Anterior stabilization of three-column thoracolumbar spinal trauma

ROD J. OSKOUIAN JR., M.D., CHRISTOPHER I. SHAFFREY, M.D., RICHARD WHITEHILL, M.D., CHARLES A. SANSUR, M.D., NADER POURATIAN, M.D., ADAM S. KANTER, M.D., ASHOK R. ASTHAHIRI, M.D., AARON S. DUMONT, M.D., JASON P. SHEEHAN, M.D., W. JEFFREY ELIAS, M.D., AND MARK E. SHAFFREY, M.D.

Departments of Neurological and Orthopaedic Surgery, University of Virginia Health System, Charlottesville, Virginia

Object. The purpose of this study was to evaluate the results obtained in patients who underwent anterior stabilization for three-column thoracolumbar fractures.

Methods. The authors retrospectively reviewed available clinical and radiographic data (1997–2006) to classify three-column thoracolumbar fractures according to the Association for the Study of Internal Fixation (AO) system, neurological status, spinal canal compromise, pre- and postoperative segmental angulation, and arthrodesis rate.

The mean computed tomography–measured preoperative spinal canal compromise was 48.3% (range 8–92%), and the mean vertebral body height loss was 39.4%. The mean preoperative kyphotic deformity of 14.9° improved to 4.6° at the final follow-up examination. Although this angulation had increased a mean of 1.8° during the follow-up period, the extent of correction was still significant compared with the preoperative angulation (p < 0.01). There were no cases of vascular complication or neurological deterioration.

Conclusions. Contemporary anterior spinal reconstruction techniques can allow certain types of unstable three-column thoracolumbar fractures to be treated via an anterior approach alone. Compared with traditional posterior approaches, the anterior route spares lumbar motion segments and obviates the need for harvesting of the iliac crest.

KEY WORDS • spinal cord injury • spinal fracture • trauma • thoracolumbar spine • instrumentation • titanium cage

Abbreviations used in this paper: AP = anteroposterior; ASIA = American Spinal Injury Association; CT = computed tomography; SCI = spinal cord injury; VB = vertebral body.
Anterior stabilization of three-column thoracolumbar trauma

### Neurological Assessment and Radiographic Analysis

The neurological status was classified according to the ASIA classification system (with ASIA Grade A representing a complete SCI in individuals in whom S4–5 sensory or motor function is absent). Preoperative AP and lateral radiographs were obtained in all patients to assess fracture level and degree of segmental kyphosis. Preoperative CT scans were acquired through the injured level, and these studies were used to assess canal compromise and to delineate fracture morphology (Fig. 1). The degree of CT-based canal compromise was estimated according to the method of Hashimoto, et al., and kyphosis was calculated according to the method of Atlas, et al. Magnetic resonance imaging was undertaken to evaluate signal changes in the spinal cord in patients with a neurological deficit. Postoperative spinal alignment, hardware position, and the presence of a fusion mass were evaluated on AP and lateral radiographs as well as on CT scans. Computed tomography was repeated in 37 patients (62%) to assess fusion when pseudarthrosis was suspected. Thus, in patients in whom a CT scan was obtained plain radiographs were also obtained to determine if there was a solid fusion.

### Operative Technique

The patient was placed in the true lateral position, with an axillary roll under the right axilla and the fracture level positioned over the break of the table. We prefer to conduct the approach from the left side to avoid retracting the liver and injuring the inferior vena cava. We have found that exposures above and below the diaphragm are usually needed to create an adequate working area for decompression and placement of the instrumentation, particularly in cases involving fractures at the L-2 or a more superior level. In an anterior retroperitoneal or transdiaphragmatic retroperitoneal approach, we undertook a two-level, three-VB fusion that involved subtotal corpectomy, placement of a femoral strut allograft, local bone and rib autograft, and lateral instrumentation (two trans-VB screws inserted above and below the fractured level and connected by two longitudinal rods or a plate). After the corpectomy was performed, distraction was applied and the allograft was carefully positioned. This structural graft was then supplemented using rib, VB autograft, titanium interbody cage, or an expandable cage (Fig. 2).

