Surgical Management of Post-Discectomy Spondylodiscitis with Transforaminal Lumbar Interbody Fusion (TLIF) and Posterior Instrumentation

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Abstract: Background: Post operative lumbar disc space infection is relatively uncommon. The anterior approach has been the traditional surgical approach for treatment of this complication. Posterior approach was sometimes added for instrumentation only. Purpose: To present the results and clinical outcome, at a minimum of twelve months, following transforaminal lumbar interbody fusion (TLIF) and posterior instrumentation for post-discectomy spondylodiscitis. Study design: A case series Materials and Methods: Nine patients (age 38– 68 years; mean: 47.8 years) with post-lumbar discectomy spondylodiscitis, were treated surgically by TLIF and posterior spinal instrumentation. All patients had significant back pain despite a full conservative treatment regimen by broad spectrum antibiotics and brace. The follow-up ranged from 12 to 36 months with an average of 22 months. All patients were available for follow up which included physical examination, scoring of function and radiographs. Outcome measures: To assess the invasiveness of the operation, we evaluated operative time, blood loss, and complications. Visual pain analogue scale (VPAS), activities of daily living (ADL) (Barthel index), CRP, and ESR in the preoperative, postoperative and final follow-up periods were used to evaluate the surgical outcome. Results: Although we encountered some postoperative complications including wound infection; at the final follow-up visit, VPAS and Barthel index improved in all patients. Changes in CRP and ESR revealed suppression of infection in all cases. Conclusion: Surgical treatment for postoperative spondylodiscitis with TLIF and posterior spinal instrumentation provides patients with satisfactory final outcomes.
[Ahmed Fathey Sheha **Surgical Management of Post-Discectomy Spondylodiscitis with Transforaminal Lumbar Interbody Fusion (TLIF) and Posterior Instrumentation**.] Life Science Journal,. 2011; 8(4): 296-303] (ISSN: 1097-8135). http://www.lifesciencesite.com.

Key-words: Pyogenic spondylodiscitis- Transforaminal Lumbar Interbody Fusion (TLIF) - Posterior Spinal instrumentation.

1. Introduction

The relatively uncommon complication of postoperative spondylodiscitis was first described as a clinical entity by **Turnbull in 1953** [(1)]. Postoperative spondylodiscitis represents 30.1% of all cases of pyogenic spondylodiscitis [(2)] and has been reported to occur after almost every open and minimally invasive spinal procedure, including laminectomies [(3,4)], discectomies [(5–18)], and fusions with or without instrumentation [(5,13,19–22)] . It has also been documented to occur following less invasive procedures, such as discography [(23–25)], chemonucleolysis [(26, 27)], myelography [(28)], paravertebral injections and lumbar puncture [(29)].

The optimal management of postoperative infections of the spine is controversial. Infections after discectomy or laminectomy are usually treated non operatively with long-term antibiotics [(30-33)]. Surgical debridement is usually reserved for patients in whom medical management of the disease has failed, those with neurological compromise, unstable mechanical deformity, an epidural abscess, or intractable pain [(34- 38)].

Due to the fact that instrumentation placed for fusion operations in otherwise normal patients has been shown to increase postoperative infection rates, many authors have expressed understandable concern about the placement of instrumentation in an infected patient. Historically, many have preferred to recommend bed rest and prolonged spinal bracing rather than placing internal implants. Others have advocated a staged operation with a period of antibiotic therapy bridging the debridement and instrumentation procedures [(39- 42)].

In recent series, excellent outcomes have been demonstrated for single-stage procedures in which hardware placement is performed within and adjacent to debrided areas, and these studies have not shown significantly increased rates of infection recurrence [(38, 43,44)].

In addition, even, it has been shown that transforaminal lumbar interbody fusion (TLIF) yields satisfactory results, offers excellent exposure with minimal risk; particularly in cases of repeat spine surgery, in which the presence of scar tissue makes traditional posterior lumbar interbody fusion techniques difficult or impossible [(45)]. Also, TLIF seems to be a viable alternative to anteroposterior

circumferential fusion or anterior lumbar interbody fusion [45].

Thus it was hypothesized that, in cases of spondylodiscitis not responding to appropriate treatment; or those with either neurological compromise or with severe intractable back pain; these patients may benefit from a TLIF and posterior instrumentation.

