Eur Spine J (1999) 8 : 495–500

ORIGINAL ARTICLE

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Short segment fixation of thoracolumbar burst fractures without fusion

Received: 24 February 1998
Revised: 1 March 1999
Accepted: 27 May 1999

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Abstract There continues to be controversy surrounding the management of thoracolumbar burst fractures. Numerous methods of fixation have been described for this injury, but to our knowledge, spinal fusion has always been part of the stabilising procedure, whether this involves an anterior or a posterior approach. Apart from an earlier publication from this centre, there have been no reports on the use of internal fixation without fusion for this type of fracture. The aim of the study was to determine the outcome of patients with thoracolumbar burst fractures who were treated with short segment pedicle screw fixation without fusion. This is a retrospective review of 28 consecutive patients who had short segment pedicle screw fixation of thoracolumbar burst fractures without fusion performed between 1990 and 1993. All patients underwent a clinical and radiological assessment by an independent observer. Outcome was measured using the Low Back Outcome Score.
The minimum follow-up period was 2 years (mean 3.1 years). Fifty percent of patients achieved an excellent result with the Low Back Outcome Score, while 12% were assessed as good, 20% fair and 16% obtained a poor result. The only significant factor affecting outcome was the influence of a compensation claim ($P < 0.05$). The implant failure rate (14% of patients) and the clinical outcome was similar to that from series where fusion had been performed in addition to pedicle screw fixation. The results of this study support the view that posterolateral bone grafting is not necessary when managing patients with thoracolumbar burst fractures by short segment pedicle screw fixation.

Key words Burst fractures · Outcome · Short segment fixation · Fusion

Introduction

There continues to be considerable controversy regarding the management of thoracolumbar burst fractures. Many authors feel that failure of the middle osteoligamentous complex is an indication for operative intervention [2, 6, 14, 20]. There have been numerous methods of internal fixation described for this injury, but to our knowledge spinal fusion has always been part of the stabilising procedure, whether this be via an anterior or posterior approach [1, 3, 7, 13, 15].

Since the establishment of the Spinal Injuries Unit at the Royal Adelaide Hospital in 1961, unstable thoracolumbar fractures have generally been managed by internal fixation without fusion. As with the management of most fractures in the appendicular skeleton, the rationale has been to use internal fixation as an aid to reduction in addition to maintaining bony alignment. Provided this reduction was achieved soon after injury, it was considered that sufficient bone and soft tissue healing would occur to obviate the need for bone grafting, as is the case with internal fixation for limb fractures. Our earlier experience with Knodt rods and Harrington distraction rods without fusion for the treatment of thoracolumbar and lumbar fractures [18] was considered to support this principle.

All fractures that were fixed had at least two column involvement according to the classification of Denis [5].

During the past 5 years, unstable thoracolumbar burst fractures, with or without neurological deficit, have been managed at our unit by short segment pedicle fixation (one level above and one level below the affected vertebrae) without fusion. The only exception to this practice has been in occasional cases with incomplete paraplegia where satisfactory reduction of retropulsed fragments could not be achieved by a posterior approach alone. In such instances it has been our practice to supplement short segment pedicle screw fixation with anterior decompression and strut grafting. We are unaware of any reports in the literature on the use of short segment fixation without fusion, a method of treatment that we consider to have significant potential advantages. The aim of this study was to evaluate the results of this procedure in patients with no neurological deficit.

Materials and methods

During a 3-year period from 1990 to 1993, 73 patients were admitted to our unit with a diagnosis of thoracolumbar burst fracture. Nineteen patients had an associated neurological deficit and were excluded from this review. Study inclusion was limited to neurologically intact patients who presented with a non-pathological burst fracture in the T12-L2 range, with CT evidence of retropulsed fragments from middle column disruption, and who were managed with internal fixation. The indications for fixation were kyphos > 20° and/or anterior body collapse > 50% in a patient. A total of 28 patients meeting these criteria were entered into the study. Four patients were excluded from analysis either because they were untraceable or were unwilling to attend for review, leaving 24 of the patients (86%) available for clinical and radiographic assessment.

