Anterior Versus Posterior Approach in the Treatment of Chronic Thoracolumbar Fractures

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Abstract

The purpose of this study was to compare the results of anterior approach vs posterior approach in the treatment of chronic thoracolumbar fractures. A total of 36 patients with chronic thoracolumbar fractures were divided into 2 groups. Group A was treated by an anterior approach and group B was treated by a posterior approach. During the minimum 24-month follow-up period (range, 24-62 months), all patients were prospectively evaluated for clinical and radiologic outcomes. Intraoperative blood loss, operative time, operative complications, pulmonary function, Frankel scale, and American Spinal Injury Association (ASIA) motor score were used for clinical evaluation, and Cobb angle was examined for radiologic outcome.

All patients in this study achieved solid fusion, with significant neurologic improvement. Operative time, perioperative blood loss, ASIA score on admission and at final follow-up, and complications of respiratory tract infection and intercostal nerve pain were not significantly different between the 2 groups (P>.05), but complications of hemopneumothorax, abdominal distension, and constipation were fewer in group B (P<.05). Postoperative pulmonary function (P<.05) and correction of posttraumatic kyphosis were better in group B (P<.05).

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Approximately 90% of all spinal fractures occur in the thoracolumbar region. Progressive collapse of the vertebral body and late kyphosis could be associated with these fractures because of inappropriate nonoperative treatment. In such cases, neurologic deficit occurs insidiously and worsens gradually. Surgery is generally believed to be the appropriate treatment of chronic thoracolumbar fractures associated with neurologic deficit. The matter of which surgical approach should be used for the treatment of chronic thoracolumbar fractures associated with neurologic deficit remains controversial.

It was believed that anterior decompression and reconstruction supplemented with instrumentation was superior to posterior decompression and reconstruction. Some authors reported that decompression of the spine can be completed through the posterior approach and posterior surgery superior to anterior surgery because of satisfactory correction for the posttraumatic kyphosis. It was difficult to make an absolute recommendation because of the lack of high-quality, prospective, randomized control.

The purpose of this study was to compare the results of anterior- vs posterior-approach decompression and reconstruction of the spine in patients with chronic thoracolumbar fractures in a prospective, controlled study.

MATERIALS AND METHODS

We preselected 36 consecutive patients who had a single-level thoracolumbar chronic fracture. These patients were divided into 2 groups (18 patients each) according to the sequence of admission: odd-numbered patients were treated through an anterior approach, and even-numbered patients were treated through a posterior approach. All patients were included based on written informed consent. This study was approved by the Institutional Review Board and the ethics committee of our institution.

SURGICAL TECHNIQUE

All patients in group A underwent a left-side anterolateral retroperitoneal approach with single-level subtotal corpectomy, decompression, and reconstruction of the spine. Reconstruction used a titanium mesh cage filled with autogenous bone strips derived from the resected vertebral body. Activity was restricted for at least 3 months postoperatively. Sports and heavy labor were prohibited for 6 months. Each patient was evaluated immediately postoperatively, at 3, 6, and 12 months postoperatively, and annually thereafter.

In group B, all surgical procedures were performed with the patients under controlled general anesthesia with endotracheal intubation. In the transpedicle closing-wedge osteotomy procedure, using a standard posterior midline approach, screws were placed down the pedicles from 2 vertebral bodies above the fractured site to 2 vertebral bodies below it. After a wide laminectomy and bilateral foraminotomies were performed to decompress the neural elements, the transverse process and the corresponding rib were removed to expose the lateral wall of the pedicle. Meticulous subperiosteal dissection was performed down to the lateral wall of the vertebral body until the anterior surface of the vertebral body was comfortably palpable. Under direct visualization, the pedicles and the lateral portion of the vertebral body were removed using a small osteotome, leaving a thin rim of posterior vertebral wall beneath the dura. After resection, rods precontoured to the normal sagittal alignment were seated into screws and locked under compression over the resected margins. Postoperative management of group B was the same as that of group A.

Clinical Outcome

Intraoperative blood loss, operative time, operative complications, pulmonary function, Frankel scale, and American Spinal Injury Association (ASIA) motor score were evaluated for clinical outcome.