2. Patients and Methods

A prospective study of 9 patients with post-discectomy spondylodiscitis was conducted in the period from January 2008 to January 2010. The follow up continued till February 2011. 6 patients were male and 3 were females. The age range was 38-68 years with a mean age of 47.8 years.

All our patients had undergone open discectomies as a method of treatment for symptomatic prolapsed lumbar discs, which was complicated by infection in the operated disc spaces. Conservative treatment with broad spectrum antibiotics and bracing failed in all cases. The antibiotic regimen was chosen empirically to cover gram positive, gram negative and anaerobic organisms. Initially and for the first 2 weeks, Ampicillin/ sulbactam and metronidazole were administered intravenously. This was followed by oral ciprofloxacin and clindamycin until normalisation of the CRP. The mean duration of the conservative treatment was 3.3 months (range: 1.5–5.5). Despite adequate and prolonged conservative treatment, the nine patients studied continued to suffer from significant low back pain, the average severity of which, assessed by the visual pain analogue scale (VPAS), was 8.1 (range: 6-10). Plain radiographs revealed disc space narrowing with erosion and sclerosis of the adjacent end-plates in all cases. Accordingly, those patients were treated by one stage surgical debridement, TLIF and posterior instrumentation.

Preoperative evaluation included full examination of the patients and their radiological data, including plain radiographs and magnetic resonance imaging (MRI). In addition, laboratory tests were performed in the form of white blood cell count (WBC; count/mm3), C-reactive protein (CRP; mg/dl), and erythrocyte sedimentation rate (ESR; mm/h). Patients were evaluated by Barthel Index [46], which has been used since the 1960s because of its high reliability and validity [47], as regards the activities of daily living (ADL), and the VPAS as regards the severity of back pain.

The invasiveness of surgery was evaluated by calculating the operative time and blood loss and recoding the complications. Patients were mobilized within the first few postoperative days, wearing a semi flexible lumbosacral brace. All patients received a six-week antibiotic regimen (3 weeks intravenous and 3 weeks oral), according to the result of culture and sensitivity. If no organism was identified, the empirical preoperative antibiotic regimen was continued.

During the first 6 weeks (the antibiotics period), ESR and CRP were done on weekly basis, then they were done again during each follow up visit. Plain radiography, VPAS and Barthel Index were checked at intervals of 6 weeks then 3, 6, 12, 24 and 36 months postoperatively. All patients were available for follow-up. The mean follow-up period was 22.2 months (range: 12–36).

Surgical technique:

The patient is placed in the prone position. To prevent cross contamination, autologous posterior iliac cancellous bone graft is first harvested and its incision closed. Posterior spinal elements are exposed through a midline longitudinal incision. A subperiosteal dissection of the paraspinous muscles is completed to the transverse processes. Pedicle screws are sized and inserted, under C-arm x-ray guidance, before decompression to minimize blood loss and achieve distraction. The spinal canal is entered through a unilateral laminectomy and inferior facetectomy. The interspinous ligament as well as the ligamentum flavum on the opposite side are left intact. The exiting nerve root is identified and protected. The thecal sac is gently retracted medially if necessary. Discectomy is performed through this unilateral approach. Radical debridement with resection of all infected and necrotic disc and bony tissue is performed and samples are sent for culture and sensitivity. After the initial discectomy, gradual distraction is applied to the pedicle screws on the opposite side. An osteotome is used to achieve flat endplate surfaces, until bleeding bone is reached. Bone graft is packed inside the interbody space, and then distraction is released. The construct is compressed to establish an optimum graft-bone interface and to re-establish lumbar lordosis. The rod-screw system is tightened. Bone graft is also laid over the transverse processes after adequate decortication to establish a circumferential fusion.

Statistical Methods

Preoperative, intraoperative, and postoperative data were collected and maintained in a single computer database. Data were statistically described in terms of range, mean and frequencies. Comparison of the pre and postoperative means to calculate the significance was done by the paired “t” test. All statistical calculations were done using SPSS

(Statistical Package for the Social Science version 15; SPSS Inc., Chicago, IL, USA).