The ratio of men to women was 2 : 1, with 16 male and 8 female patients. Mean age at the time of injury was 33.1 years (± 14.2, range 18–62). The majority of fractures resulted from motor vehicle accidents (75%), while 16% were due to a fall and 8% resulted from a direct blow. Levels fractured were T12 : 8, L1 : 12, L2 : 4.

Mean duration of hospitalisation was 12.4 days (± 6.3, range 8–35). The average time from admission to operation was 0.8 days. Following surgery there were on average 3.5 days before trunk control returned and mobilisation started. Implant removal, which took place between 6 and 12 months after the original procedures in 20 patients, involved an additional mean hospital stay of 3.4 days (± 1.6, range 2–6).

Management

After pedicle screws were inserted into the vertebrae above and below the fractured vertebra, fixation was achieved with connecting rods or plates producing distraction and slight lordosis. Fifteen patients had Steffee plates and screws (AcroMed), five patients were treated with Cotrel Dubousset (CD) screws and rods (Sofamor) and three patients had the AO Universal Spinal System (Synthes) implanted. No laminectomies or laminotomies were performed. No fusions were carried out, and in addition there was no attempt at bone grafting the vertebral body via the pedicle. Postoperatively the patients were managed with bed rest until they regained trunk control, and they were then allowed to mobilise without the use of any external support. Implants were routinely removed at 6 to 12 months following surgery, except in four patients, who declined.

