Role of Transpedicular Instrumented Fusion in Lumbar Spondylodiscitis

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Abstract

Background: Spondylodiscitis is a progressive inflammatory process affects either the intervertebral disc, the vertebral body, the posterior vertebral arch either alone or in combination, medical treatment is the standard method to treat such condition, the use of instrumented fusion still has many absolute indications, however the use of metallic implant in presence of infected focus is still controversial.

Aim of the Work: The aim of this study is to evaluate the feasibility, indications and surgical outcome of instrumented fusion in the management of lumbar spondylodiscitis.

Material and Methods: Between January 2007 and December 2011. A total of 27 patients with lumbar spondylodiscitis were diagnosed and surgically treated by the author.

17 patients had previous surgical intervention and 10 patients developed spontaneous spondylodiscitis.

Surgical decompression followed by instrumented fusion was done in all cases either in single stage in 23 patients or in two stages in 3 patients and three stages in 1 patient.

The mean follow-up was 18±6 months.

A total of 21 patients had excellent outcome, 3 patients had good to fair outcome, one patient died secondary to deep venous thrombosis and pulmonary embolism.

Conclusion: Although the use of instrumented lumbar fusion adjuvant to decompression in treatment of lumbar spondylodiscitis has been proven to be effective, however the encouraging outcome encountered in this small series would expand the spectrum to recruit more cases.

Key Words: Tranpedicular screws – Spondylodiscitis – Lumbar spine.

Introduction

VERTEBRAL osteomyelitis and spondylodiscitis comprise <4% of all bone infections, the vascularity of vertebrae is extremely rich near the end-plate, which allows pathogens entrapped in the endplate to cause destruction of the disc and adjacent vertebrae. Clinically, spondylodiscitis is the most common type spinal infection, and it occurs most commonly in the lumbar region [3]. Infective spondylodiscitis can result in disc destruction, pathologic fracture, and abscess formation. Pain is the most common symptom and neurologic deficit may affect up to 17% of the patients [3].

The diagnosis may be delayed by more than a month in over two thirds of the patients [2]. Traditionally, most patients have been thought to respond to medical management, with external immobilization and culture-specific antibiotics for a minimum of 4 to 6 weeks [2-4]. As such, indications for surgery have been limited to the failure of medical management, progressive neurologic deficit with or without an associated abscess, intractable pain, or vertebral destruction leading to early or late spinal instability or segmental kyphosis [5,6]. However, large clinical series have found the need for surgical intervention in up to 43% to 57% of patients, and up to 14% of patients may have experienced late recurrence of infection even with appropriate management [2,7]. Further, a large number of patients with vertebral osteomyelitis develop disabling chronic back pain, even after successful treatment [8], and substantially improved functional and radiographic outcomes have been reported after surgical versus medical management of these infections [7]. These combined factors would seem to suggest that a more aggressive approach to early diagnosis and a lower threshold for surgical intervention may be indicated [3].

Treatment of spinal infections remains challenging for spinal surgeons. The goals of surgical treatment are debridement of infective foci, collection of pathogens, decompression of neural element, and re-stabilization of the deformed spine. Regardless of whether the infection is pyogenic or non-pyogenic, the infective foci of infective spondylo-
discitis are always located around the involved disc, and hence, debridement of the infected disc with reconstruction of the interbody bony defect must be considered first [3].

A posterior approach with laminectomy is contraindicated, as it will result in global instability. An anterior approach for infective spondylodiscitis may achieve more radical debridement and fusion [6,7]. The addition of posterior instrumentation to anterior procedures can stabilize the spine and prevent kyphotic deformity [8]. The complication rate of anterior spinal surgery is relatively higher than that of posterior spinal surgery [9], especially when performed in patients with chronic lesions with adhesion, in thoracolumbar and lumbosacral junctions, or in patients with a history of previous anterior surgery. Combining anterior and posterior approaches may increase the surgical risks, especially in immunocompromised patients [3].

The purposes of this study were to determine the safety and efficacy of a single posterior approach with transfemoral lumbar interbody debridement and fusion (TLIF) plus pedicle screws fixation for infective spondylodiscitis in the lumbar spine.

Material and Methods

Between January 2007 and December 2011. A total of 35 patients with lumbar spondylodiscitis were admitted to the Neurosurgery Department Menofya University Hospital, Menofya, Egypt all of them were managed by the author.

Of these, 32 patients the author selected 27 patients who had been included in this retrospective study.

Inclusive criteria include:
- Patients with failure of medical management of 6 weeks course of intravenous anti biotics.
- Progressive neurologic deficit with or without an associated abscess.
- Vertebral destruction leading to early or late spinal instability or segmental kyphosis.