3. Results

VPAS and Banthel index showed significant improvement. ESR and CRP returned to normal or near normal at latest follow up (Table 1). The average blood loss was 0.74 Litre (range: 0.5-1.2). The average operative time was 165.5 minutes (range: 120-240).

Cultures of the pus samples obtained during surgery showed no growth in two cases, *Staphylococcus Aureus* in 5 cases, Klebsiella in one case and *Escherichia Coli* in one case. There has been no residual infection, recurrence of infection or metal work failure to date. Adequate radiological fusion was achieved in all cases.

Postoperative Complications:

Transient L5 nerve root palsy in one patient, which resolved spontaneously over approximately 4 months. One other patient had wound infection which was cured in 3 weeks, by repeated dressings in addition to the routinely administered antibiotics. There were no other notable complications related to the procedure.

Table (1): Comparison of the preoperative and postoperative means of the evaluation parameters:

	Preoperative		**Postoperative**		**Significance**
	Mean	***Range***	***Mean***	***Range***	
VPAS	*8.1*	6-10	*1.3*	0-3	P < 0.001
Barthel index	*42.2*	30-60	*94.4*	80-100	
ESR (1st hour)	*95.75*	64-120	*17.3*	10-30	
CRP	*51.4*	38-66	*< 6*		

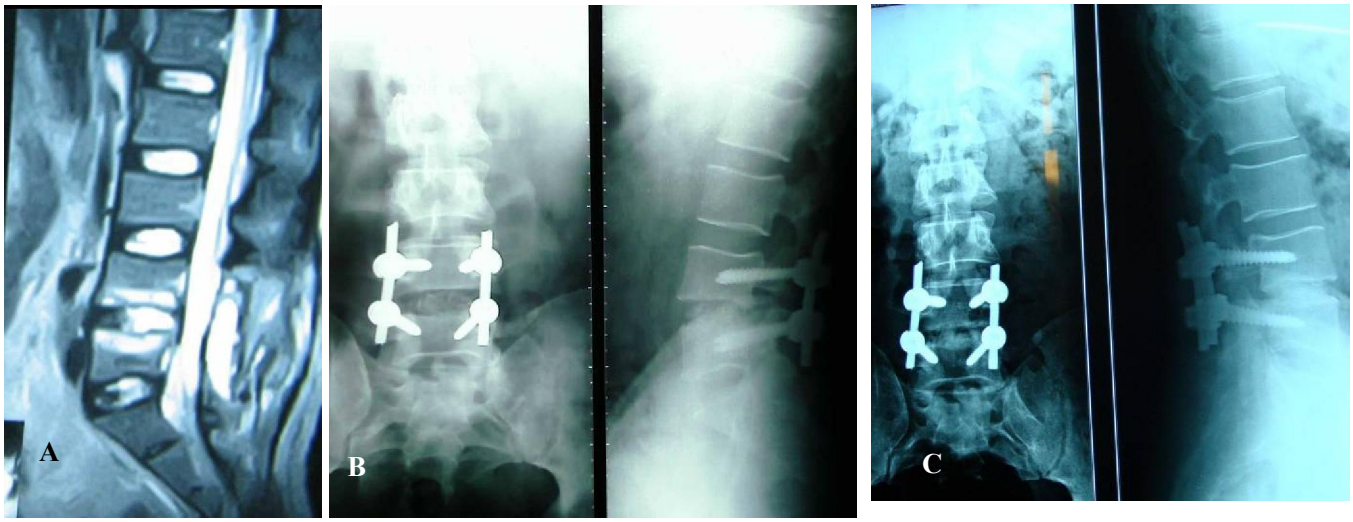

Fig. (1): A: Preoperative MRI showing L4/5 spondylodiscitis. B: postoperative plain radiographs following TLIF with autologous iliac bone graft and posterior instrumentation. C: 2.5 years follow up plain radiographs showing satisfactory fusion.