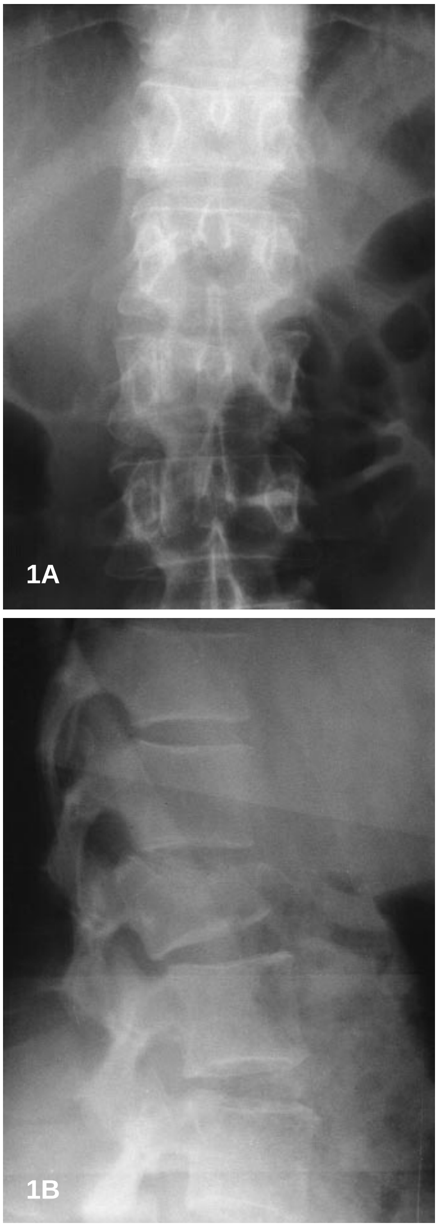
Clinical evaluation

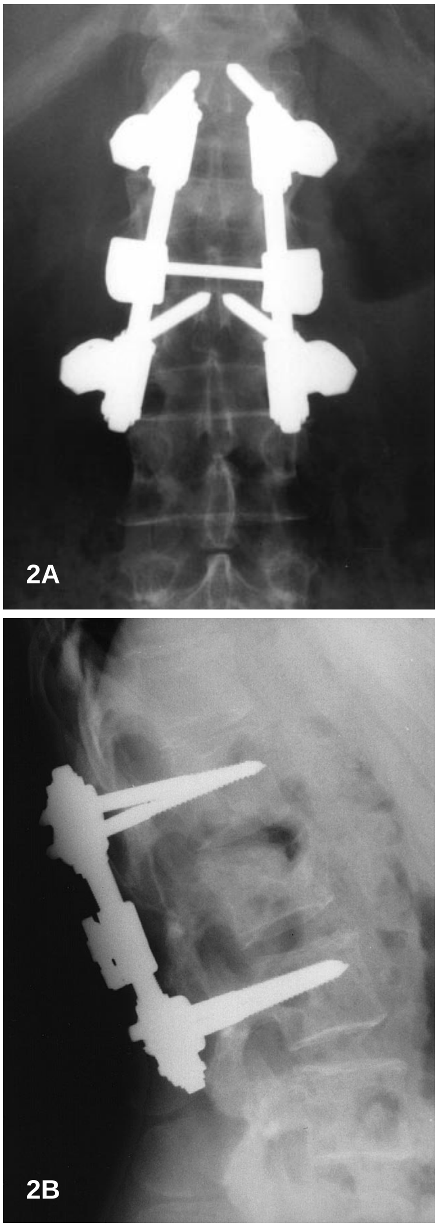
The patients were invited to attend a clinical and radiographic review by an independent observer (P.L.S.), who at no time had been involved in the patients' treatment.

The clinical assessment included completion of the Low Back Outcome Score (LBOS) devised by Greenough and Fraser [9]. In this scoring system, 13 factors including pain, employment status, sporting participation, rest required and activities of daily living are assessed, with pain and active pursuits being weighted to produce a maximum score of 75 (Table 1). The grading system used was 'ex-

Table 1 Low Back Outcome Score (LBOS)

Factor	Outcome	Points
Current pain (visual analogue scale)	7–10	0
	5–6	3
	3–4	6
	0–2	9
Employment (housewives related to previous abilities)	Unemployed	0
	Part-time	3
	Full-time, lighter	6
	Full-time, original	9
Domestic chores or "oddjobs"	None	0
	A few but not many	3
	Most or all but more slowly	6
	Normally	9
Sport/active social (dancing)	None	0
	Some – much less than before	3
	Almost as much as usual	6
	Back to previous level	9
Resting	Resting more than ½ a day	0
	Resting ½ the day	2
	Little rest needed occasionally	4
	No need to rest	6
Treatment or consultation	More than once a month	0
	About once a month	2
	Rarely	4
	Never	6
Analgesia	Several times each day	0
	Almost every day	2
	Occasionally	4
	Never	6
Sex life	Severely affected, impossible	0
	Moderately affected, difficult	2
	Mildly affected	4
	Unaffected	6
Sleeping, walking, sitting, travelling, dressing	Severely affected, impossible	0
	Moderately affected, difficult	1
	Mildly affected	2
	Unaffected	3





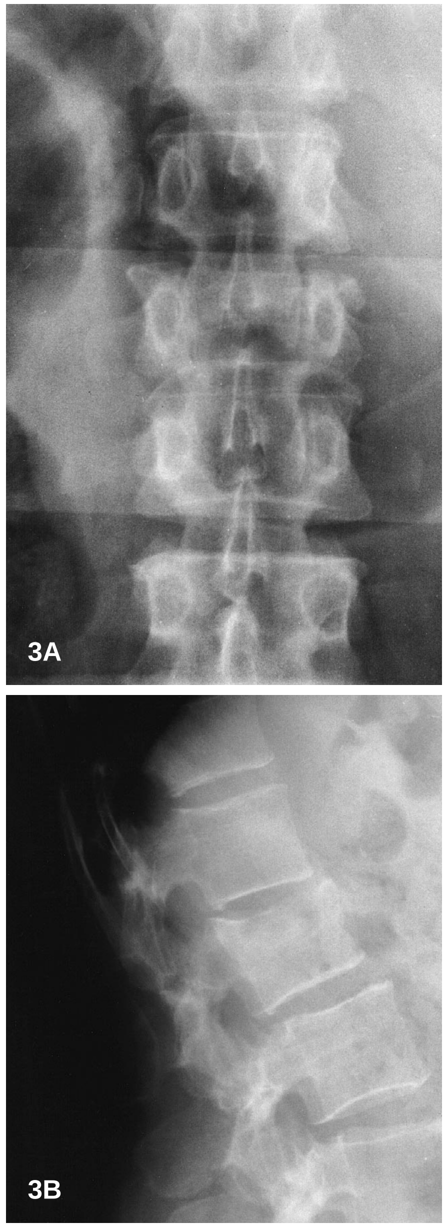


Fig. 1 **A** Anteroposterior (AP) and **B** lateral radiographs of burst L2

Fig. 2 **A** AP and **B** lateral radiographs of the fracture following fixation

Fig. 3 **A** AP and **B** lateral radiographs of the same fracture at follow-up 4 years following injury and 3 years after removal of the fixator

cellent' (65–75), 'good' (50–64), 'fair' (30–49) and 'poor' (0–30) [9]. The compensation status of patients was recorded.

