Selection criteria and outcome of operative approaches for thoracolumbar burst fractures with and without neurological deficit

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The goals of operation for unstable thoracic and lumbar fractures include decompression of neural elements, restoration of vertebral height and alignment, stabilization, and early mobilization. Spinal immobilization and restoration of normal canal dimensions may be associated with improvement in neurological function for partial deficits.1–8,11–17,18,20–23,25–28,30,32,33,37–39,41,42 Although there is agreement that fracture–dislocation and unstable seat belt injury is adequately treated with posterior reduction and fixation, the choice of operative technique (anterior vs. posterior) for an unstable burst fracture remains disputed with respect to neural decompression, restoration of lost vertebral height, and the risk of perioperative and late complications.1–8,13–15,18,20–23,25–28,30,32,33,37–39,41,42 Most controversial is the treatment of burst fractures without neurological deficit. The risks of developing late sequelae from these unstable deformities, namely delayed neurological deficit and painful kyphosis, are not well defined.

In this study we performed a retrospective evaluation of operative technique and outcome for unstable thoracolumbar fractures with and without neurological deficit. The goals were to define clearly our criteria for selection of operative approach using fracture characteristics and to evaluate subsequent clinical and radiographic outcome data to assess the success of decompression, reconstruction, and stabilization.

Clinical Material and Methods

Patient Demographics

Twenty-five consecutive patients (18 male and seven female) who underwent operation for thoracolumbar burst fractures between 1993 and 1995 performed by the senior author (L.V.A.) at Hermann Hospital (Houston, TX) were included in the study. The mean age of the patients was 34.4 years (range 14–59 years). Causes of the fractures were motor vehicle, motorcycle, or airplane accidents (12 patients), falls (10 patients), equestrian accidents (two patients), and crush injury (one patient). Six incidents were
work related and four were hunting accidents. Four patients had a history of alcohol or drug use. Associated injuries were common (21 patients), including extremity fractures or major lacerations (10 patients), pulmonary contusion or aspiration (three patients), closed head injury (four patients), abdominal trauma (two patients), and pelvic fractures (two patients).

Preoperative Evaluation and Timing of Operation

All patients received a comprehensive trauma assessment. Plain radiographs and computerized tomography (CT) scans (including sagittal reconstruction in most patients) were obtained in all cases; magnetic resonance (MR) images were available in most. Preoperative spinal angiography was not performed. High-dose steroids were administered intravenously over a 24-hour period to patients with a deficit. Factors determining the timing of operation included timing of transfer from an outside hospital, associated injuries, neurological condition, and the obtaining of informed consent from the patient and family. The operation was scheduled for the earliest opportunity but not on an emergency basis. The overall mean interval between injury and operation was 4.7 days (range 1–27 days); 22 patients (88%) underwent surgery within 7 days.

Fracture Classification

Fractures were classified according to the three-column scheme of Denis.6 Burst fractures were classified by failure of the vertebral body under axial load with both anterior and middle columns under compression. Features included posterior cortical wall and superior endplate fractures with loss of vertebral body height, increase in interpedicular distance, and tilting and retropulsion of bone, endplate, and disc into the canal. Injuries were limited to the anterior and middle columns in 10 cases and involved all three columns in 15. Posterior column injuries included stable laminar (greenstick) fractures9,23 in six patients and unstable posterior arch or laminar fractures34 in nine patients.

Selection of Operative Technique

Vertebral body height, canal compromise, and kyphosis were assessed preoperatively and used to determine operative approach. Anterior surgery was performed in patients with at least a 40% ventral canal compromise, a 40% or greater loss of body height, and/or kyphosis measuring at least 15°. The absence of neurological deficit or the presence of a complete motor deficit did not preclude an anterior approach. Posterior stabilization was added after multilevel corpectomies or if posterior column injuries were unstable. Posterior transpedicular decompression and segmental fixation were used primarily in patients with less than 40% canal encroachment, at most 40% loss of body height, and either a neurological deficit or a deformity that was considered unstable.