### Follow-Up Protocol

The mean follow-up duration was 21.1 months (range 6–60 months). Patients were examined at routine intervals. Radiographic studies were performed at 3, 6, 12, and 24 months, and neurological function was documented. For patients who had not undergone recent examinations and for those no longer required to attend follow up, a final follow-up telephone interview was scheduled to determine pain and work status according to the Denis Pain and Work Scales. There was no case of neurological deterioration following anterior decompression and stabilization. In patients with an incomplete SCI there was a median improvement of almost half an ASIA grade (0.45) at final follow up (Table 3). The Denis Pain and Work Scale scores are summarized in Tables 4 and 5. A summary of preoperative canal compromise, operating room time, blood loss, duration of postoperative hospital stay, and pre- and postoperative kyphotic deformity data are presented in Table 6. The mean preoperative spinal canal compromise as seen on CT scanning was 48.3% (range 8–92%) and the mean VB height loss was 39.4% (range 24–64%). The mean preoperative segmental kyphotic deformity of 14.9° (range 4–33°) improved significantly to 4.6° (range 0–12°) after surgery. The final follow-up value had increased a mean of 1.8°, however, although this was still significant compared with the preoperative angulation (p < 0.01).

There was no correlation between age, sex, canal compromise, and fracture level and neurological recovery. Preoperative canal compromise did not correlate with ASIA or Denis pain or work status grades. We also found no correlation between canal compromise and neurological recovery or between the degree of kyphosis and pain outcomes.

### Summary of Complications

One case of screw fracture was noted incidentally on a follow-up study, but this did not lead to displacement of the instrumentation; rather, there was CT evidence of solid fusion, and no additional treatment was required. In seven patients in whom a thoracotomy tube was not required at the time of the initial procedure, one was necessary postoperatively to treat pleural effusion. Admission chest radiography in four of these seven patients failed to demonstrate significant trauma-induced pulmonary contusions. Postoperative ileus requiring nasogastric suction for bowel relief

---

**TABLE 1**

**Summary of primary fracture level**

<table>
<thead>
<tr>
<th>Fracture Level</th>
<th>No. of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-11</td>
<td>2</td>
</tr>
<tr>
<td>T-12</td>
<td>13</td>
</tr>
<tr>
<td>L-1</td>
<td>37</td>
</tr>
<tr>
<td>L-2</td>
<td>5</td>
</tr>
<tr>
<td>L-3</td>
<td>3</td>
</tr>
</tbody>
</table>

**TABLE 2**

**Summary of AO classification injuries**

<table>
<thead>
<tr>
<th>Ant &amp; Pst Element Injury</th>
<th>No. of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>w/ distraction</td>
<td></td>
</tr>
<tr>
<td>Type B</td>
<td>47 (78%)</td>
</tr>
<tr>
<td>B1</td>
<td>18</td>
</tr>
<tr>
<td>B2</td>
<td>18</td>
</tr>
<tr>
<td>B3</td>
<td>11</td>
</tr>
<tr>
<td>w/ rotation</td>
<td></td>
</tr>
<tr>
<td>Type C</td>
<td>13 (22%)</td>
</tr>
<tr>
<td>C1</td>
<td>11</td>
</tr>
<tr>
<td>C2</td>
<td>2</td>
</tr>
<tr>
<td>C3</td>
<td>0</td>
</tr>
</tbody>
</table>

* Type A compression VB (anterior- and middle-column) fractures: A1 = impaction, A2 = split, and A3 = burst; Type B distraction (three-column) fractures: B1 = posterior injury—ligamentous, B2 = posterior injury—ossceous, and B3 = anterior injury—through disc; and Type C rotational (three-column) fractures: C1 = Type A w/ rotation, C2 = Type B w/ rotation, and C3 = rotational shear. Abbreviations: ant = anterior, pst = posterior.
developed in 15 patients. There were also three cases of pneumonia in critically ill patients whose mobilization was impaired by associated pelvic and/or calcaneal fractures. There were no cases of hardware-related infection or pseudarthrosis. Approach-related painful intercostal neuralgia that developed in an additional five patients was treated with intercostal nerve blocks and pain medication. In two patients abdominal wall outpouching developed, presumably due to denervation of the internal and external oblique and transverse abdominal muscles.

Discussion

Although other authors have reported on the successful single-stage anterior surgical treatment of thoracolumbar spinal fractures in patients with or without neurological dysfunction, their cases involved two-column injuries (AO Type A), and the rates of pseudarthrosis were unacceptable. Most spine surgeons have recommended posterior stabilization for the significantly more unstable three-column injuries similar to the Denis fracture–dislocation, McAfee unstable burst fracture and flexion–distraction injuries, and AO Types B and C injuries. The placement of an anterior-column interbody cage has been shown to be an efficacious adjunct to achieving arthrodesis. The authors of biomechanical studies have demonstrated that cages placed in the anterior column are able to withstand forces in all planes except for extension. Titanium mesh cages are being used for various surgical indications to promote anterior fusion. Interbody cages and, more recently, expandable cages are being used to treat traumatic spinal instability and restore segmental kyphosis. In a review of complications associated with the Kaneda device, McAfee briefly reported on the use of anterior stabilization in 10 patients with thoracolumbar burst fractures in whom vertebrectomy constituted the placement of carbon fiber cages packed with autologous bone; good outcomes and improved kyphosis were observed postoperatively.