Radiographic evaluation

All patients at the time of injury had plain radiographs and CT scans performed (Fig. 1), and these investigations were repeated within 1 week of fixation (Fig. 2). At the time of the independent review only plain radiographs were taken (Fig. 3). Analysis of lateral plain films included the measurement of the Cobb angle (through the adjacent vertebrae) and percentage anterior body collapse. From the CT scan, percentage narrowing of the mid-sagittal diameter of the spinal canal was calculated according to the formula adopted from Willen et al. [21].

Statistical analysis

The radiographic parameters were plotted against the LBOS result and Pearson's correlation coefficient calculated to determine the relationship of each variable to the result. The mean Low Back Outcome Score was calculated for compensation and non-compensation patients, the difference being assessed for significance by the Chi-square test.

Results

At review all patients had a minimum follow-up of 2 years, with a mean of 3.1 years. A satisfactory result as determined by the LBOS (Table 2) occurred in 20 patients, with four patients showing a poor result.

Descriptive statistics summarising the Cobb angle, percentage anterior body collapse and reduction in mid-sagittal diameter, at the time of injury, following fixation and at review, are given in Table 3. The Cobb angle, percentage loss of anterior body height and percentage loss of mid-sagittal canal diameter, at injury, post-fixation and at review, were correlated against the LBOS. There was no statistically significant correlation between any of the radiological parameters and results (Table 4).

Table 2 Results of the Low Back Outcome Score at review

Result	No. of patients	% of patients
Excellent (65–75 points)	12	50
Good (50–64 points)	3	12
Fair (30–49 points)	5	20
Poor (0–29 points)	4	16

Table 3 Summary of radiographic date at injury, post-surgery and at review

Radiographs	Mean	± SD	Min.	Max.
Cobb angle (°)				
At injury	20.75	9.4	7	39
Post-surgery	5.79	3.1	2	18
Review	13.9	7.6	5	42
Anterior body height loss (%)				
At injury	38.00	14.2	8	72
Post-surgery	16.12	7.1	0	38
Review	21.4	8.7	0	42
Loss of mid-sagittal diameter				
At injury	32.8	12.10	8	47
Post-surgery	21.6	9.1	0	42

Table 4 Correlation coefficients and significance of anatomical parameters and their relationship to LBOS

Factor	Correlation coefficient	Significance
Cobb angle		
At injury	0.15	NS
Post-fixation	0.24	NS
Review	0.21	NS
Anterior height loss		
At injury	0.12	NS
Post-fixation	0.22	NS
Review	0.3	NS
Mid-sagittal diameter		
At injury	0.18	NS
Post-fixation	0.10	NS

Table 5 Compensation status and mean LBOS

Compensation status	No. of patients	Mean LBOS
Claimants	12	45.1
Non-claimants	12	67.4

$P < 0.05$

Although there was a 15° average improvement of kyphosis post-fixation, loss of correction over time was nearly 8°, resulting in a 7° mean correction of kyphosis (Table 3). Like Lindsey and Dick [16], we also found that some of this loss of correction was due to loss of height of the upper disc spaces.

There were 12 patients claiming compensation, and this was the only factor found to have a significant correlation with outcome as measured by the LBOS (Table 5).

Complications

There were four implant failures due to screw breakage (three CD and one Steffee). There were no neurological complications related to surgery, or more specifically to pedicle screw placement. There were no wound infections. One patient needed further corrective surgery following removal of the fixation device, when she subsequently developed a kyphos of 42°. No other patients have needed surgery for back pain or deformity.