Radiographic Evaluation

Cobb angle was evaluated for radiologic outcome. The Cobb method was used for the local kyphosis angle on lateral plain radiographs, and the Cobb angle was measured between the inferior endplate of the intact vertebra above and the superior endplate of the intact vertebra below.

Statistical Analysis

Data were expressed as mean±standard deviation. Statistical evaluation including separate unpaired t tests, Pearson chi-square tests, and contingency table chi-square tests were conducted for comparison between groups A and B. The tests were performed using SPSS version 12.0.1 software (SPSS, Inc, Chicago, Illinois). The level of significance was set at P<.05.

RESULTS

Between January 2005 and June 2009, a total of 36 patients who underwent single-level chronic thoracolumbar fracture associated with neurologic deficit were included in the prospective study (Figures 1-3). The 2 groups were comparable (P>.05) with respect to age, sex, duration from injury to surgery, time of follow-up visit, and levels of fracture (Table 1). The patients in both treatment groups were prospectively followed for a minimum of 24 months (range, 24-62 months) (average, 36.5±11.3 months in group A vs 34.7±10.6 years in group B) (P>.05), with no patients lost during the follow-up period.

Operative time, perioperative blood loss, ASIA score on admission and at final follow-up, and complications of respiratory tract infection and intercostal nerve pain were not significantly different between the 2 groups, but complications of hemopneumothorax, abdominal distension, and constipation were fewer in group B (Table 2). Canal decompression...
was complete in the 2 treatment groups (Figures 4, 5), and the 2 groups improved their neurologic function by approximately 13.1 ASIA motor scores at final follow-up. Frankel grades on admission and at final follow-up were not significantly different ($P > .05$), but the 2 groups increased approximately 1.5 Frankel grades at final follow-up (Table 3). Comparison of pulmonary function, including vital capacity, forced vital capacity, and maximal voluntary ventilation, was better in group B ($P < .05$) than in group A postoperatively (Table 4). No major perioperative complications, such as wound or urinary tract infections, deep venous thrombosis, pulmonary embolism, and visceral injuries, occurred.

No motion was observed in fusion segments on radiographs, and solid fusion was obtained in all patients of both groups. No cases of hardware failure, such as screw bending, loosening, or breakage or plate breakage, occurred in any patient. Cobb angle was not significantly different on admission between the 2 groups ($P > .05$), but it was significantly different postoperatively and at final follow-up ($P < .05$) (Table 5). Sagittal alignment of the fractured segment was satisfactorily restored immediately postoperatively in group B (Figure 6). Mean postoperative kyphotic angle was 4.1°, and mean angle of correction was 23.7°. Cobb angle correction of the rigid and significant posttraumatic kyphosis was not satisfactory with the anterior approach (Figure 7). In group A, mean postoperative kyphotic angle was 15.2°, and mean angle of correction was 11.1°.

**DISCUSSION**

For chronic thoracolumbar fractures, neural compression by displaced bone fragments and late kyphosis can produce neurologic deficit. Surgical treatment is usually required in cases with posttraumatic kyphosis and neurologic deficit; nonoperative treatment is generally ineffective. Surgical goals parallel those of unstable spine trauma and include neurologic deficit improvement through neural decompression, deformity correction, and spine stabilization. The question as to how these fractures should be approached and stabilized (anteriorly, posteriorly, or combined anteroposteriorly) has been the subject of debate.

### Table 1

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Group A</th>
<th>Group B</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age, y</td>
<td>38.7±5.9</td>
<td>40.2±7.35</td>
<td>.446</td>
</tr>
<tr>
<td>No. of men/women</td>
<td>10/8</td>
<td>12/6</td>
<td>.733</td>
</tr>
<tr>
<td>Mean time from injury to surgery, y</td>
<td>2.8±1.5</td>
<td>3.2±1.6</td>
<td>.455</td>
</tr>
<tr>
<td>Mean follow-up, mo</td>
<td>36.5±11.3</td>
<td>34.7±10.6</td>
<td>.426</td>
</tr>
<tr>
<td>Level of fracture, no.</td>
<td></td>
<td></td>
<td>.906</td>
</tr>
<tr>
<td>T11</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>T12</td>
<td>6</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>L1</td>
<td>7</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>L2</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

*Anterior approach.