Exclusion criteria:
- Patients with uncontrolled infection, with persistent elevation of inflammatory markers (ESR, CRP).
- Patients who are immune comprised (uncontrolled blood sugar, chronic liver disease, chronic kidney disease, malignancy, patient on immune suppressive drugs).
- Patients displaying destruction of more than 50% [based on pre-operative radiography and Magnetic Resonance Imaging (MRI)] of vertebral bodies.

Medical records, imaging studies, laboratory data, neurologic function data and functional outcomes were reviewed and analyzed.

17 patients had previous lumbar surgical intervention while 10 patients developed spontaneous spondylodiscitis.

The surgical procedure applied was debridement, Transforaminal Lumbar Interbody Fusion (TLIF), with transfemoral instrumented fusion using a single posterior approach, this was done in all cases either in single stage in 24 patients or in 2 stages in 2 patients 3 stages in one patient.

Laboratory investigations:

All patients had routine laboratory work up, white blood count with a differential count, Erythrocyte Sedimentation rates (ESRs), and C-Reactive Protein (CRP) levels were checked serially and recorded.

Radiological assessment includes:
- Pre-operative and post-operative plain radiography of the lumbar spine AP/LA/dynamic views.
- MRI with contrast of the lumbosacral spine before operation.
- CT lumbar spine pre and post-operative.

The interbody fusion status was analyzed at 6 months and at the final follow-up. Solid fusion was defined as continuous trabeculae bridging across the interface of the treated segments, whereas the presence of any radiolucent interruption at the treated segments was defined as pseudarthrosis. The fusion was classified as inadequate when the radiographic image was vague which could not be defined as solid or pseudarthrosis.

According to the culture results and recommendations of the infectious disease specialist, antibiotic treatment was initiated after surgery guided by the clinical symptoms and the ESR and CRP data and kept tell all inflammatory parameters got normalized.

Excellent outcome: Patient who have almost no back or radicular pain post-operative, who had returned to their normal daily activity.
**Good outcome:** Patient who have residual back pain or radicular pain post-operative, and they need on and off medication to control pain, they can carry out their daily activity but with assistance.

**Poor outcome:** Patient who have significant residual back pain or radicular pain post-operative, and they need continuous medication to control pain, they can’t carry out their daily activity.

**Operative procedure:**

In all cases meeting the above-mentioned criteria for surgery, the surgical strategy included a single-stage posterior approach posterior pedicle screw-and-rod instrumentation, followed by the radical resection of the affected intervertebral disc, bony debridement and intervertebral fusion. The rode on the side of TILF was not fixed in place till debridement and interbody fusion was carried out. Trans-pedicle screws were inserted into the intact bodies one level superior and one level inferior to the diseased disc. However, in the presence of greater bony destruction or osteoporosis, the fixation was extended over a longer distance to cover one segment above.

One posterior midline skin incision, followed by a bilateral para-median approach (Wiltse approach), was performed. The TILF side was determined pre-operatively, according to the severity of bony destruction, epidural abscess, and radiculopathy. Unilateral facetectomy and limited laminotomy were performed to expose the infected disc at the foraminal level. The pus, infected disc, endplate and sequestrum was removed. After removal of the infected tissue, the disc space was irrigated with Vancomycin solution, interbody fusion was achieved using either bone graft harvested from the iliac crest in (9 patients) and the intervertebral PEEK cage filled with autologous bone graft obtained from the respective facetectomy and laminotomy as part of the TILF procedure in (18 patients) inserted oblique to bridge the complete diameter of the bony endplates through the Transforminal-Lumbar-Interbody-Fusion (TILF) technique. Thereafter, the wound was closed in a standard fashion.

The samples collected from the debrided tissues were cultured for aerobic and anaerobic microbes, tuberculous bacilli and fungi and the extracted tissue was sent for histopathological examination.

Patients were followed-up at 1, 3, 6 months and then annually. The follow-up period ranged from 7 to 16 months, mean follow-up 12±6 months.

**Results**

A total of 27 patients underwent Transforminal-Lumbar-Interbody-Fusion (TILF) for lumbar spondylodiscitis. The remaining 25 patients (15 men and 12 women) were followed-up for more than 12 months the follow-up period ranged from 7 to 16 months, mean follow-up 12±6 months. The mean age at surgery was 43.4 years (range 27-63 years). One patient died from pulmonary embolism secondary to deep venous thrombosis 4 weeks after the operation.

Regarding the pre-operative intervention in 17 patients, who had post-operative discitis, 12 patients had simple discectomy, three patients had percutaneous endoscopic discectomy, two patients had discectomy for recurrent disc same level.

The involved levels were L4-5 in thirteen patients, L5-S 1 in eleven patients, L3-4 in two patients, and L2-3 in one patient.