Traditional Posterior Techniques

The first clinically effective spinal implant with which to promote deformity reduction and internal fixation after thoracolumbar junction trauma was the Harrington distraction rod. Distraction rod–related complications included flat-back syndrome, loss of initial correction, and neural injury related to overdistraction and upper-region hook dislodgment. The technique was subsequently modified such that a sleeve was fitted to the rod to obtain lordotic force at the level of injury and three-point fixation. Historically, the posterior approach has been attractive because the anatomy and the approach are familiar. It can be performed in a timely fashion, without the assistance of a general or vascular surgeon, and it avoids thoracotomy–associated complications such as iatrogenic vascular, bowel, or pulmonary injury. We believe that a posterior approach is reasonable and can provide immediate stability in cases involving these unstable fractures.

Multisegmental posterior instrumentation systems that were originally developed for scoliosis have also been used in the treatment of thoracolumbar burst fractures. Posterior segmental transpedicular systems have been extensively applied to achieve indirect reduction of thoracolumbar burst fractures if surgery can be performed soon after injury. The success of this technique in achieving deformity reduction depends on the presence of an intact posterior longitudinal ligament and anulus fibrosis of the intervertebral disc. Some surgeons have advocated that the procedure be performed within 48 to 72 hours of injury to promote optimal results. The extent of reduction is less predictable than that of direct canal decompression. Direct canal decompression can be achieved using an anterior procedure. Decompression can also be performed via a transpedicular approach, which can increase the amount of canal decompression compared with a purely posterior approach. Lemons and associates reviewed 22 cases of thoracolumbar fracture in which posterior instrumentation—

![Fig. 1. Preoperative sagittal (A) and axial (B) CT reconstructions obtained in a 29-year-old patient presenting with paraparesis and an L-1 burst fracture associated with 65% canal compromise.](image-url)
Anterior stabilization of three-column thoracolumbar trauma

Augmented fusion was performed with or without bilateral transpedicular decompression. They found that the extent of spinal canal reconstruction failed to correlate with neurological recovery. They proposed that the transpedicular decompression failed to improve neurological recovery because “manipulation of the already damaged neurological structures” had already occurred. In a comparison between anterior and posterior decompression, Bradford and McBride reported improved neurological outcome in the anterior-approach group, and this correlated with significantly less residual canal stenosis. There also seems to be an increased incidence of postoperative kyphosis that occurs in association with a transpedicular decompression and shorter-spanning posterior segmental instrumentation alone. Markel and Graziano reported that posterior decompression and fusion led to excellent correction of spinal deformity, improvement in neurological function, and high fusion rates. Despite improved results, the constructs still require fixation two levels above and below the injury. Attempts to shorten the constructs have resulted in higher failure rates. Late loss of kyphosis correction has been associated with both techniques, as is delayed neurological deterioration presumably due to ongoing compression caused by incompletely reduced bone fragments.

Anterior Approaches

A benefit of the anterior approach is that it permits a more direct and complete decompression of the spinal canal, potentially allowing a better neurological outcome. Although many authors have argued that neurological recovery is improved by anterior decompression, this contention has not been significantly demonstrated in prospective studies. Esses and associates have reported a prospective randomized study of 40 patients who underwent either anterior decompression or posterior transpedicular distraction. They found no intergroup difference with respect to Frankel grade improvement or kyphosis correction, although canal decompression was substantially greater after the anterior operation. Gertzbein has reported prospective data that demonstrate that an anterior procedure was beneficial in patients with late-onset kyphosis and in restoring bladder continence. One argument against the anterior approach is the risk of increased morbidity. Although high complication rates were reported in earlier studies, the authors of newer studies have observed minimal complications, suggesting that a significant learning curve may be associated with the anterior or anterolateral approach to the thoracolumbar junction.