Anterior plating systems (Acromed, Cleveland, OH and Sofamor Danek, Memphis, TN) were utilized in all isolated anterior approaches. Anterior fixation was also used in combined constructs when reinforcement of the strut graft was indicated.

Pedicle screws (Isola System; Acromed) were preferred for posterior fixation. Hook-and-rod systems (Acromed) were used when anterior fixation precluded screw placement or pedicle anatomy was incompatible with cannulation.

Operative Technique and Perioperative Care

Operative techniques included transthoracic, thoracodorsal, retroperitoneal,3,5,23–25,27,33,36,37,39 and midline posterior approaches.3 Cell-saver replacement was used. Left thoracotomy and flank incisions were selected to avoid retraction of the liver and vena cava. Dissection proceeded along the rib one or two levels above the injured segment(s). Between T-10 and L-4 retroperitoneal dissection was selected; detachment of the arcuate ligaments of the diaphragm from L-1 and intrapleural exposure was required between T-10 and T-12. The anterior longitudinal ligament was preserved and segmental vessels at, above, and below the injured level were divided unilaterally proximal to the foramen. The fractured body and associated discs were removed using a high-speed drill and curette. The posterior longitudinal ligament was preserved unless epidural fragments or hematoma were suspected. A femoral allograft packed with autologous cancellous chips was fashioned to the defect and placed as a weight-bearing strut graft. Fixation was then performed as indicated. Thoracostomy tubes and/or retroperitoneal drains were placed.

If a posterior procedure was indicated, this was undertaken while the patient was still anesthetized. Pedicle screw placement was accomplished using anatomical landmarks and confirmed by radiographs. Pedicle screws were used in the thoracic spine up to the T-9 level. Polymethylmethacrylate was occasionally injected into the tapped pedicle prior to screw placement to increase pull-out strength.10,29 Bilateral screws were used at one level above and below unstable levels. Hook-and-rod constructs typically incorporated two intact levels above and below unstable levels, using claw configurations at the poles. Distraction rods were contoured to maintain spinal alignment and cross links were applied. Autologous iliac crest cancellous intertransverse fusion was performed in all cases. Subfascial drains were placed. Patients were observed postoperatively in intensive care and mobilized within 2 days in most instances with a brace (thoracolumbosacral orthosis).

Clinical and Radiographic Studies

Hospital records, office charts, and radiographic studies were reviewed and patients or family members were interviewed. The mean durations of clinical and radiographic follow up through December 1995 were 16.3 months (range 7–29.3 months) and 8.8 months (range 3–19 months), respectively. Films were reviewed directly to assess incorporation.

Postoperative neurological and bladder function were assessed at discharge, clinic visits, and phone interviews. Frankel16 (paraplegia, Table 1), Benzel–Larson2 (traumatic myelopathy, Table 2), and modified Prolo40 (employment/activity and pain, Table 3) rating grades were obtained at 3, 6, and 12 months, with subsequent follow-up reviews structured individually. Radiographs were obtained postoperatively and follow-up evaluations were
Fracture Characteristics

surgery. Hardware breakage in patients more than 1 year after motion on flexion–extension films, and no evidence of construct was inferred by stable correction, absence of visualization when obscured by hardware, a solid construct was inferred by stable correction, absence of motion on flexion–extension films, and no evidence of hardbreakage in patients more than 1 year after surgery.

Results

Anterior techniques were indicated in 23 of 25 patients. The approaches were transthoracic in one, thoracoabdominal in 15, and retroperitoneal in seven patients. In nine of these patients, a combined anterior and posterior operation was performed for unstable three-column injury. Anterolateral plating was used in all 14 cases of ventral operation without posterior fixation (Fig. 1). Three patients who underwent a combined approach also had anterior plating and, therefore, received hook-and-rod constructs posteriorly (Fig. 2). Pedicle screws were used exclusively in seven of 11 posterior constructs, including six patients treated with a combined approach, to limit instrumentation and preserve lumbar curvature when possible (Fig. 3). Two patients were treated with posterior bilateral transpedicular decompression, distraction, and fixation. One of these patients required a mixed construct when pedicle cannulation could not be performed inferiorly.

