work and other activities with little or no complaint
Good	The patient has returned to his normal work but may have some restriction in other activities and may on occasion after heavy work have recurrent back pain requiring a rest for a few days
Fair	The patient has to reduce his working capacity, taking a lighter job or work part-time, and may occasionally have recurrence of pain requiring absence from work for one to two weeks, once or twice a year
Poor	The patient does not return to work

was found at L1-2 in four patients, at L2-3 in five, at L3-4 in three, at L4-5 in two and at L5-S1 in two.

Surgery was carried out when severe back pain and/or radicular pain persisted after conservative treatment, when a neurological deficit resulted from the presence of granulation tissue, abscess, or sequestered bone or a disc fragment compressing the dura, or when there was progressive deformity. We used posterior lumbar interbody fusion with posterior instrumentation in patients who had a small abscess in the anterior aspect of the vertebral body which could be drained through the disc space from a posterior approach, in those with spinal stenosis or with an epidural abscess in the posterior aspect of the dura and in those with lesions at L5-S1 which would be difficult to treat by anterior fixation.

A full blood count, measurement of the erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP), the Mantoux test,⁸ plain radiography, isotope bone scanning and MRI (T1, T2 and contrast-enhanced T1 images) were carried out prospectively in each patient, as was CT-guided fine-needle biopsy of the infected disc space.

Operative technique. Laminectomy and pedicle screw fixation were carried out under general anaesthesia. Whenever possible, pedicle screw fixation avoided the infected vertebral segment and the screws were sited in the adjacent vertebral bodies. Next, the disc space was distracted and the infected end-plate, disc and soft tissue were meticulously debrided. The space was then packed with 10 ml to 20 ml of autogenous iliac bone and compressed. A posterior lumbar interbody fusion with autogenous cancellous iliac bone grafting was undertaken in each case with additional posterolateral bone grafting to create a circumferential fusion. The disc material and infected end-plate removed during surgery were sent for culture and histological examination.

Post-operative care. Intravenous antibiotics were given post-operatively for a mean of 6.1 days (5 to 7), in addition to antituberculous chemotherapy. Each patient was mobilised on the third day and wore a lumbosacral orthosis for three months. Their antituberculous chemotherapy had been started pre-operatively and was continued for a mean of 13.9



Fig. 1a

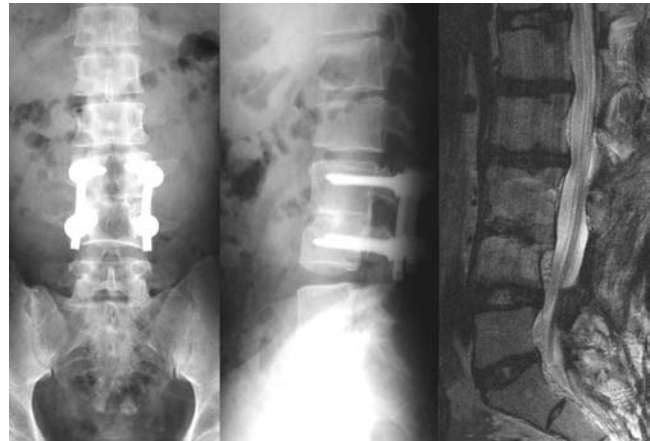


Fig. 1c



Fig. 1b

A 28-year-old man with tuberculous spondylitis at L3-4 who had posterior lumbar interbody fusion with autogenous iliac-bone grafting and posterior instrumentation. Figure 1a – Pre-operative anteroposterior (AP) and lateral radiographs showing interspace narrowing of the L3-4 and irregular end-plates. Figure 1b – T2-weighted sagittal and contrast-enhanced T1-weighted axial MR images showing an epidural abscess and destruction of the L3-4 disc space. Figure 1c – AP and lateral radiographs taken 29 months after surgery showing that bony union has been achieved and a T2-weighted sagittal MR image taken two years after surgery showing that there was no reactivation of the tuberculous spinal lesion.

months (12 to 18). The standard four-drug therapy consisting of isoniazid (5 mg/kg), rifampicin (10 mg/kg), ethambutol (15 mg/kg), and pyrazinamide (25 mg/kg) was administered as the first-line treatment for four months, and was followed by isoniazid, rifampicin and ethambutol for a mean of 9.9 months (8 to 14). The treatment was regularly supervised by a chest physician (SJK). Removal of the implant was not routinely undertaken.

Static and dynamic radiographs were taken of each patient at three, six and 12 months after surgery and at the final follow-up. The quality of the spinal fusion and the measurement of the lumbar lordosis angle were evaluated by two surgeons (JSL, KTS). The lumbar lordotic angle was measured from the upper end-plate of T12 to the upper end-plate of S1 pre-operatively, post-operatively and at the final follow-up. Fusion was assessed using the criteria of Lee, Vessa and Lee⁹ (Table I). Functional outcome was graded using the neurological classification of Frankel et al⁷ (Table II) and the functional criteria of Kirkaldy-Willis et al¹⁰ (Table III).