4. Discussion

Postoperative spondylodiscitis represents almost 30.1% of all cases of pyogenic spondylodiscitis [(2)] and has been reported to occur after almost every open and minimally invasive spinal procedure. In most patients, the infection is often mild, self-limited and will resolve spontaneously without any treatment intervention. In many cases, there may be a delay in diagnosis because of the frequent occurrence of back pain after spinal surgery. In fact, some reports have shown misdiagnoses in this patient population because of the lack of suspicion of infection as a causative factor [(12,13)]. In addition, the patient may tend to seek advice elsewhere due to increasing back pain, and thus the exact follow up and incidence of the reported cases may be misleading. Inspite of this, it has been reported that the incidence of postoperative spondylodiscitis after any type of spinal procedure ranges from 0.26 to 20% [(3,4,7,8,12,14,23,48)]. This incidence and severity generally increases with the complexity of the procedure [(49)], ranging from 0.6% to 3.7% after discectomy [(14, 50)] to 3.7% to 20% after posterior instrumented fusion [(51,52)]. This explains the small number of cases recruited in this study, being only nine cases over two years.

The exact cause of postoperative spondylodiscitis is controversial, the majority of

investigators think that it results from the direct inoculation of an offending pathogen into the avascular disc space [17,23] . Some authors believe that there are two types of spondylodiscitis, a septic form caused by an infectious agent and an aseptic form resulting from an inflammatory reaction [10,26] . Others believe that there is no such thing as an aseptic spondylodiscitis and that this form is actually the result of a less virulent, low grade infection [23, 53]. Once inoculated, the process of infection and discitis begins. More than often, the main causative organism is not identified. When an organism is identified, the most common infectious etiologic agent is *Staphylococcus aureus* followed by other Staphylococcus species [8,13,16,17,19,21,24,54-56] and anaerobic organisms [2]. Other less common organisms include *Streptococcus viridans* and other Streptococcus species [55], *Escherichia coli*, *Pseudomonas aeruginosa* [4], fungus and others [53,56]. Because all the patients in the current study are from the low socio-economic class and because of the difficulty to identify the causative organism, we elected not to perform CT guided biopsy and give the patients empirical broad spectrum antibiotics covering both aerobic and anerobic pathogens.

It has been reported that the WBC is elevated in only 42.6% of spondylodiscitis cases [56]. That is why we did not rely on WBC as an outcome measure in the current study although it was done as a part of the routine blood investigations. The laboratory studies most sensitive and indicative of the presence of an inflammatory process are the ESR and the CRP. However, it should be noted that in adults, ESR trends are confused by associated medical conditions and the nonspecific elevation in the rate that often occurs with increasing age. Nevertheless, the ESR is a useful tool in the management of adult pyogenic spondylodiscitis, and the authors of most studies on this disease, view a 50 to 66% reduction in the ESR as compatible with eradication of infection [57-59]. The current study showed 82% reduction in the ESR.

Plain radiographic signs of spondylodiscitis are not sensitive and tend to lag behind physical examination findings and laboratory markers. The first plain radiographic sign often noted between the fourth and sixth postoperative week is a loss of intervertebral disc space height. This can be accompanied with blurring or clouding of the vertebral end plates above and below the infected disc space [13]. CT scanning, MRI with gadolinium and also, radionuclide studies are more sensitive. MRI is the radiographic imaging modality of choice in diagnosing postoperative spondylodiscitis [5] with a reported sensitivity and specificity of 93% and 97%, respectively [60]. It has been shown that MRI is superior to both gallium 67 and technetium 99 bone scanning in diagnosing postoperative discitis and will demonstrate disc changes sooner than CT [60].

Complete eradication of infection should be verified by postoperative normalization of ESR and CRP levels. Trends in these values are greatly affected by concomitant medical conditions and the inflammatory response to surgery. Follow-up magnetic resonance imaging may be useful as well, but interpretation of these images is made difficult by the presence of enhancing non infected granulation tissue and artifacts from the hardware.

In the treatment of spondylodiscitis, numerous authors have preferred to recommend bed rest and prolonged spinal bracing rather than surgical intervention. Others have advocated a staged operation with a period of antibiotic therapy bridging the debridement and instrumentation procedures [39-42].Open surgical drainage for spondylodiscitis was historically reserved for patients with an epidural abscess [61]. The prognosis is stated to be better when treatment is instituted early during the infection [62,63].

There are no obvious advantages to avoidance of hardware placement into debridement cavities. Indeed, the reported sporadic cases of extrusion of anteriorly placed grafts indicate that fixation should be used if possible [64].