Fracture Characteristics

Most patients suffered a 40 to 60% compromise of both body height and canal size with overall mean values of 49% and 45.6%, respectively. Mean preoperative kyphosis was 16.6°. The average degree of preoperative middle-column compression was 50% for anterior/combined and 30% for posterior procedures, whereas the kyphotic deformity was 17.4° for anterior/combined and 7.5° for posterior operations. These data are summarized in Table 4.

Perioperative Variables

Average operative times were 339 minutes for anterior procedures, 354 minutes for posterior procedures, and 635 minutes for combined approaches. The mean net blood losses for the operations after cell-saver replacement were 380 ml for a posterior approach, 829 ml for an anterior approach, and 1519 ml for combined procedures. Perioperative transfusion was required in 15 patients. The average hospital stay was 14.5 days for all patients (range 8–34 days), with mean values of 8.5 days for posterior, 14.9 for anterior, and 15.1 days for combined procedures. Patients wore braces postoperatively in all instances (mean 10.1 weeks, range 8–24 weeks).

Neurological Outcome

Eight patients presented without deficit (Frankel Grade E); all of these remained intact after the operation. This included seven patients with severe vertebral deformity treated anteriorly (Fig. 4), and one with a 30% canal encroachment treated posteriorly. In 17 patients with deficit, 16 recovered motor function and 1 remained at Frankel Grade B. Three other Frankel Grade B patients improved to a C grade, but did not recover ambulatory function. All five Frankel Grade C patients improved to the D grade and walked postoperatively. All eight Frankel Grade D

TABLE 1
Frankel paraplegia scale

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
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<tbody>
<tr>
<td>A</td>
<td>complete: both motor &amp; sensory paraplegia</td>
</tr>
<tr>
<td>B</td>
<td>sensory only: motor paraplegia complete, includes sacral sparing</td>
</tr>
<tr>
<td>C</td>
<td>motor useless: motor power present w/o practical value to patient</td>
</tr>
<tr>
<td>D</td>
<td>recovery: no weakness, sensory loss, or sphincter disturbance; abnormal reflexes may be present</td>
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TABLE 2
Benzel–Larson neurological grading system of thoracic and lumbar spine injuries with regard to myelopathic function

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>complete functional neural transection: no motor or sensory function</td>
</tr>
<tr>
<td>II</td>
<td>motor complete: no voluntary motor function w/ preservation of some sensation</td>
</tr>
<tr>
<td>III</td>
<td>motor incomplete–nonfunctional: minimal nonfunctional voluntary motor function</td>
</tr>
<tr>
<td>IV</td>
<td>motor incomplete–functional (nonambulatory): some functional motor control that is useful but not sufficient for independent walking</td>
</tr>
<tr>
<td>V</td>
<td>motor incomplete–functional (limited ambulation): walking w/ assistance is onset, but w/ significant difficulty that limits patient mobility</td>
</tr>
<tr>
<td>VI</td>
<td>motor incomplete–functional (unlimited ambulation): difficulty w/ micturition; significant motor radiculopathy; discoordinated gait</td>
</tr>
<tr>
<td>VII</td>
<td>normal: neurologically intact or minimal deficits that cause no functional difficulties</td>
</tr>
</tbody>
</table>

TABLE 3
Prolo economic and functional rating scale

<table>
<thead>
<tr>
<th>Economic (activity) Status</th>
<th>Functional (pain) Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade</td>
<td>Description</td>
</tr>
<tr>
<td>E1</td>
<td>complete invalid (worse)</td>
</tr>
<tr>
<td>E2</td>
<td>no gainful occupation (including housework or retirement activities)</td>
</tr>
<tr>
<td>E3</td>
<td>working/active but not at premorbid level</td>
</tr>
<tr>
<td>E4</td>
<td>working/active at previous level w/ limitation</td>
</tr>
<tr>
<td>E5</td>
<td>working/active at previous level w/o restriction</td>
</tr>
</tbody>
</table>