Discussion

The treatment of thoracolumbar burst fractures remains controversial. Conservative treatment still has its advocates and appears to yield acceptable results [17]. There is a trend towards short segment fixation either anteriorly or posteriorly [3, 13, 15, 20], with results reported to be superior to those obtained by conservative management. However, a comparison of results may be unreliable due to different methods of assessment of outcome [12]. The LBOS used in this review is a more objective method of assessment than is provided by subjective responses to questions on success. Using the LBOS, 62% of patients achieved an excellent or good result, which compares favourably with other reported series [1, 11, 17].

Our results demonstrated that after a substantial initial correction there was a gradual partial loss of alignment, largely due to loss of disc height, leaving an overall kyphosis correction of 7°. This loss of initial correction has been reported by other authors who have routinely fused the spine; some of them reporting a more marked correction loss than that in our series [3, 4, 16, 19]. Further loss of soft tissue support resulting from the increased exposure and tissue destruction required to perform a fusion is the likely explanation for any additional loss of correction when fusion is employed. Our mean follow-up was only 3.1 years, and it remains to be seen whether the deformity increases over time. We are, however, encouraged by our past experience of internal fixation without fusion [18] and the results of the current series to date.

None of the anatomical parameters measured at the time of injury, post-fixation or at review seem to have had any bearing on the final result. We are, however, unable to say from our study that radiographic parameters are unimportant in the decision regarding treatment. This group was preselected, with most having either a kyphotic deformity greater than 20° or more than 50% loss of anterior vertebral body height. Had these patients been treated conservatively then their outcomes may have been worse, as was our finding in an earlier series [18]. The lack of correlation of clinical results with bony radiographic parameters highlights the likely importance of the associated soft tissue on outcome. This feature is usually ignored in the literature as it is very difficult to quantify and measure.

The great advantage of internal fixation is a shorter hospital stay. Our mean stay was 12.5 days compared to 28.5 days in a group of conservatively treated patients [17], although a further mean stay of 3.4 days was required for implant removal. The lack of problems associated with implant retention beyond 2 years in four patients suggests that routine removal of these internal fixation devices may not be necessary.

We feel there are several advantages in not performing a posterior or posterolateral fusion. In our experience, carrying out such a fusion greatly extends the operating time and increases blood loss, often in critically injured patients. Bone grafting itself is not without complications: a long-term study reporting 37% of patients identified donor site pain as a problem 10 or more years after their operations [8]. Another potential advantage is that the facet joints are less disturbed adjacent to the fracture, with reduced surgical soft tissue stripping being required when a bed for the graft does not have to be prepared.

Failure of the implant is of concern, with four screw breakages occurring in our series. However, even in the presence of a solid fusion, pedicle screws can break and our implant failure rate is no higher than in other series where fusion has routinely been performed [3, 7].

We were a little surprised to find that the only factor to influence outcome was the presence of a compensation claim. Although the adverse effect of compensation on recovery has been well documented following low back injury in the workplace, this has only applied to patients without fractures [10]. We are not aware that compensation has previously been shown to be a factor in determining outcome following vertebral fractures, although Carl et al. [3] did comment that the four out of five people who did not return to work following instrumentation for burst fractures were Workman’s Compensation recipients. Clearly future studies of outcome after spinal trauma should allow for the adverse influence of compensation.

Conclusion

Short segment pedicle screw fixation of thoracolumbar fractures without fusion gives satisfactory results. We consider that routine posterior or posterolateral fusion is unnecessary in the operative management of these fractures.

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REVIEWER'S COMMENT

The authors are to be congratulated for their excellent work. The study results support the efficacy of the method, and the many advantages of not having to perform a fusion in these trauma cases speak for themselves. Any surgeon who has been doing the same will be happy to read this report and feel confirmed in their strategy. Once again a challenging new concept of spinal management has emanated from the Spinal Unit in Adelaide. Although the retrospective aspect of the study does not weaken it by any means, I hope that the authors, or someone else, will complete the work by performing a prospective, randomised trial comparing fused and unfused cases. The same outcome score should then be used and special attention given to the worker's compensation issue.

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