The instrumentation levels were one above one below in 24 patients, two above one below in 3 patients (including one patients who required iliac screw fixation.

The most common pyogenic pathogen was methicillin-resistant Staphylococcus aureus (18 patients) followed by pseudomonas (6 patients) and the most common non-pyogenic pathogen was tuberculosis (2 patients) fungus infection (1 patients).

Pyogenic spondylodiscitis (24 patients) and were treated with 4-6 weeks of parenteral antibiotics followed by oral antibiotic for totally 3 months. Tuberculosis (two patients)was treated with 12 months of oral anti-tuberculosis drug administration. One patient with candida fungal infection, treated by IV antifungal for two weeks followed by oral antifungal for 6 weeks.

**Complications:**

One patient with psudomonus infection following L4/5 fixation had progressive increase of his back pain and radicular pain he had increase of his ESR and CRP, his plain X-rays showed migration of one L4 screw toward the disc space above with destruction of end plate, his MRI showed enhancement of the disc space vertebral body at both L4/L5 and L5/LS 1 levels, he had exploration, removal of the implant and the interbody cage, debridement of all infected tissues with insertion of autogenous bone graft at L4/L5 and L5/S 1 levels together with instrument fusion with pedicle screws at L4/L5 and L5/S 1 levels and iliac screws (case 4).
Two patients had L5 root weakness postoperative, it was transient in one patient and remained permanent in one patient.

Three patients had post-operative wound infection, it was treated conservatively in 2 patients and one patient had to be taken to the theater for local debridement.

One patient died secondary to deep venous thrombosis and pulmonary embolism 2 weeks post-operatively.

A total of 21 patients had excellent outcome, 4 patients had good outcome and one patient had poor outcome, one patient died secondary to deep venous thrombosis and pulmonary embolism.

Fig. (1): (A) Sagittal MRI patients with post discectomy spondylodiscitis, after pedicular screws fixation L4/5 with transforaminal cage fusion. (B) 3D CT reconstruction of lumbar spine showing migration and loosening of the upper screws, aggressive destruction of the disc space. (C) Plain X-ray AP view showing extension of the fixation one segment above and below the affected segment with two iliac screws in place.

Fig. (2): (A) Sagittal MRI of case with L4/5 spondylodiscitis. (B) 3D CT reconstruction showing the L4/5 pedicle screws and intervertebral cage in place.
Fig. (3): (A) Sagittal MRI of a case of L4/5 spondylodiscitis. (B) Plain X-ray showing the L4/5 pedicle screws in place together with L4/5 bony fusion.

Fig. (4): (A) Sagittal MRI showing the extension of the inflammatory process and edema at the L4/5 segment. (B) Sagittal MRI after control of infection with 4 weeks antibiotics. (C) CT scan 3D reconstruction showing the L4/5 pedicle screws and the intervertebral cage in place.

**Discussion**

Antibiotics represent the primary treatment option for infective spondylodiscitis, unfortunately, some patients require surgical debridement owing to poor infection control, neurologic deficit, back pain, spine instability or for pathogen culture. Some authors have noted that a large percentage of these cases should be treated with combined surgical and medical management, and that there may even be a higher incidence of chronic pain without surgery the rationale for this approach is that rigid stabilization across the infected involved vertebral body and disc space will allow better antibiotic penetration and tissue healing [5,17].

The benefits of primary stabilization are clear: It allows early mobilization, facilitates nursing...
care and rehabilitation, and also reduces the risk of complications associated with long-term bed rest.

The majority of patients who present with spondylodiscitis. Have several comorbid conditions, these factors, along with the operation itself, the post-operative immobilization, and usually a long hospital stay for intravenous antibiotic treatment contribute to the increased risk of clinical and surgical complications [5,10]. Surgery can be performed using a combined anterior and posterior approach [10-13], an anterior approach alone [14], or a posterior approach alone with posterior interbody fusion [15]. However, surgery-related morbidity is higher in anterior surgery than in posterior surgery [9,16], and the combined approach may increase surgical risks.

To minimize these complications, a single-level procedure that limits the extent of surgical intervention is a favored option rather than the more extensive anterior approach or the combined anterior and posterior procedure [5,17]. However the best surgical approach for spondylodiscitis. Is still controversial [10-13].

Pedicle screw-rod systems have several advantages over instrumentation devices. They provide rigid segmental fixation along all the 3 columns of the spine and enable correction of spinal deformity [5,10,11]. Pedicle screw instrumentation also allows intraoperative distraction of the compromised disc space allowing debridement and bone grafting. Thus, the surgical exposure and fixation can be reduced to a minimum number of segments [5,17]. In fact, all of the patients in our series had single-level procedures.

