Anterior Versus Posterior Fixation for the Treatment of Lumbar Pyogenic Vertebral Osteomyelitis

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abstract

Full article available online at Healio.com/Orthopedics. Search: 20130523-33

This study was designed to observe the clinical outcome of anterior versus posterior instrumentation in the treatment of Pyogenic vertebral osteomyelitis of the lumbar spine.

Twenty-three patients underwent either anterior (anterior fixation group) or posterior fixation (posterior fixation group) combined with a single-stage anterior radical debridement and had an average follow-up of 38 months. Clinical evaluation was performed using the Oswestry Disability Index and visual analog scale. Serial tests of the erythrocyte sedimentation rate and C-reactive protein levels were used to monitor for infection recurrence. Radiography was performed pre- and postoperatively to assess the deformity correction and for bony fusion. Serial erythrocyte sedimentation rate and C-reactive protein levels reflect the active state of infection and can guide postoperative treatment. Patients in the anterior fixation group showed significantly better results on the Oswestry Disability Index than those in the posterior fixation group 2 years postoperatively. The visual analog scale values demonstrated a significant difference between the 2 groups at 1 and 2 years postoperatively, with pain significantly improved in the anterior fixation group. Radiological results showed no significant difference in fusion time, deformity correction, and cage subsidence.

Both anterior and posterior fixation had satisfactory outcomes and were reliable and safe for the treatment of Pyogenic vertebral osteomyelitis of the lumbar spine. Patients with anterior fixation may achieve better postoperative results, such as better well being and less pain.
Pyogenic vertebral osteomyelitis is a rare condition, and its diagnosis is often initially overlooked. Symptoms include persistent infection, neurological impairment, and significant deformity; if conservative therapy fails, surgical intervention is often required. However, controversies still exist concerning the optimal treatment for Pyogenic vertebral osteomyelitis regarding operative approach, fixation, and staging. Varying results of the surgical techniques, including anterior debridement and interbody fusion with anterior or posterior fixation, were reported in the literature.1-17

The current study was designed to evaluate the efficacy and safety of 2 types of fixation for Pyogenic vertebral osteomyelitis of the lumbar spine: anterior vs posterior fixation combined with anterior debridement and interbody fusion with either the iliac crest or titanium mesh cages.

**Materials and Methods**

From 2003 to 2010, twenty-three patients with Pyogenic vertebral osteomyelitis suitable for operative treatment at the authors’ institution were included in this study and voluntarily signed an informed consent form before enrollment. The diagnosis was based on clinical symptoms, radiological findings, and laboratory examination and was subsequently confirmed by histopathological analysis of all specimens obtained intraoperatively. All experimental procedures were approved by the Ethics Committee of Qilu Hospital of Shandong University.

All patients were assigned to either the anterior fixation group (n=12) or posterior fixation group (n=11) and had a minimum follow-up of 24 months (mean, 38 months; range, 24-67 months). Patients ages ranged from 23 to 62 years (anterior fixation group mean, 38.2±12.1 years; posterior fixation group mean, 39.4±10.9 years); 13 patients were men and 10 were women.

Fourteen patients had different degrees of low back pain. Various degrees of fever were present in 15 patients. Seven patients had neurological complications. All patients had elevated erythrocyte sedimentation rates (ESR) (38.5±9.6 mm/hr) and C-reactive protein (CRP) (69.2±16.2 mg/dL) levels, and imaging evaluations included radiographs, computed tomography (CT), or magnetic resonance imaging (MRI) that were taken preoperatively to determine the affected level and the angles of deformity. When the patient was stable, a percutaneous biopsy of the affected vertebral segments was performed for diagnosis under fluoroscopic monitoring.

Intravenous broad-spectrum antibiotics were initially administered, and then more sensitive agents were initiated once the causative organism was identified. All patients had received a 2-week preoperative intravenous antibiotic regimen.

Indications for surgery included intractable back pain, recurrence of infection after conservative therapy, neurological complications, paravertebral abscess, and vertebral body destruction associated with segmental instability.

