

## Posterior Surgical Decompression and Fusion Augmented with Internal Fixation in Thoracic and Lumbar Spondylodiscitis; is it Possible?

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### ABSTRACT

**Background Data:** Posterior surgical treatment of spinal infections was adopted since 1912. However, most authors strictly advocated anterior or anterolateral debridement and subsequent bone grafting and fixation. These procedures often bear a high risk for elderly and debilitated patients.

**Purpose:** To assess the efficacy of posterior surgical decompression, fusion and fixation in thoracic and lumbar spine spondylodiscitis.

**Study Design:** A retrospective clinical case study.

**Patients and Methods:** Fifteen patients suffering from thoracic and lumbar spondylodiscitis, both tuberculous and non-tuberculous, underwent posterior surgical decompression with posterolateral and interbody fusion augmented with posterior fixation, according to the degree of vertebral wedging, the kyphotic angle and high surgical risk for anterior procedures.

**Results:** Neither of our patients deteriorated as regards the motor power. Improvement of the kyphotic and lordotic angles was evident in post-operative images. Eleven of our 15 cases (73%) improved to variable degrees, (from C to E Frankel grading); four patients had the same motor power as pre-operatively.

**Conclusion:** It is possible to perform posterior surgical decompression and fusion augmented with internal fixation in thoracic & lumbar spondylodiscitis in one or more of the following: (1) those of high anesthetic risk for circumferential surgery, (2) kyphotic angle not more than 10° beyond the normal range in dorsal spine (3) the percentage of the anterior and posterior vertebral height is ≤ 30% (4) diminished or loss of lumbar lordosis, (5) average body weight. (2013ESJ046)

**Key Words:** Spondylodiscitis, kyphosis, internal fixation, fusion

### Introduction

In 1912, the first described surgical treatment of tuberculous spinal infections via posterior approach was adopted. Because the vertebral body and the disc space

are almost always affected, most authors strictly advocated anterior debridement and subsequent bone grafting using anterior, anterolateral, and posterolateral approaches with postoperative

prolonged immobilization. However, with these procedures, which often bear a high risk for the elderly and debilitated patients, the access to the neural elements is limited, particularly in cases of concomitant epidural suppuration.<sup>16</sup>

Before the advent of antibiotic therapy, the treatment of pyogenic vertebral osteomyelitis involved drainage of abscesses, rest on a plaster bed, and attention to nutrition and general hygiene. The mortality rate with this approach was between 25% and 70%. The use of antibiotics has significantly changed the prognosis with this disease. The goals of treatment are to establish tissue and bacteriologic diagnoses, prevent or reverse neurologic deficits, relieve pain, establish spinal stability, correct symptomatic spinal deformity, eradicate the infection, and prevent relapses. Biopsy, by either a closed or an open method, is mandatory in any case of spine infection before the institution of antibiotic therapy.<sup>5</sup>

## Patients and Methods

### Patient Population:

Between June 2005 and June 2012, we reviewed 60 patients with both tuberculous and non-tuberculous spondylodiscitis who underwent surgery. Only 15 of these patients were included in the present study after meeting one or more of the following criteria: 1) radiological demonstration of thoracic, thoracolumbar, or lumbar infection, their kyphotic angle is  $\leq 10^\circ$  beyond the normal range in dorsal spine and anterior vertebral height is decreased by  $\leq 30\%$  & diminished or loss of lumbar lordosis (2) Patients, in whom general conditions doesn't tolerate circumferential surgery (after consultation of the anesthesiologist), (3) average body weight. There were 3 women and 12 men whose average age was 61 years (range 36–76 years). All patients presented with back pain with neurological deficits. Classification of spinal cord function was made using the Frankel Scale.<sup>2</sup> In this work; we had one patient (7%) with Frankel A, two patients (13%) with Frankel (B), seven patients (47%) with Frankel C and 5 patients (33%) with Frankel D.

### Diagnostic Testing:

In all cases we conducted the standard laboratory tests, including a white and red blood cell count, erythrocyte sedimentation rate and C-reactive protein. Magnetic resonance and computerized

tomography imaging were performed in all cases as well.