Statistical analysis. Serial changes in the lordotic angle were assessed using the Friedman test with Dunn's post-multiple comparison test (MedCal Software, Mariakerke, Belgium). A p-value ≤ 0.05 was considered to be statistically significant.

Results

Spinal fusion was carried out over a mean 2.4 levels (1 to 5).

Bony union and change in lordotic angle. Bony union was seen within a year in 15 patients (Figs 1 and 2). In one patient, whose implant had been removed because of a deep infection, fusion did not occur.

The mean lordotic angle before the operation was 27.8° (9° to 45°) which improved post-operatively to 37.4° (28° to 46°). At the final follow-up it was 35.8° (28° to 48°). There were statistically-significant differences between the pre- and post-operative (p < 0.001), the

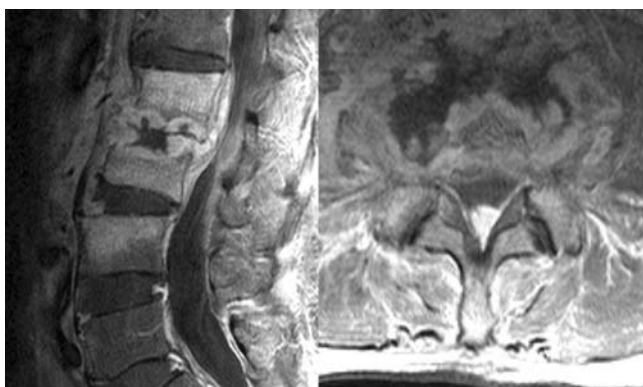


Fig. 2a

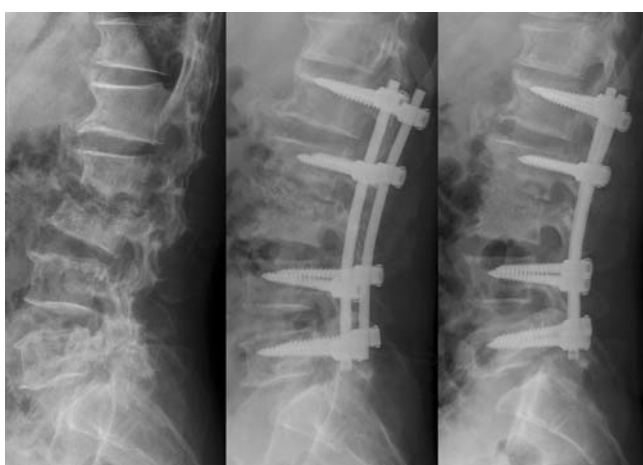


Fig. 2b

A 56-year-old man developed tuberculous spondylitis at L2-3 and underwent posterior lumbar interbody fusion with autogenous iliac-bone grafting and instrumentation. Figure 2a – Contrast-enhanced T1-weighted sagittal and axial MR images showing destruction of the L2-3 disc space and the presence of a paraspinous abscess. Figure 2b – Pre-operative, immediate post-operative and post-operative lateral radiographs showing fusion at L2-3 at two years.

post-operative and final ($p > 0.05$) and the pre-operative and final lordotic angles ($p < 0.05$).

Clinical findings. In eight patients, the diagnosis of tuberculosis was established by culturing acid-fast bacilli from material obtained from the spinal lesion, and in four others by the observation of acid-fast bacilli on smears. The remaining four patients had negative findings on both culture and smear. The Mantoux test was positive in 12. Typical caseating granulomas were demonstrated histologically in each patient.

On admission, the mean white blood cell count was 8898 ml (5700 to 11 360), the mean ESR was 72 mm/hr (10 to 101) and the mean CRP level was 5.77 mg/dl (1.02 to 10.56). The ESR was elevated in 15 patients (93.8%) and the CRP level in 16 (100%). The ESR fell after surgery, and

had returned to normal in seven patients by six weeks. In 12 patients it had returned to normal at final follow-up. The CRP level had fallen by six weeks and returned to normal within three months of surgery in 15 patients. In the other patient, it remained elevated six months after fusion and returned to normal three months after the implant had been removed.

Four patients had post-operative complications. Two had a transient nerve-root injury due to retraction. A superficial wound infection in one patient resolved following local treatment. A single deep wound infection was treated by removal of the implant at six months.

Using the Frankel neurological classification⁷ one patient improved by two grades (C to E), seven by one grade, and eight remained unchanged. Using the Kirkaldy-Willis criteria,¹⁰ functional outcome was excellent in eight patients, good in five, fair in two and poor in one.