**Surgical Technique**

All patients underwent a single-stage procedure, and all operations were performed by the same surgical team.

For the anterior fixation group, radical anterior debridement with discectomy and partial or complete corpectomy to healthy bleeding cancellous bone was performed (Figure 1). Then, anterior fusion was accomplished with either the iliac crest or titanium mesh cages filled with an iliac autograft. The anterior fixation extended 1 level above and 1 level below the infected vertebrae.

For the posterior fixation group (Figure 2), initially, a posterior stabilization with fusion first fixed in an uninvolved segment adjacent the focus was performed with transpedicular fixation techniques. After this procedure, thorough anterior debridement and interbody fusion was performed in the same fashion as the anterior fixation group.

The tissue specimens removed during the operations were submitted for microbiological culture and histopathological analysis to determine the diagnosis of Pyogenic vertebral osteomyelitis. For all patients, an intravenous antibiotic regimen was performed postoperatively.

**Follow-up**

All patients were examined every 3 months during the first postoperative year and annually thereafter. At each postoperative follow-up examination, patients were clinically and radiologically assessed. Clinical results were analyzed according to the Oswestry Disability Index (ODI),18 and pain was scored from 0 (no pain) to 10 (the worst imaginable pain) using the visual analog scale (VAS). The serial ESR and CRP levels were also measured to monitor the recurrence of infection, and radiographs or CTs were taken postoperatively at each follow-up to evaluate bony union, deformity correction, loss of correction, and subsidence of titanium mesh cages.

**Statistical Analysis**

For all calculations, SPSS version 13.0 software (SPSS, Inc, Chicago, Illinois) was used to analyze the results. One-factor analysis of variance was performed for the measurement data. A P value less than .05 was considered statistically different.

**Results**

As can be seen in the Table, the average operation duration was 169.2±14.0 and 215.0±15.7 minutes for the anterior and posterior fixation groups, respectively, and was longer in the posterior vs anterior fixation group (P<.01). No operative complications were recorded, and no cases of persistent or recurrent infection were recorded at the final follow-up. The diagnosis of Pyogenic vertebral osteomyelitis was confirmed by histopathological examination in all patients.

The patients achieved solid bony fusion as confirmed by radiographs or CT,
and mean fusion time was not significant between the anterior (8.5±2.3 months) and posterior (8.2±2.4 months) fixation groups (P>.05) (Table).

Preoperative, immediately postoperative, and final Cobb’s angle were compared based on serial radiographs. From preoperative to immediately postoperative radiographs, mean corrections of 1.3°±2.0° (anterior fixation group) and 1.9°±2.8° (posterior fixation group) were achieved. From postoperative to the final follow-up radiographs, mean segmental losses of correction of 1.5°±1.0° (anterior fixation group) and 1.7°±0.9° (posterior fixation group) were observed, in accordance with a cage subsidence of 1.1±0.7 mm (anterior fixation group) and 1.3±0.6 mm (posterior fixation group). These results showed no significant differences (P>.05) (Table).

The serial detection of CRP and ESR had approximately the same change in both groups during the survey period (Figure 3). No significant difference was found between the groups (P>.05). The ESR and CRP levels peaked 4 to 7 days
postoperatively. The CRP level was more sensitive than the ESR level, with a rapid decrease after 7 days postoperatively. The ESR and CRP levels normalized after 7 weeks postoperatively.

The pain significantly improved from before surgery to 2-year follow-up in both groups ($P < .01$). Ten patients (4 in the anterior fixation group and 6 in the posterior fixation group) reported mild or intermittent back pain. Five patients (1 in the anterior fixation group and 4 in the posterior fixation group) felt middle back pain that was different from their preoperative pain and required a simple analgesic for pain control.

The VAS was used to measure the average intensity of lumbago. Higher scale values indicated a worse result. No significant differences were found preoperatively between the groups, but statistical differences were found at 1 ($P = .043$) and 2 years postoperatively ($P = .046$) (Figure 4). Patients in the anterior fixation group reported less postoperative pain.