The use of interbody grafts in patients with spinal osteomyelitis is accepted [65-67]. Autologous interbody bone grafting in the setting of an active infection was first reported for chronic vertebral osteomyelitis by **Wiltberger** [68] in 1952, and has been used safely ever since [69,70].

In most articles in which single-stage procedures for spinal infections have been described, anterior debridement with placement of allograft or autograft has been used, combined with placement of a posterior stabilizing construct. This approach is based on the principle that instrumentation placed posteriorly involves a second operating field that is not (at least directly) contaminated. The first report in which this strategy was used was published by **Fountain** [71] . **Fountain** presented a mixed series of patients, and the treatment for infection was anterior corpectomy and fusion as well as posterior stabilization with Harrington rods. The first series describing the consistent placement of posterior instrumentation at the time of debridement was published in 1988 by **Redfern *et al.***, [72]. In 1996, **Rath *et al.,*** [73] reported on a series of 43 patients with thoracic or lumbar spondylodiscitis who were treated entirely via a posterior approach, however, the transforaminal approach was not used. In 2003, **Liljenqvist *et al.,*** [44] reported on a series of 20 patients with thoracic or lumbar spondylodiscitis who all underwent single-stage operations consisting of anterior debridement and reconstruction in which

an expandable titanium cage was used, along with posterior fixation in which a pedicle screw/rod construct was used.

Reconstruction of the anterior column for the treatment of spondylodiscitis has received great interest, because it shares 80% of the lumbar spine load, and such reconstruction places the interbody graft under compression and increases the fusion rate [74-76]. Anterior lumbar interbody fusion may frequently require involvement of an access surgeon and may be a separate approach for the posterior instrumentation [77]. Posterior Lumbar Interbody Fusion (PLIF) is also commonly used but requires bilateral exposure with loss of the posterior tension band at the level of fusion. It decreases the bony surface for posterior fusion, requires significant retraction of the neural elements, and more importantly, particularly in spondylodiscitis cases, cannot be performed safely in a revision case secondary to scar tissue formation [45].

In 1982, with the rationale of offering a secure fusion in a single stage operation, **Harms and Rolinger** [78] pioneered a modified PLIF technique called transforaminal lumbar interbody fusion (TLIF). Compared with the more traditional techniques, it provided several advantages by accessing the spinal canal and disc via a path that runs through the far-lateral portion of the vertebral foramen. Also due to the fact that minimal retraction on the nerve roots and dural sac is required, the surgical risk for neurological deficit is significantly lower. In addition, TLIF achieves a single-stage circumferential fusion through only a posterior approach.

The use of TLIF technique in the management of spondylodiscitis cases has not yet, to the best of our knowledge, been described in literature. It seems a logical pathway to achieve debridement, access the disc space, bypass the scared zone, and simultaneously achieve solid circumferential fusion, avoiding the more complicated anterior approach. Although it may be considered technically demanding, the mean operative time, mean blood loss and complication rate have all shown to be reasonable in the current study. Furthermore, the good results achieved make this technique ideal for managing postoperative spondylodiscitis. One limitation of this study is the inability to recruit a larger number of patients because it highly focused on a certain population.

Conclusion

These results demonstrate that TLIF, is a useful therapeutic tool in dealing with cases of postoperative spondylodiscitis as it offers adequate debridement, good postoperative stability, and allows a single-stage circumferential fusion through only a single posterior approach, with minimal complication rates. A possible follow up to this study would be to use the described technique for all cases of spondylodiscitis.

Case presentation:

A 38 years old male farmer developed L4/5 spondylodiscitis following open discectomy. The diagnosis was confirmed by MRI (Fig. 1A). Following full dose broad spectrum antibiotics and bracing for 8 weeks, the CRP was back to normal but he continued to complain of back pain of increasing severity with night exacerbation and inability to perform his routine activities of daily living. Repeated inflammatory markers showed evidence of reactivation of infection. His final CRP check was 38 and ESR was 64 at the first hour. Disc space debridement, TILF with autologous iliac bone graft and posterior instrumentation with titanium pedicle screw system, were performed (Fig. 1B). The patient achieved satisfactory fusion, his back pain improved dramatically and there has been no recurrence of infection, at 2.5 years follow up (Fig. 1C).

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10/28/2099