There are biomechanical advantages to repairing anterior-and middle-column lesions with an anterior construct. It has been demonstrated in biomechanical studies that fewer motion segments need to be included to achieve a stronger construct. In a porcine model designed to assess the control of axial rotation after corpectomy, Gurwitz and associates demonstrated that posterior pedicle screw-plate system alone was 76% less stiff axially, posterior instrumentation with anterior strut was 3% stiffer, and anterior instrumenta-

Fig. 2. Immediate postoperative sagittal (A) and AP (B) CT reconstructions of an L-3 burst fracture, demonstrating adequate canal decompression, a titanium cage filled with autograft, and bicortical trans-VB screw purchase.
tion with an anterior strut was 15% stiffer than an intact spine. In a calf spine model, Gurr, et al., demonstrated that the Kaneda device spanning two motion segments conferred similar mechanical stiffness as posterior pedicle screw systems spanning four motion segments. In another biomechanical study involving a calf spine model, Lim and coworkers demonstrated that a short transpedicular construct was less effective in controlling flexion-extension movements than an anterior strut construct with a Kaneda device, which effectively controlled motion in all loading modes.

The goals of treatment in patients with unstable thoracolumbar burst fractures should be threefold: 1) achievement of spinal alignment and decompression of neural elements; 2) stabilization of an unstable fracture; and 3) prevention of further progressive deformity or neurological injury, as well as the provision of a painless, functional spine, and maximization of neurological and clinical recovery.

Although we previously favored a posterior approach, we now advocate the use of an anterior approach, based on anatomical and biomechanical considerations, in the treatment of anterior- and middle-column lesions. We hypothesize that restoration of normal spinal alignment and balance will improve outcomes in patients in whom the deformity is a result of a traumatic SCI. Theoretically, an anterior approach maximizes restoration of the anterior and middle column, restores normal kyphosis, and improves sagittal balance. The ability to reduce the segmental kyphosis reliably with an anterior interbody cage, distraction, and decompression and provide immediate anterior- and middle-column stability demonstrated in recent studies by Sasso, et al.,

This finding is similar to the improvement in Frankel grade on the Frankel Scale or the modified Frankel Scale. Patients with incomplete SCI improved a minimum of one grade in 37 of 42 patients who underwent anterior decompression for thoracolumbar burst fractures. Bradford and McBride reported improvement of at least one Frankel grade in 37 of 42 patients who underwent anterior decompression for thoracolumbar burst fractures. Bradford and McBride reported on 59 patients with thoracolumbar burst fractures and incomplete neurological deficits who were managed surgically. They compared the extent of neurological recovery with the extent of canal decompression, noting a substantially higher rate of recovery in patients in whom decompression was performed via an anterior approach. The findings in other stud-

### TABLE 3
Comparison of ASIA grades at admission and at discharge in 60 patients treated for three-column spinal trauma

<table>
<thead>
<tr>
<th>ASIA Grade</th>
<th>No. of Patients</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>29</td>
<td>26 (90)</td>
<td>3 (10)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>9</td>
<td>5 (56)</td>
<td>3 (33)</td>
<td>1 (11)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>7</td>
<td>3 (43)</td>
<td>4 (57)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>7</td>
<td>3 (43)</td>
<td>4 (57)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>12</td>
<td>12 (100)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* ASIA grades: A = completely independent; B = self-care requires aid; C = requires more than basic supervision; D = dependent in basic self-care; E = completely disabled.

### TABLE 4
Summary of pain-related results obtained in 60 patients who underwent anterior stabilization

<table>
<thead>
<tr>
<th>Denis Pain Scale Score</th>
<th>No. of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>5</td>
</tr>
<tr>
<td>P2</td>
<td>20</td>
</tr>
<tr>
<td>P3</td>
<td>15</td>
</tr>
<tr>
<td>P4</td>
<td>13</td>
</tr>
<tr>
<td>P5</td>
<td>7</td>
</tr>
</tbody>
</table>

* Denis Pain Scale scores: P1 = no pain; P2 = occasional minimal pain and no need for medication; P3 = moderate pain, occasional medications needed, and no interruption of work or activities of daily living; P4 = moderate-to-severe pain, occasional absence from work, and significant changes in activities of daily living; and P5 = constant, severe pain and need for chronic medications.