The ODI was used to measure the lumbar restrictions. Higher scores indicated a worse outcome. No significant differences were found preoperatively or 6 months and 1 year postoperatively between groups. A statistical difference was found in both groups between the preoperative to 2 year postoperative scores ($P < .001$). However, 2 years postoperatively, significantly better results were found in the anterior fixation group compared with the posterior fixation group ($P = .034$) (Figure 4).

## DISCUSSION

Pyogenic vertebral osteomyelitis responds well to conservative treatment if the patients are diagnosed in an early stage. However, patients with progressive biomechanical instability-related pain, epidural abscesses, neurologic deficit, and refractoriness to antibiotic therapy usually require surgical intervention. More surgeons have acknowledged that surgical intervention with fixation could relieve pain, improve vertebral column balance and neurologic function, and result in early ambulation.

The authors treated patients with Pyogenic vertebral osteomyelitis in a single-stage surgery, which was a safe and efficient method to control the infection and reconstruct the spinal column. Yilmaz et al. and Gonzalvo et al. suggested that single-stage surgery was the best surgical choice due to less blood loss and shorter hospitalization and results in better correction of spinal deformity compared to 2-stage surgery. In the current study, patients in both groups had a satisfactory deformity correction, which suggests that a single-stage operation was reliable for the treatment of Pyogenic vertebral osteomyelitis. Because vertebral bodies and disk spaces are mainly involved in Pyogenic vertebral osteomyelitis, the anterior approach is the standard method. Anterior radical debridement offers the advantages of eradication of the infectious focus and decompression of the canal, and the anterior reconstruction of the spinal column can provide effective correction of deformity and stabilization of the affected segments.

Reconstruction with titanium mesh cages has achieved excellent outcomes for Pyogenic vertebral osteomyelitis and the authors concluded that the titanium mesh cage had fewer postoperative complications and presented immediate support of the spinal column.

In the current study, all patients treated with a titanium mesh cage had no sign of infection recurrence at final follow-up. The use of a titanium mesh cage for active Pyogenic vertebral osteomyelitis seemed not to be associated with recurrent infection and had beneficial effects on the eradication of infection, vertebral column reconstruction, and fusion.

For the surgical technique used in the anterior fixation group, satisfactory results were reported in a previous study. Anterior fixation following debridement and fusion provides a better deformity correction, faster operative time, fewer postoperative complications, and earlier rehabilitation than posterior fusion. The implants used in the surgical location do not lead to infection persistence or recurrence. The intact posterior elements preserve the function of the lumbar spine and improve postoperative quality of life. Also, anterior fixation presses the involved segments to prevent titanium mesh cage malposition and increase the spinal stability. In vitro biomechanical experiments proved that anterior fixation provided the same stability as posterior pedicle screw fixation and thus avoided supplementary posterior surgery.

## Table

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Anterior Fixation Group ($n=12$)</th>
<th>Posterior Fixation Group ($n=11$)</th>
<th>$p^*$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operative time, min</td>
<td>169.2±14.0</td>
<td>215.0±15.7</td>
<td>.000</td>
</tr>
<tr>
<td>Fusion time, mo</td>
<td>8.5±2.3</td>
<td>8.2±2.4</td>
<td>.784</td>
</tr>
<tr>
<td>Kyphosis, deg</td>
<td>8.4±6.2</td>
<td>10.5±5.4</td>
<td>.400</td>
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<tr>
<td>Correction, deg</td>
<td>1.3±2.0</td>
<td>1.9±2.8</td>
<td>.548</td>
</tr>
<tr>
<td>Correction loss, deg</td>
<td>1.5±1.0</td>
<td>1.7±0.9</td>
<td>.666</td>
</tr>
<tr>
<td>Cage subsidence, mm</td>
<td>1.1±0.7</td>
<td>1.3±0.6</td>
<td>.534</td>
</tr>
</tbody>
</table>

Abbreviation: deg, degrees.