Posterior instrumentation for infective spondylodiscitis may improve the surgical outcome, accelerate healing, and prevent kyphotic deformity formation [8,20], but the use of instrumentation in spinal infection remains controversial. Few studies reported the safety of posterior spinal instrumentation using a posterior approach only [15,19].

Hematogenous dissemination secondary to bacteremia seems to be the most common pathophysiologic mechanism leading to spondylodiscitis. The genitourinary tract is often the identifiable source in elderly patients. Other sources of infection include the upper respiratory tract, the oral cavity, cutaneous ulcer, traumatic wounds, and procedure site [6,8]. In this series, five out of ten patients had identifiable risk factors for the development of spondylodiscitis.

Spinal instability, deformity, and, particularly, the presence of an epidural abscess can cause a neurologic deficit. In general, only the anterior vertebral elements are affected by the infection and the intact posterior column maintains some degree of stability. Therefore, decompressive laminectomy and discectomy alone may further destabilize the spine and result in increased neurologic deficit [3,5]. That is why in spontaneous discitis we used TILF approach with laminotomy and factectomy to get access to the disc space for debridement of all infected tissues and leaving the rest of bony structure of the posterior arch intact to maintain the spine stability.

In seven (41%) of our patients, an epidural abscess formation was found in the preoperative MRI scans and was confirmed during the surgical procedure. The presence of an epidural abscess preoperatively explained the incidence of neurologic deficit (35%) in our cases. In our study and in several others, the progression of the neurologic deficit was the most common indication for surgery [1,2,12,14]. Intractable back pain secondary to destruction of the disc and vertebral body with subsequent instability was the second most common indication in our study.

The rate of fusion reported in the literature for patients who underwent one-stage operations is excellent (94% to 100%), as it was in our series [2-5,10,13,19]. In the natural course of pyogenic spondylodiscitis, granulation tissue from the subchondral vertebral endplate invades and reabsorbs the affected disc, enabling the infected region to heal spontaneously after approximately 6 weeks [2,4,20,21].

The posterior approach for infective spondylodiscitis is still controversial. Laminctomy is contraindicated for infective spondylodiscitis, as it can lead global instability. Some authors described a one-stage posterior approach using a Posterior Lumbar Interbody Fusion (PLIF) technique with pedicle screw fixation for infective spondylodiscitis and achieved good infection control [15,17]. PLIF requires a laminectomy and retraction of the adhesive nerve roots, and it may increase the risks of nerve injury and posterior deep wound infection and result in spinal instability. Consequently, the utility of PLIF for spondylodiscitis remains unclear. TILF with interbody cages or bone grafts is widely accepted for treating degenerative disc disease of the lumbar spine. TILF is simpler and safer than PLIF [18]. Gautam et al., [19] reported good results using TILF for lumbar tuberculosis. Our series included both non-pyogenic (2 tuberculosis and 1
fungal) and pyogenic lumbar spine infections. TILF can achieve adequate debridement and obtain tissue for culture (culture rate 82.1%). Through inserting massive bone grafts, instead of cages, TILF can enhance interbody fusion (fusion rate 82.1%), and prevent cage subsidence or biofilm formation. TILF can also preserve posterior element and prevent post-laminectomy instability.

Instrumentation-related complication was rare.

TILF with pedicle screws fixation for infective spondylodiscitis is safe and it may provide immediate stability and acceptable interbody fusion rates and maintain post-operative alignment. Ambulation and rehabilitation with adequate brace protection could be performed as soon as possible after surgery.

In conclusion, although the use of transpedicular instrumented fusion in lumbar spondylodiscitis was considered to be controversial, however the encouraging outcome encountered in this small series would expand the spectrum to recruit more cases a single posterior approach with TILF and pedicle screws instrumentation for infective spondylodiscitis of the lumbar spine is safe and effective. This strategy has the additional benefit of avoiding the risks of anterior or staging surgeries.

References


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تثبيت الفقرات بالمسامية في حالات
التهاب الفضروف بين الفقرات

تثبيت الفقرات الخلفي بالمسامية في حالات إلتهاب الفضروف بين الفقرات ما زال أمرا مثيرا للجدل خصوصا حين تكون الإشارة إلى وضع جسم مدعى في بيئة إلتهابات عضوية.

في هذه الدراسة تم عمل تثبيت فقاري في 27 حالة من هذه الحالات 17 منها تعرضت لتدخل جراحي سابق في العضود الفقرى و10 لـ.

مع متابعة 24 شهر: أشارت النتائج إلى تحسن ملحوظ في 21 حالة، و10 تحسن جيد إلى ضعيف بحالة توفيت بسبب حملة بالثوريان الرئوي، وهذه النتائج تؤدي بنا إلى إعادة النظر والإستخدام الأكثر والتشجيع لاستخدام تثبيت الفقرات في حالات إلتهابات الفضروف الفقرى.