R. J. Oskouian Jr., et al.

### TABLE 5
Summary of work status–related results obtained in 60 patients who underwent anterior stabilization

<table>
<thead>
<tr>
<th>Denis Work Scale Score</th>
<th>No. of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>0</td>
</tr>
<tr>
<td>W2</td>
<td>20</td>
</tr>
<tr>
<td>W3</td>
<td>16</td>
</tr>
<tr>
<td>W4</td>
<td>14</td>
</tr>
<tr>
<td>W5</td>
<td>10</td>
</tr>
</tbody>
</table>

* Denis Work Scale scores: W1 = able to return to previous employment (heavy labor) or physically demanding activities; W2 = able to return to previous employment (sedentary) or return to heavy labor with restrictions; W3 = unable to return to previous employment, but works full time at new job; W4 = unable to return to full-time work; and W5 = no work, completely disabled.

Numerous studies have demonstrated that autogenous bone graft is the best fusion substrate and that an iliac graft is not well tolerated postoperatively. In this series we used rib autograft and noted early that patients were complaining of donor site pain after harvesting the large iliac crest struts. The use of the cage, the harvested rib, and corpectomy bone harvested using an osteotome has always provided abundant autologous bone to span the defect without the need for iliac crest material.

### TABLE 6
Summary of perioperative data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>op time (min)</td>
<td>302 (230–372)</td>
</tr>
<tr>
<td>blood loss (ml)</td>
<td>710 (310–1400)</td>
</tr>
<tr>
<td>kyphotic deformity (˚)</td>
<td>14.9 (4–33)</td>
</tr>
<tr>
<td>preoperative</td>
<td></td>
</tr>
<tr>
<td>postoperative</td>
<td>4.6 (0–12)</td>
</tr>
<tr>
<td>% canal compromise</td>
<td>48.3 (8–92)</td>
</tr>
<tr>
<td>% VB height loss</td>
<td>39.4 (24–64)</td>
</tr>
<tr>
<td>duration of stay (days)</td>
<td>6.0 (4–20)</td>
</tr>
</tbody>
</table>

ies, however, do not necessarily support the relationship between canal decompression and neurological improvement. In their prospective study of 40 patients with thoracolumbar burst fractures, Esses, et al. performed either an anterior or a posterior approach and reported that the extent of canal decompression was considerably greater in the anterior-approach group but that intergroup neurological improvement was not different. Analysis of our results also demonstrated that status in patients with incomplete SCI improved by at least half an ASIA grade at the last follow-up examination.

Postoperative Back Pain

Back pain commonly results from unstable thoracolumbar burst fractures. The exact origin of the pain in these patients is unclear, but the loss of normal sagittal balance may play a role. This association between back pain and kyphosis has been demonstrated in studies of patients with spinal deformities of other causes in which loss of sagittal balance is clearly associated with increased pain. In a recent multicenter study involving 298 adults with spinal deformity, Glassman and colleagues reported that sagittal balance was identified as the radiographic parameter most highly correlated with adverse health status outcomes. They also showed upper thoracic kyphosis is associated with a better outcome than lumbar kyphosis. In a multicenter spinal fracture study, Gertzbein at the 2-year follow-up examination that a kyphotic deformity greater than 30° was associated with an increased incidence of significant back pain. It has been shown in many studies involving the conservative treatment of thoracolumbar burst fractures, however, that there is no correlation between the degree of residual kyphosis and the degree of back pain or work status. Good outcomes in terms of pain relief have been noted in patients who have undergone either anterior- or posterior-approach surgery. Another theory is that avoiding iliac crest harvesting may also lead to reduced postoperative pain. Summers and Eisenstein reported a 25% incidence of chronic pain at the iliac donor site in 290 patients who underwent anterior lumbar fusion; the most significant pain was associated with the harvesting of a tricortical iliac crest graft. We observed no correlation among pain outcome, canal compromise, and the degree of kyphosis.

Another theoretical consideration that may favor the use of an anterior approach such as ours is that thoracolumbar burst fractures are most common in young male patients. The recording of long-term pain outcomes has not been performed. The benefits of our approach—diminished low-back pain resulting from the need to fuse fewer levels and the anatomical restoration of the spinal balance—may not become apparent until later in life. This theory awaits the confirmation of long-term data.

Work Status

A useful measure of the success of any treatment modality is the ability of the patient to return to his or her pre-morbid functional level. The work status outcomes in our series compare favorably with other published outcomes associated with either an anterior or a posterior approach. Okuyama, et al. reported a Denis Work Scale score of W1 or W2 in 14 (74%) of 19 patients with unstable thoracolumbar burst fractures who underwent anterior decompression, stabilization, and fusion. In a series of anterior de-

Anterior stabilization of three-column thoracolumbar trauma

compression and stabilization procedures for thoracolumbar burst fractures, Kaneda and associates reported that 86% of their 130 patients returned to their previous jobs and an additional 10% returned to work in some capacity, but the specific Denis Work Scale scores were not recorded. The incidences of return to work in patients who have undergone posterior-approach surgery for thoracolumbar fractures range from 48 to 79%; however, return-to-work status has not been classified according to Denis Scale scores.