TABLE 4
Mean fracture characteristics in 25 patients operated on for thoracolumbar burst fractures

<table>
<thead>
<tr>
<th>Operative Technique</th>
<th>Loss of Body Height (%)</th>
<th>Loss of Spinal Canal (%)</th>
<th>Kyphosis (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preop</td>
<td>Postop</td>
<td></td>
<td></td>
</tr>
<tr>
<td>anterior (14 patients)</td>
<td>50.4</td>
<td>48.3</td>
<td>16.8° (0–45)</td>
</tr>
<tr>
<td>combined (9 patients)</td>
<td>51.1</td>
<td>37.5</td>
<td>18.3° (5–35)</td>
</tr>
<tr>
<td>posterior (2 patients)</td>
<td>30</td>
<td>32.5</td>
<td>7.5° (5–10)</td>
</tr>
<tr>
<td>total (25 patients)</td>
<td>49</td>
<td>45.6</td>
<td>16.6°</td>
</tr>
</tbody>
</table>
patients walked postoperatively, but only four recovered Frankel E status. Continence was restored in seven patients, all treated anteriorly. No Frankel Grade B patient recovered continence. At follow-up review, 21 patients (84%) were ambulatory, whereas 18 (72%) were continent. No patient deteriorated neurologically after surgery. Pre- and postoperative neurological function is summarized in Table 5.

Functional and Pain Outcome

The Prolo outcome scale has been used to evaluate functional results. All patients were incapacitated neurologically or by pain at presentation. Nineteen patients (76%) have returned to their former employment or activity level (Grades E4–5), and two (8%) are engaged in retraining (E3). Four patients (16%) professed incapacity for gainful activity (E2). Totally disabled patients include a Frankel Grade B and a Frankel Grade C patient, as well as two patients who have recovered ambulation and continence after suffering work injuries for which they received compensation. All neurologically intact patients returned to work except for one work-injured patient. Excellent relief from back or radicular pain (Grades F4–5) was reported by 18 patients (72%). Five patients (20%) have moderate daily pain (F3), including both patients treated posteriorly. The two patients (8%) noted above, who were incapacitated after work injuries, also reported severe daily back pain (F2). Functional and pain results are presented in Table 6.
Radiographic Outcome

Twenty-four patients had radiographic follow up that lasted at least 6 months. Hardware breakage did not occur. Anterior graft incorporation was demonstrated in 16 patients and was not seen before 6 months. In the other seven patients treated via an anterior approach, six exhibited a stable appearance without fusion at 6 months, and one neurologically intact patient obtained follow up in another state after 3 months. Fusion was solid or inferred in all 11 posterior constructs. One patient, who underwent a two-level lumbar corpectomy, anterior plating, and a four-level hook-and-rod posterior fixation, developed loss of lumbar lordosis (“flat back” syndrome). She is employed but complains of moderate daily back pain.

Correction of deformity by technique is presented in Table 4. The mean postoperative kyphosis was 2.8° and 19 patients (76%) were restored to anatomical alignment (< 5°). Five patients who underwent anterior procedures had stable compression deformities with 5 to 15° kyphosis, and two of these also developed 5° of scoliosis. Four have excellent pain relief and one has moderate daily back pain. One patient treated posteriorly experienced a loss of correction. This man had a 40% loss of body height, 30% canal compromise, and 10° deformity preoperatively, and required a mixed construct. Despite initial correction to 5°, his kyphosis progressed postoperatively to 20°, and his vertebral body height further collapsed to 50% before stabilizing. His spine eventually fused and the construct remained intact; the patient resumed work, but experiences moderate daily pain.