*One-factor analysis of variance ($P < .05$ was considered statistically significant).
For the surgical technique used in the posterior fixation group, anterior debridement, fusion with a titanium mesh cage or the iliac crest, and posterior fixation also offered biomechanically stable support. Oga et al\textsuperscript{23} recommend that dorsal fixation be an adequate distance from the focus of inflammation. During the surgical procedure, posterior fixation was performed before anterior debridement and fusion to avoid infection in the posterior operation field. After dorsal fixation, it was difficult to offer suitable pressure to the spondylodesis segments to make the column stable and prevent the extrusion of fusion elements.\textsuperscript{23} Fushimi et al\textsuperscript{2} reported that single-stage posterior fusion was effective in patients with Pyogenic vertebral osteomyelitis who had relatively minor bony destruction. Based on the authors’ experience, this surgical method is suitable for patients with little to no deformity who only need stabilization of fusion segments rather than additional correction. Once posterior fixation is completed, it is difficult to adjust correction during anterior surgery.

In the current patients, low-back pain significantly improved in both groups. No significant difference was found in ODI between the 2 groups 6 months postoperatively. However, ODI showed significantly better results in the anterior than the posterior fixation group 2 years postoperatively. The VAS scores indicated similar results as the ODI in the 2 groups.

The anterior fixation group had less lumbago during the follow-up period. A significant difference was found between the groups 1 and 2 years postoperatively. Posterior fixation may result in more invasion in the lumbar region than anterior fixation. Through the posterior surgical approach, iatrogenic injury of the paraspinous muscle and posterior normal elements is unavoidable. Furthermore, back muscle damage after lumbar back surgery affects postoperative trunk muscle performance and leads to low back pain.\textsuperscript{25,26} The residual pain may also be related to the posterior instruments or to the stiffness caused by the fixation.\textsuperscript{27} Rathjen et al\textsuperscript{28} reported the removal of painful implants in 21 patients. Weistroffer et al\textsuperscript{29} reported that 22% of 50 patients required removal of implants secondary to pain. The dorsal implants had a risk of developing infection, and the reported incidence rate of infection following posterior spinal fixation ranged from 2.6% to 6.7%.\textsuperscript{30,31} Although ESR and CRP are not used specifically for diagnosis of Pyogenic vertebral osteomyelitis, the serial measurement of both could be used to monitor the development of the infection.\textsuperscript{32} The CRP level was more sensitive than the ESR level during follow-up. If the value remains high or there is a new increase in both levels, a serious complication should be suspected. Two patients in the current study had abnormal elevations of ESR and CRP levels during treatment, but no recurrent infection was observed when highly sensitive antibiotics were provided.

Based on postoperative radiological evidence, titanium mesh cages and fixation implants provided effective stabilization of the lumbar column. Similar radiological results for the current patients were found in both groups, including correction of deformity, loss of correction, subsidence of the titanium mesh cage, and time of bony union. No significant difference was found between the 2 groups at the final follow-up. Both groups achieved satisfactory stability of the spinal column.

Pyogenic vertebral osteomyelitis accounts for approximately 1% to 7% of all bone infections.\textsuperscript{33,34} Because of the low incidence rate of Pyogenic vertebral osteomyelitis, few patients participated in the current study. Therefore, the number of patients, follow-up time, and incomplete randomization are the limitations of the current study. Therefore, additional studies with more patients, a longer follow-up time, and a recurrence of infection will be used in a follow-up study to look for a more effective and suitable
treatment method for Pyogenic vertebral osteomyelitis.

**Conclusion**

Data from the current study demonstrate that both procedures are reliable and safe for the treatment of Pyogenic vertebral osteomyelitis. No significant differences in deformity correction and bony fusion were observed between the groups. However, anterior fixation yielded better results than posterior fixation, including more well being and less pain.

**References**


5. Liljenqvist U, Lerner T, Bullmann V, Hackmore. Results than posterior fixation, including more well being and less pain.