### Involved Levels and Deformity:

In terms of the spinal tuberculous & pyogenic spondylitis, the disc space and adjacent vertebrae were involved in all patients. The degree of vertebral body (VB) wedging, if present, was determined as follows: the percentage of height of the anterior VB to height of posterior one. We defined the kyphotic angle, if there was a wedged vertebra, as two lines were drawn, one through the superior surface of the first non-wedged vertebra cephalic to the lesion, and one through the inferior surface of the first non-collapsed vertebra caudal to the lesion. Perpendicular lines were then drawn from these lines and the angle was measured at their intersection. If there was no collapsed vertebra, the lines were drawn through the superior surface of the cephalic vertebra and the inferior surface of the caudal vertebra. The angle was measured in the preoperative; early postoperative periods and during follow up.

### Surgical Procedure:

The indications for operative management in this series were one or more of the following; presence of neurological deficits, VB wedging of  $\leq 30\%$ , spinal deformity in which there is diminished or loss of lumbar lordosis, kyphotic angle not exceeded 10 degrees beyond the normal range in dorsal spine, epidural abscess compressing the dural sac, large paravertebral abscess, radicular or dural compression due to granulation tissue causing neurological deficit or severe pain.

All patients were treated by surgical debridement and internal fixation via a posterior approach. A total laminectomy, according to the extent of spinal canal compression, was followed by debridement of the affected intervertebral discs and the VBs. If necessary, a facetectomy or pediclectomy was also conducted. In addition to debridement of the infected tissue, the affected segments were stabilized by placing transpedicular screws. The screws were placed into the healthy part of the pedicle & body of the affected vertebra if possible. If the screws could not be placed into the affected vertebra bilaterally, or if thoracolumbar junction involvement were present, two vertebra above and either one or two vertebrae below were incorporated into the instrumentation system. In one of the early patients, we put a cross-connector due to osteoporosis of the unaffected

vertebrae, proven by the densometric studies, coinciding with the basic precautions recommended by Moatzet al.<sup>12</sup> If the bone fragments obtained during laminectomy were not sufficient, we used autograft material as iliac bone. In one patient, who had infection affecting the posterolateral part of the D8-9 and paravertebral soft tissue infection, we prepared the fixation system as a standby, but after evacuation of the pus, we found that segment stable and we abandoned the transpedicular screws, depending on the biomechanical principle of the inherent stability of the dorsal spine. In all patients, the biopsy specimens were sent for pathological examination, and the pus obtained from the abscesses was sent for culture for Mycobacterium tuberculosis, as well as aerobic and anaerobic nonspecific microorganisms.