Postoperative Morbidity

Operative complications occurred in three patients (12%). Two patients required wound revision for incisional hernia after a retroperitoneal approach. One patient presented with a wound abscess 1 year after a combined approach and required drainage, posterior hardware removal, and intravenous administration of antibiotic medications. There were no intraoperative complications from anterior or posterior fixation. No patient died.

Discussion

Anterior Technique

Our results suggest an advantage to regaining neurological function after anterior decompression. Anterior and lateral approaches (transthoracic, thoracoabdominal, retroperitoneal, lateral extracavitary, and extrapleural thoracotomy) are widely recommended in retrospective studies for acute burst fractures with significant canal compromise in the presence of neurological deficit.1–5,7,13,20,21,23–27,30,32,34,35 Although an advantage for neurological recovery following anterior decompression has been proposed by many authors,1–5,7,13,20,21,23–27,30,34,35 it has not been significantly demonstrated in prospective studies.14,18 Esses and associates14 reported a prospective, randomized study of 40 patients treated with either anterior decompression or posterior transpedicular distraction. There were no significant differences between groups with respect to Frankel improvement or kyphosis correction, although canal decompression was substantially increased after anterior operation. They concluded that anterior decompression was indicated for fresh injuries with major deficit and canal compromise, and for injuries presenting late with major kyphosis. Gertzbein18 reported prospective data demonstrating that anterior operation was beneficial in patients suffering from neurological deterioration before operation, in patients with late kyphosis after injury, and in restoring bladder continence.

Retrospective studies also endorse an anterior or lateral technique for symptomatic late kyphosis,5–8,14,20,21,23,27,28,32 and persistent or delayed neurological deficit with canal
Thoracolumbar burst fractures

TABLE 6
Summary of functional and pain outcome at follow-up evaluation in 25 patients operated on for thoracolumbar burst fractures*

<table>
<thead>
<tr>
<th>Operative Technique</th>
<th>No. of Patients</th>
<th>Mean Status Act/Employ</th>
<th>Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>E</td>
<td>F</td>
</tr>
<tr>
<td>anterior (14 patients)</td>
<td>3.9</td>
<td>4.1</td>
<td>10</td>
</tr>
<tr>
<td>combined (9 patients)</td>
<td>3.9</td>
<td>4.4</td>
<td>7</td>
</tr>
<tr>
<td>posterior (2 patients)</td>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>total (25 patients)</td>
<td>3.9</td>
<td>4.2</td>
<td>19</td>
</tr>
</tbody>
</table>

* Based on a modified Prolo outcome scale. See Table 3 for explanation of economic (activity) status (E) and functional (pain) status (F). Abbreviations: Act = activity; Employ = employment.

Advocates cite superior canal decompression, restoration and maintenance of vertebral body height, correction of kyphosis, and excellent relief of pain.1–5,7,13,14,20,21,23,25–28,30,32,33,35 Anterior procedures also spare the paraspinal muscles, replace fragmented discs with bone graft, and virtually eliminate the concern over hardware compromise despite postural or posterior reduction.2–5,8,21,23,27,28,30,33 Advocates cite superior canal decompression, restoration and maintenance of vertebral body height, correction of kyphosis, and excellent relief of pain.1–5,7,13,14,20,21,23,25–28,30,32,33,35 Anterior procedures also spare the paraspinal muscles, replace fragmented discs with bone graft, and virtually eliminate the concern over hardware removal.20 Valid objections to anterior technique address the potential morbidity of intrapleural, diaphragmatic, and retroperitoneal dissection, with attendant bleeding and visceral retraction. Certainly, patients are expected to have a longer hospital stay due to pneumothorax, ileus, blood loss, and pain; this has been confirmed in our experience. However, major morbidity has not been encountered.