Kyphosis Correction

Anterior decompression and instrumentation-augmented fusion for thoracolumbar fractures can effectively restore VB height and at the same time correct the kyphotic deformity. Briem, et al. found no difference in kyphotic deformity at follow-up examination between patients who underwent posterior stabilization alone or those treated with combined posterior stabilization and anterior fusion. They observed a loss in VB height only in the posterior stabilization group. Wood and colleagues reported no difference in mean kyphosis values at final follow-up examination when comparing surgically and nonsurgically treated patients. Shen, et al. observed a progression of kyphosis of 4° in the nonoperative group and a correction of kyphosis of 11° in the surgical group on 2-year follow-up imaging studies; however, in other studies, no difference in kyphosis has been observed between patients receiving posterior hardware with or without a transpedicular bone graft. Regardless of the treatment, kyphosis has been shown to progress after initiation of the therapy. In a number of studies, investigators have reported no correlation between final kyphotic angle and pain or functional outcome, which underscores the findings in our present study.

In patients who have undergone posterior surgery, kyphosis correction is maintained, particularly after the placement of short-segment constructs that include a single level above and a single level below the curvature. This loss of correction has rarely been reported after an anterior procedure, but the relationship between kyphosis correction and clinical outcome has yet to be determined. As stated previously, in several studies including ours no correlation has been noted between the degree of residual kyphosis and pain or work status. Conversely, Malcolm and associates reported that patients’ pain was reduced after correction of sagittal-plane deformity. In patients with scoliosis and other nontraumatic deformities, the value of restoring sagittal alignment to prevent long-term back pain is well recognized.

At last follow-up examination the mean postoperative kyphotic deformity had increased by 1.8°, but this was shown to be statistically insignificant. The extent of deformity correction was better than that which we had achieved previously using either an anterior or posterior approach and is consistent with values reported in published studies involving the anterior approach. We attributed this difference to better attention to preoperative positioning and the use of distraction to achieve greater reduction in the curvature. In our series pseudarthrosis was absent and, in contrast to a posterior approach, we have observed no significant loss of kyphosis correction. One explanation may be that the titanium mesh cage and the dual rod device pro-
mote load sharing rather than graft stress shielding. Because we have also noted over time that some settling of the cage and the construct occurs, we advocate long-term follow-up radiographic observation. We also believe theoretically that, in a contemporary cohort of posterior surgery-treated patients, improved kyphosis correction is possible due to the need to fixate fewer vertebrae and to major improvements in posterior instrumentation.

Conclusions

After performing single-stage, stand-alone anterior surgical management of some forms of three-column (Types B and C) thoracolumbar fractures, we found that our results were similar to those previously reported for such treatment of theoretically more stable two-column injuries. We certainly do not advocate single-stage stand-alone anterior management of all thoracolumbar spinal fractures. The anterolateral approach is safe and effective for some thoracolumbar fractures. No attempt was made to treat any rotational shear (AO Type C3) lesions with this approach based on anatomical and biomechanical considerations, because of the significant instability associated with such injuries. When used, an anterior approach permits direct decompression of the spinal canal and restoration of segmental kyphosis, which theoretically provides maximal restoration of spinal balance and immediate anterior-column support. The lumbar motion segments are spared; they are not spared when traditional posterior segmental instrumentation techniques are used. Functional outcomes and pain control were quite good, and results compared favorably with those associated with the management of thoracolumbar fractures.

References

16. de Peretti F, Hovorka I, Cambas PM, Nasr JM, Argenson C: Short device fixation and early mobilization for burst fractures of the thoracolumbar junction. Eur Spine J 5:112–120, 1996
Anterior stabilization of three-column thoracolumbar trauma


49. Sanderson PL, Fraser RD, Hall DJ, Cain CM, Osti OL, Potter GR: Short segment fixation of thoracolumbar burst fractures without fusion. Eur Spine J 8:495–500, 1999


Manuscript received April 15, 2005. Accepted in final form April 19, 2006.

Address reprint requests to: Rod J. Oskouian Jr., M.D., Department of Neurological Surgery, University of Virginia Health System, Box 800212, Charlottesville, Virginia 22902. email: rjo2w@virginia.edu.