**Antibiotics Medication:**

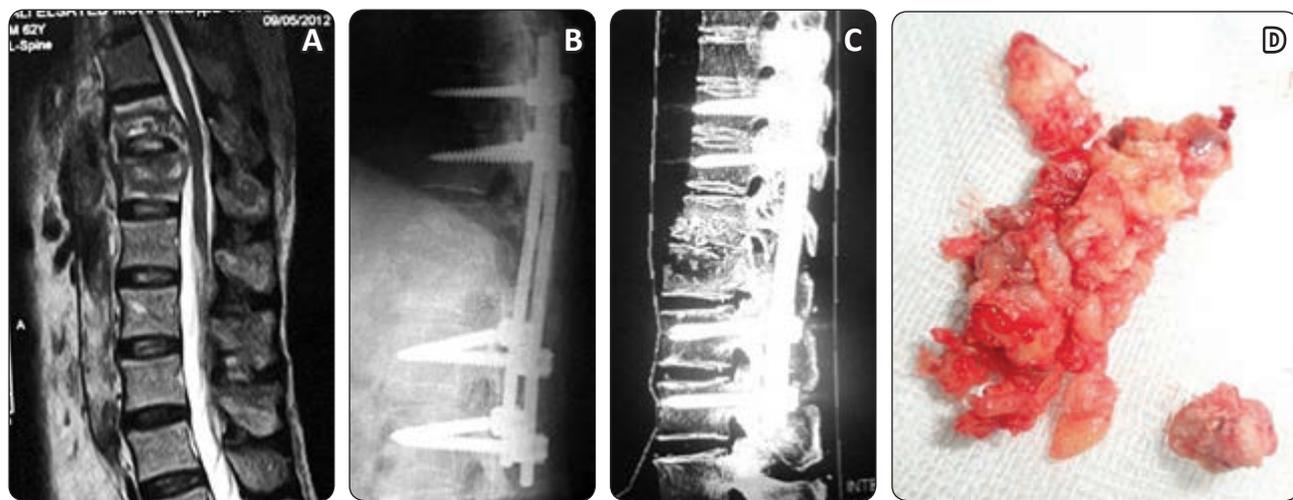
Coinciding with Sofianos and Alpesh,<sup>18</sup> who demonstrated that infections are better controlled with antibiotics in a mechanically stable environment. For pyogenic cases, antibiotics were given according to the results of the result of culture. For tuberculosis proven patients, antituberculosis chemotherapy was instituted on the day of surgery and was continued for 12 months. This treatment was regularly supervised by chest physicians. White and red blood cell counts, the ESR, and liver function values were monitored.<sup>9</sup> The patients underwent regular 2-month follow-up examinations for the 1st year then according to the clinical condition. Follow up Plain X-rays & CT bone

window was essential for evaluation of the screws placement & correction of the deformity.

**Results**

Neither of our patients deteriorated postoperatively as regards the motor power. Eleven of our 15 cases (73%) improved to variable degrees, (from C to E Frankel grading); four patients had the same motor power as pre-operatively. In 4 patients, the diagnosis was established by culturing acid-fast bacilli from the material obtained in the spinal lesion, and in the other 11, it was proved to be non-tuberculous. In all 4 tuberculous patients, typically caseation granulomas were demonstrated grossly & histologically. All of our patients had improvement of preoperative back pain that was attributable to suspected instability.

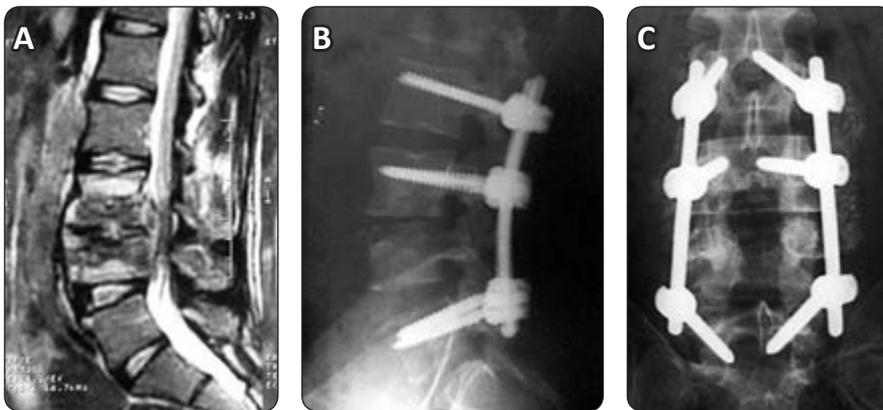
Spinal Alignment: aiming mainly at mechanical correction of the deformity, improvement of the kyphotic angles was evident in the early post-operative images (Figure 1, 2), Patient No 6 where the pre-operative kyphosis angle was 20° then became 0° in the post-operative follow up (Table 1). Correction of the lordotic curve was achieved in patient No. 3, (Figure 3) where the pre-operative angle of lordosis was 30° then 45° postoperatively. Even in patient No. 4, in whom hemilaminectomy & evacuation of the pus without the need of posterior instrumentations, the kyphotic angle pre-operatively was 20°. In the early post-operative it was 5°, and then re-worsened to 15°.