Posterior Technique

The use of posterior reduction and stabilization for burst fractures is based on the ability of an intact posterior or longitudinal ligament and posterior annulus to force fragments out of the spinal canal with instrumented reduction.8,14,15,21 Authors of numerous retrospective studies advocate a posterior approach for reduction and stabilization.6,8,11,21,38,42 Esses and coworkers8 reported prospective data in 61 patients treated with posterior reduction. The mean canal compromise was reduced from 50 to 30%, but only four patients improved in Frankel grade and three patients required an anterior operation for severe ventral compression. Lindsey and Dick31 reported prospective results in 12 patients and found correction from 17 to 6° without significant change after a 2-year follow-up review. Danisa and colleagues8 retrospectively reviewed 27 posterior and 16 anterior procedures performed on fractures with comparable characteristics and found no significant differences in neurological, structural, functional, or pain outcomes. These authors concluded that posterior and anterior operations were equally effective, but that patients undergoing combined procedures received inferior treatment. They endorsed posterior reduction as the initial treatment for acute fractures based on reduced cost and morbidity. Anterior operation was suggested for persistent compression with deficit or late kyphosis. Combined procedures were not recommended.8

In our study, patients underwent a combined procedure for single-level injury with concomitant posterior column instability or multilevel injury. Operative time, blood loss, and length of stay were increased in these patients; however, excellent structural, neurological, functional, and pain outcomes were obtained. Other authors also recommend combined procedures when indicated.1,3,15,21,23,26,30,33 Posterior stabilization may be preceded or followed by bilateral transpedicular decompression or impaction of retropulsed fragments to attempt neural decompression.1,3,8,13,17,22,23 Indirect decompression may provide improved canal reduction compared to distraction alone, particularly in fractures with relatively preserved body height or lateral fragments.3,8,13,17,22,23 The major risks of posterior procedures involve indirect neural decompression, graft harvest, infection, and construct failure. We reserved posterolateral decompression and fixation for 2 unstable fractures with less than a 40% canal compromise and up to a 40% loss of body height.

Instability and Selection Criteria

In this study anterior approaches were used for two major reasons: direct neural decompression in the presence of deficit and a 40% or more canal compromise or when a load-bearing strut was indicated for significant deformity. Our criteria for using an anterior strut, with or without deficit, included canal compromise and a loss of vertebral body height that was at least 40% or a kyphosis of 15° or more. Selection criteria were based on the potential risks of progressive canal stenosis, late kyphosis, and neurological decline. Anterior operation for mechanical instability without deficit has been previously reported for 50% or more canal compromise or axial compression and 15 to 40° kyphotic deformity.20,21,23,26,27

Evidence to support an anterior operation for mechanical instability may be found in the literature. Several authors contend that distraction alone is unable to restore canal dimensions reliably with a 50% or more encroachment or adequately clear retropulsed, compressive fragments.1,3,13,17,21–23,26,32,33 Reports of patients with persistent neural compression and deficit despite posterior reduc-
tion, who subsequently require an anterior procedure for definitive decompression, support this concern.4,6,12,13,15,32,38

Moreover, anterior and middle column failure can exceed the strength of transpedicular or claw-hook constructs, resulting in pullout or breakage. Several authors have reported failure to maintain correction of middle column compression due to compressed cancellous bone, despite distraction or pedicle screw instrumentation.1,6,22,23,32,42

In this study, loss of correction and progression of kyphosis from 10 to 20° did occur in one instance of posterior reduction. This represented the failure of a mixed pedicle screw and laminar claw-hook construct to withstand the anterior load. This case emphasizes the critical need for anterior load-bearing in burst fractures, even with apparently moderate structural failure.

**Fixation Techniques**

Anterior fixation devices for trauma are described in several series.5,8,20,23,25–28 Biomechanical studies have demonstrated improved construct rigidity with the Kaneda device after corpectomy and improved resistance to displacement with different angled screws.19,29 Anterior thoracic and lumbar plates appear indicated when pathological motion is suspected after anterior decompression, especially in the absence of posterior column disruption; these devices may also serve to prevent displacement of the reconstructive graft and to maintain spinal immobilization until the fusion heals.4,20,23,29 In this study, anterior plating was performed in all isolated anterior approaches and to secure graft position as indicated in combined procedures. No complications were encountered in their use and no anterior construct failed during our limited follow-up review.