Discussion

Surgery for tuberculous spondylitis is indicated for spinal deformity, the failure of non-operative management, persistent severe pain and neurological dysfunction which does not resolve or which develops while patients are undergoing antituberculous chemotherapy.¹¹ In addition, older patients with Pott's paraplegia require decompressive surgery to avoid the hazards of prolonged immobilisation.¹² Nussbaum et al¹³ recommended surgical treatment even for those with a mild neurological deficit because both epidural infection and bone destruction typically progress for a time after antituberculosis chemotherapy has been started.

Various surgical techniques have been used to treat spinal tuberculosis but there are few reports on the use of posterior lumbar interbody fusion and pedicle screw fixation.⁴ Combined anterior radical debridement and arthrodesis has some advantages, including direct access to, and excision of, the focus of disease, rapid bony union, and less progressive kyphotic collapse.¹⁴ In contrast, posterior fusion with rigid instrumentation is safer, technically easier and avoids the potential intra- and post-operative complications which can be associated with the anterior approach.¹⁵ Although the epidural abscess associated with lumbar tuberculous spondylitis is usually anterior, in cases of epidural suppuration, access to the neural elements can be limited if an anterior approach is used.¹⁶

Because modern imaging facilitates early diagnosis and the advent of more effective regimens of antituberculous chemotherapy, it is now possible to treat patients conservatively rather than by an anterior radical approach.⁶ Moon et al³ reported 56 patients with active tuberculosis of the lumbar and lumbosacral spine who had been treated conservatively with triple chemotherapy for 12 to 18 months. They emphasised the importance of early diagnosis and the immediate initiation of chemotherapy in order to cure the disease and to minimise the residual kyphosis. Recent reports^{4,11,13,16} emphasise the importance of tailoring the treatment of spinal tuberculosis to the individual. Nuss-

baum et al,¹³ based their treatment on the degree of bone destruction. Aggressive debridement and fusion were only carried out in patients in whom extensive involvement of vertebral bodies resulted in kyphosis. Güzey et al⁴ and Rath et al¹⁶ reported good neurological results after posterior debridement and internal fixation in patients with neurological impairment due to spondylitis. Their results were comparable with the best results obtained after anterior decompression which may be explained by the extent of the neural decompression possible through a posterior approach. Mehta and Bhojraj¹¹ advocated posterior instrumentation with anterior debridement and grafting in patients with kyphosis. They also reported good results after posterior transpedicular debridement and instrumented fusion without anterior debridement in patients at high risk because of their underlying medical condition.


In our series, we carried out posterior debridement, posterior lumbar interbody fusion with autogenous iliac-bone grafting and posterior instrumentation with pedicle screws. We prefer a posterior approach because of our familiarity with it, its simplicity, and its low complication rate. Posterior lumbar interbody fusion with instrumentation may be performed safely in patients with spinal tuberculosis except for those with multilevel involvement and a large paravertebral abscess. Such cases are few because modern imaging techniques allow earlier diagnosis. The benefits of our approach are early ambulation, decreased morbidity, and good access to dural abscesses, sequestered bone and small abscesses in the anterior spine. Posterior instrumentation can be used to correct deformity and any concurrent spinal stenosis in elderly patients can be treated simultaneously.

The stability provided by posterior fixation, particularly transpedicular fixation, protects the vertebral correction, and patients are able to return to normal activities within a short period of time. In general, transpedicular screws can be placed in an affected vertebra if the upper part of the vertebral body is not destroyed by the infection^{5,16} thereby reducing the surgical exposure and the extent of fixation. The results of our study show that lumbar tuberculous spondylitis can be successfully treated through the posterior approach by meticulous debridement of necrotic bone and the infected disc followed by bone grafting. Compared with anterior debridement and a strut bone graft, the disadvantage of posterior lumbar interbody fusion and pedicle screw fixation is that when destruction is severe the fusion may need to be extended by one or two more segments.

Our results demonstrate that posterior lumbar interbody fusion with autogenous iliac-bone grafting and posterior instrumentation can give satisfactory results for lumbar tuberculous spondylitis. It allows easy access to the spinal canal for neural decompression, prevents loss of correction of vertebral

alignment, and facilitates early mobilisation. We recommend this procedure for patients with an accessible small abscess in the anterior spine and slight vertebral body destruction, an epidural abscess in the posterior dura, spinal stenosis, and in those who cannot be treated from the front because the abscess is in the lower lumbar spine.

Supplementary Material

 Tables showing the clinical details, laboratory findings and radiological and clinical results of the 16 patients are available with the electronic version of this article on our website at www.jbjs.org.uk

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