**Figure 1.** (A) pre-operative T2 sagittal MRI showing D11/12 spondylodiscitis with kyphosis, (B) post-operative plain X-rays showing correction of kyphosis, (C) sagittal CT showing correction of kyphosis and bone graft, (D) the excised caseous material. (Patient 6)



**Figure 2.** (A) pre-operative T1 sagittal MRI, (B) sagittal and axial (C) CT revealing the lytic part of the vertebral body, (D) sagittal CT 12 months post-operative CT, pus evacuation without instrumentation was applied in spite of pre-operative planning showing worsening of the kyphosis. (Patient 4)



**Figure 3.** (A) pre-Operative T2 sagittal MRI revealing L3/4 tuberculous spondylodiscitis. Rt, (B) lateral and (C) AP plain X-rays 10 months post-operatively revealing good alignment and cure (Patient 3).

**Table 1.** Summary Data of our 15 Patients.

No	Age	Sex	Level	Surgery	Preop Frankel	Postop Frankel	Organism	A1	A2
1	70	M	D6-7	TP	B	D	P	35 (K)	35
2	65	M	D7-8	TP	D	D	P	37 (K)	30
3	36	M	L3-4	TP	C	E	T	30 (L)	45
4	43	M	D8-9	Laminectomy	D	E	P	20 (K)	5
5	54	M	D10-11	TP	C	D	P	7 (K)	0
6	62	M	D11-12	TP	C	D	T	20 (K)	0
7	50	F	L5-S1	TP	D	E	P	39 (L)	45
8	50	M	L3-4	TP	D	E	P	40 (L)	45
9	70	M	D7-8	TP	C	D	T	35 (K)	35
10	70	F	D6-7	TP	A	A	P	37 (K)	37
11	70	M	D7-8	TP	D	E	P	40 (K)	40
12	76	M	D7-8	TP	B	B	P	40 (K)	40
13	48	M	D6-7	TP	C	E	P	34 (K)	34
14	70	M	D6-7	TP	C	D	P	38 (K)	38
15	70	F	D7-8	TP	C	C	T	39 (K)	39

TP: transpedicular screw, A1: preoperative kyphotic angle, A2: postoperative angle. T: tuberculous, P: pyogenic, A1: preoperative spinal angle, A2: postoperative spinal angle, K: Kyphosis, L: Lordosis, M: male, F: female.

## Discussion

Talu et al,<sup>19</sup> Yong et al,<sup>21</sup> and Dennis and Tandon,<sup>7</sup> concluded that anterior radical debridement and strut graft is the golden standard in the surgical treatment of spinal tuberculosis, but it should always be accompanied by posterior instrumentation and fusion to shorten the immobilization period and hospital stay, obtain good and long lasting correction of kyphosis, and prevent further collapse and graft failure.

Panagiotis et al,<sup>14</sup> reported that there is a controversy in the literature regarding the most appropriate approach to treat spondylitis. Anterior, posterior, and combined approaches as well as one-stage versus two-stage approach have been discussed. They concluded that patients with thoracolumbar osteomyelitis could successfully undergo anterior surgery with insertion of titanium mesh cage and posteriorly instrumented fusion performed sequentially on the same day under one anesthesia. The presence of the mesh cage anteriorly at the site of spondylitis had no negative influence on the course of infection healing, and additionally it stabilized the affected segment maintaining sufficient sagittal profile. In addition, Amir et al,<sup>1</sup> reported that the cylindrical titanium mesh could be used with good results for large anterior column defect reconstructions even in the face of active pyogenic infection and has not been associated with early recurrence of infection.

Yoshiyuki et al,<sup>22</sup> demonstrated no significant differences in clinical outcomes and radiographic findings between groups with instrumentation (Groups anterior then posterior and Posterior then anterior), indicating that the surgical technique may be selected flexibly depending on the patient's condition.

We are convinced that surgery must be attempted in all patients with spinal infection associated with spinal cord compression. Narayanam et al,<sup>13</sup> concluded that a significant proportion of patients with spinal TB and severe motor deficits experience remarkable improvement after surgical decompression and hence should undergo surgery even though they might be suffering from paraplegia of considerable duration. In addition, David et al concluded that patients presenting with advanced destructive changes, spinal instability and neural

element compromise required anterior debridement and grafting, which could be performed safely at one operative stage with gratifying results, even in very elderly patients. Sascha et al,<sup>17</sup> and Patrick et al,<sup>15</sup> reported that the decision whether an anterior or posterior approach should be used must be made on an individual basis.