Posterior reduction and stabilization of burst fractures was traditionally performed with hook-and-rod distraction or Luque instrumentation.1,3,6,8,11,13–15,17,18,20–23,31,41,42 However, these systems require the inclusion of two stable levels above and below the level of injury and may demonstrate limited capability to reduce and maintain canal alignment. Additionally, ratcheting of the upper hook in lumbar spine constructs may cause flexion as well as distraction with loss of lordosis and painful “flat-back” syndrome, which was seen in one of our patients after placement of a four-level lumbar construct.25,29

Increasingly, transpedicular screw fixation has been advocated for posterior stabilization.6,8,11,14,15,21,23,31,38,41,42 Transpedicular screws grip vertebrae with a long lever arm, creating a strong distractive force, and provide three-column fixation.10,15,19,29,43 Pedicle screw constructs may be safely limited to one level above and below unstable segments (thereby minimizing the length of the construct), can reduce translational displacement, preserve motion segments, and resist loads of any type.6,10,14,15,21,23,29,31,38,41,43

In a recent metaanalysis of the fracture literature, Dickman and colleagues17 reported a 99.4% fusion rate with pedicle screws and stated that “pedicle screws performed satisfactorily with respect to pain outcome, function, and complications.” Single-level pedicle screw fixation presently represents the preferred posterior fixation technique from T11–S1,30,23 and safe use of these instruments at higher levels in the thoracic spine is reported both in this series and others.31–43

**Timing of Surgery and Outcome**

No correlation between promptness of decompression and ultimate neurological outcome has been observed in most series, despite an interval of several days.2,3,6,8,11,14,23,30,33 Clohisy and coworkers’ reported a neurological advantage to operation within 48 hours in 14 patients; however, our reported mean interval of 4.6 days is in accordance with most authors.

As confirmed in this study, no deterioration in neurological status is expected for intact patients, and all incomplete grades have the potential for neurological and functional improvement if satisfactory decompression is achieved.2,5,8,11,14,18,23,25–27,30,33 Only one patient in our series, with complete motor deficit, did not improve.

Most patients returned to work, school, or household activity after rehabilitation. Patients remaining disabled in our series either had severe motor deficit or were incapacitated by pain after a compensated work injury. In our series, 74% of patients treated with anterior or combined technique returned to prior employment. This compares favorably with the recent data of Danisa, et al.,4 and Carl and associates,8 who reported 60% and 85% of patients returning to work, respectively, after posterior stabilization. Postoperative pain was minimal in 78% of our patients who underwent anterior and combined approaches, whereas patients who underwent posterior approaches had persistent pain. Danisa and colleagues8 also found increased pain relief after anterior procedures (67% with minimal pain vs. 35% after posterior operation), although this was not statistically significant. Our results suggest that correction of middle column compression with a strut graft may provide patients with the most secure structural result and, therefore, the best opportunity for long-term function and pain relief.

**Conclusions**

Operative criteria and techniques for thoracolumbar burst fractures remain controversial. In this study we have defined our selection criteria for anterior, posterior, and combined approaches and used standardized outcome scales to evaluate the results. The importance of anterior load bearing, using an allograft strut, was emphasized for the reconstruction of burst fractures with significant middle column compression (≥40% loss of vertebral height and canal compromise) or deformity (kyphosis ≥15°). Bilateral transpedicular decompression and stabilization were reserved for canal loss that was less than 40% and axial compression up to 40%. When a posterior approach was indicated, the transpedicular screw technique was preferred for optimal reduction strength and minimal construct length. Within the limitations of a retrospective series, we found that anterior decompression, strut grafting, and fixation effectively treated both neural compression and vertebral deformity, without evidence of significant structural complications. Successful functional and pain results followed these results in most patients.

**References**

3. C. L. Schnee and L. V. Ansell


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