*Posterior approach.
aspect of the dura mater during surgical decompression. Such a procedure would offer patients with neurologic deficit a better chance at improvement than others. However, this is surgically more challenging and has a greater potential for complications.22,24-26

It is generally believed that canal decompression is limited by and often incomplete with the posterior approach for the treatment of chronic thoracolumbar fracture associated with neurologic deficit. Some authors have confirmed that direct decompression of the middle column can be done through the posterior approach.16-20,35-38 Our study shows that the Frankel grades and ASIA motor scores on admission and at final follow-up were not significantly different between group A and group B. The 2 groups improved their neurologic function by approximately 1.5 Frankel grades and 13.1 ASIA motor scores at final follow-up. Our study showed that neurologic improvement was the same in the 2 groups, so decompression by posterior approach was enough.

Kyphosis is difficult to correct with the anterior approach, especially rigid and significant posttraumatic kyphosis of chronic thoracolumbar fracture. Laminctomy may destabilize the spine with the progression of deformity, but posterior pedicle screw segmental instrumentation could allow more rigid fixation by fixation of 3 columns. Tezeren and Kuru19 reported that 5 of 9 patients treated with short-segment instrumentation had a correction loss of >10° with a 55% failure rate, whereas no patient treated with long-segment instrumentation had a correction loss of >10°.

In our study, posttraumatic kyphosis was satisfactorily restored immediately postoperatively in group B. No cases of hardware failure occurred in any patient in group A. Cobb angle was approximately 1.3° at final follow-up. Posttraumatic kyphosis can be corrected satisfactorily by a posterior approach, and 3-column fixation by long-column posterior pedicle screw was a reliable method for spinal fusion for chronic thoracolumbar fractures.

The anterior approach with a plate on the vertebral body provides good decompression and solid fusion, but the operative risk is relatively higher than that associated with the posterior approach.2,25

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Table 2

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group A</th>
<th>Group B</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean operative time, min</td>
<td>171.5±26.6</td>
<td>175.3±22.8</td>
<td>.346</td>
</tr>
<tr>
<td>Mean perioperative blood loss, ml.</td>
<td>805.6±170.1</td>
<td>811.0±175.1</td>
<td>.382</td>
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<td>Complications, no.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Hemopneumothorax</td>
<td>13</td>
<td>1</td>
<td>.000*</td>
</tr>
<tr>
<td>Respiratory tract infection</td>
<td>2</td>
<td>0</td>
<td>.486</td>
</tr>
<tr>
<td>Intercostal nerve pain</td>
<td>3</td>
<td>1</td>
<td>.603</td>
</tr>
<tr>
<td>Abdominal distension, constipation</td>
<td>10</td>
<td>3</td>
<td>.035*</td>
</tr>
<tr>
<td>Mean ASIA score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On admission</td>
<td>34.2±6.3</td>
<td>34.6±7.2</td>
<td>.899</td>
</tr>
<tr>
<td>At final follow-up</td>
<td>47.3±9.6</td>
<td>47.7±9.5</td>
<td>.902</td>
</tr>
</tbody>
</table>

Abbreviation: ASIA, American Spinal Injury Association.

*Anterior approach.

Posterior approach.

Statistically significant.

Table 3

<table>
<thead>
<tr>
<th>Frankel Score at Final Follow-up</th>
<th>Group A (n=18)</th>
<th>Group B (n=18)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frankel score on admission</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>A</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>C</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>D</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

*Anterior approach.

Posterior approach.
The posterior procedure of the thoracolumbar junction is well established; advantages include more safety in exploring the surgical site without violating the pulmonary, visceral, and vascular structures, as well as being less technically demanding.28 Our study showed that the complications of hemopneumothorax, abdominal distension, and constipation were fewer in group B. The posterior approach of transpedicle closing-wedge osteotomy is an effective and more secure treatment for chronic thoracolumbar fractures. In addition, an anterior approach is limited if the spinal cord is pressed by bone fragments from the middle column and posterior column, which could be removed by our posterior approach. Some authors recommend the combined anterior and posterior approach for the management of chronic thoracolumbar fractures.31,43 However, the operative time is longer and the risk of surgical trauma is higher. The posterior approach of transpedicle closing-wedge osteotomy may be an ideal method, although the anterior approach will spare the number of fused levels compared with the posterior approach.

### REFERENCES