If we consider the disadvantages of anterior surgery, we mention the conclusion of Kee et al,<sup>10</sup> that surgical treatment of pyogenic lumbar spondylodiscitis resulted in subsidence and loss of correction after anterior strut grafting with or without posterior instrumentation. Posterior instrumentation is thought to restore early stabilization of the graft, which could possibly shorten the period of bed rest and decrease complications relating to unstable bone grafts.

Moreover, Michael et al,<sup>11</sup> reported that the use of titanium mesh cages in the treatment of vertebral osteomyelitis effectively reconstructs the anterior column, while adding stability and restoring the sagittal profile. There is no increase in the rate of recurrence or persistence of infection related to the implantation of titanium mesh cages. But the complications were, Dislocation (settling) of the cage which managed by insertion of a new cage and posterior instrumentation, nerve root lesion required implantation of a shorter screw, Iliac vein injury which was repaired intraoperatively, and dural tear.

Chris et al,<sup>5</sup> stated that the optimal strategy for treating spinal infections remains controversial. In their patients, motor deficits were Grade 5 in 67%, in 7% motor weakness was Grade 4, and Grade 3 paresis was demonstrated in 10.5%. In the remaining patients paresis was Grade 2 in 12% and Grade 0 in 3.5%. Their results suggested that surgery, especially in conjunction with the placement of instrumentation, might be more beneficial than conservative treatment. In this work, we had one patient with Frankel A (7%); two patients with Frankel B (13%) 7 patients (47%) with Frankel C and 5 patients (33%) with Frankel D.

El Mahallawy,<sup>8</sup> reported his experience with the posterior approach in a series of 26 consecutive patients with surgically treated cases of dorsal spondylodiscitis. Dramatic improvement of back pain as we reported in our work, marked neurological recovery (17 of 26 patients, 65%),

correction of sagittal alignment and maintenance of stability with consequent ability of early mobilization were all encouraging. The fact that this technique avoids the lengthy operation and the major complications of anterior approach and the ability of excision of significant septic granulation compressing the dorsal aspect of the cord is the supportive to the exclusive posterior technique. Posterior stabilization expedites early and safe ambulation of these patients without the need for external support.

In our work, we chose the patients with kyphotic angle not exceeding 10 degrees beyond the normal range in dorsal spine. Nonetheless, Karagöz et al,<sup>9</sup> emphasized that even in cases of extensive VB collapse; high-grade kyphosis might be prevented by removing the infected material in the disc space and VBs, with posterior interbody grafts and posterior instrumentation. The areas of bone that are infiltrated by, tuberculous disease might recover and be reconstituted with drug treatment. The ischemic and infarcted bone also would recover as the disease subsides and chemotherapy improves the circulation of the lesion. Debridement of infected tissue combined with intensive antituberculosis chemotherapy can therefore eradicate tuberculous infection of the spine, even though biomaterial is present in the posterior vertebral portion. The stability provided by posterior fixation, particularly transpedicular fixation, in addition to debridement, securely protects the vertebral correction, and patients are able to return to activities of daily living within a short time.

Karagöz et al,<sup>9</sup> reported that, transpedicular screws could be placed in the affected vertebrae if the upper part of the VB is not destroyed by infection. In our work, we also inserted pedicular screws into the affected vertebrae, if possible. Thus, the affected vertebrae are incorporated into the instrumentation system, and fixation levels can be reduced. They noted a mean loss of correction of 2.8° between the early postoperative and last follow-up examinations in patients with preoperative kyphosis (mean follow-up period 44.3 months). Most loss of correction occurs in the early postoperative period between 3 and 18 months. In their patients, kyphosis did not progress after

15 months. So posterior rigid instrumentations provide stability and prevent kyphosis. In our work, in patient (4), after one year follow up, we noted a loss of correction of 5 degrees, so the lesson to be learned, transpedicular screw fixation is mandatory even with minimal maneuver.

Byung et al,<sup>3</sup> reported that, transpedicular drainage and curettage with posterior instrumentation for infective spondylodiscitis can be done. This technique not only provides a less aggressive approach without the necessity of an anterior approach and bone harvesting but also sufficient drainage and curettage of the infected vertebral body and posterior mechanical support. As a result, the blocked arterial blood flow, which contains the antibiotic component, could run through the infected vertebrae and deliver an effective dose of antibiotics with mechanical stability.

In this work, we were planning to put screws in the upper part of the pedicle of the affected vertebra so as to decrease the number of motion segments to be fixed. Rath et al,<sup>16</sup> emphasized that the transpedicular screws could be placed into unaffected parts of the osteomyelitic vertebra. Pedicle screws were placed first and distraction was applied to provide better anterior access. They reported that spinal instability and deformity are a major cause of neurological deficit. So, decompressive laminectomy alone might further destabilize the spine and result in increased neurological deficits.

Vincent et al,<sup>20</sup> stated that the core diameter of a screw significantly affects the strength and the stiffness. Pullout resistance is proportional to the volume of bone between screw threads and to the triangular area defined by the screw. Fixation, augmented with cross connection, must be done when a weight-bearing column is unable to sustain compressive forces. The use of multiple fixation points allows stress transfer and load bearing. In our surgery, we carried out the biomechanical knowledge to reinforce our work through; application of the largest possible screw & rod diameter with exact entry points. Two motion segment fixation above & below the lesion were done in some cases with application of cross connector if needed.

## Conclusion

It is possible to perform posterior surgical decompression and fusion augmented with internal fixation in thoracic & lumbar spondylodiscitis including one or more of the following: (1) those of high anesthetic risk for anterior or circumferential surgery, (2) kyphotic angle not more than 10° beyond the normal range in dorsal spine (3) the percentage of the anterior and posterior vertebral height is  $\leq$  30% (4) diminished or loss of lumbar lordosis, (5) average body weight.

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## الملخص العربي

امكانية الجراحة الخلفية لإزالة الضغط واللحام مدعوما بالتثبيت الداخلى لمرضى الإلتهاب الميكروبي للفقرات الصدرية والقطنية

المقدمة: لقد أقرت الجراحة الخلفية لعلاج حالات إلتهاب الفقرات منذ عام ١٩١٢ وبالرغم من ذلك نصح معظم الجراحون باستخدام الجراحة الأمامية أو الأمام جانبية ووضع الرقعة العظمية والتثبيت الداخلى، وكان ذلك يمثل خطورة عالية لكبار السن وذوى الحالات الحرجة.

الهدف: تحديد إمكانية الجراحة الخلفية لإزالة الضغط على الحبل الشوكى مدعوما بالتثبيت الداخلى لمرضى الإلتهاب الفقرى الغضروفى الصدرى القطنى.

طريقة الدراسة: دراسة بالأستعادة لحالات إكلينيكية.

منهج البحث: كان ذلك من خلال خمسة عشر مريضا تم دراسة حالاتهم إكلينيكية وبالأشعة، وكانوا يعانون من الألتهاب الدرني وغير الدرني.

النتائج: تحسن فى آلام الظهر والقوة الحركية فى ٧٣٪ وتحسن فى الزاوية الحديبية والفرزية.

الأستنتاج: الجراحة الخلفية لإزالة الضغط على الحبل الشوكى مدعومة بالتثبيت الداخلى لمرضى الإلتهاب الفقرى الغضروفى الصدرى القطنى ممكنة فى حالات المرضى الذين يعانون من مشكلات طبية حرجة ولا يتحملون الجراحة الطويلة الوقت وكذلك المرضى ذوى الوزن الطبيعى. والأهم من ذلك هو ألا تزيد الزاوية الحديبية عن ١٠ درجات والإسفين الفقرى عن ٣٠٪ بالنسبة للفقرات الصدرية وعلى ألا يقل أو يتلاشى الفزر القطنى.