May 2010

Operative management of unstable thoracolumbar burst fractures

Mujahid Jamil Khattak
Russell's Hall Hospital NHS Foundation Trust, UK

Shakir Syed
Russell's Hall Hospital NHS Foundation Trust, UK

Riaz Hussain Lakdawala
Aga Khan University, riaz.lakdawala@aku.edu

Operative Management of Unstable Thoracolumbar Burst Fractures

Mujahid Jamil Khattak[1], Shakir Syed[1] and Riaz Hussain Lakdawala[2]

ABSTRACT

Operative management of unstable burst vertebral fractures is challenging and debatable. This study of such cases was conducted at the Aga Khan Hospital, Karachi from January 1998 to April 2003. All surgically managed spine injuries were reviewed from case notes and operative records. Clinical outcome was assessed by Hanover spine score and correction of kyphosis was measured for radiological assessment. The results were analyzed by Wilcoxon sign rank test for two related samples and p-value < 0.05 was considered significant. Ten patients were identified by inclusion criteria. There was statistically significant difference between mean pre-and postoperative Hanover spine score (p=0.008). Likewise, there was significant difference between mean immediate postoperative and final follow-up kyphosis. (p=0.006). Critical assessment of neurologic and structural extent of injury, proper pre-operative planning and surgical expertise can optimize the outcome of patients.

Key words: *Vertebal fracture. Surgery. Hanover spine score. Kyphosis.*

INTRODUCTION

Despite advances in techniques and instrumentation, optimal approach for treatment of disrupted spinal segments remains debatable.[1,2] Choosing the most appropriate technique, requires knowledge and ability to define the extent of injury as well as appreciation of rationale of treatment methods. The goals of surgical intervention are restoration of alignment, stabilization and improvement of neurological recovery without further damage. It is difficult to decide on a single surgical technique that can manage all injuries. The selection of surgical approach (anterior, posterior or combined), type of instrumentation and modes of reconstruction (bone grafts/cages) must be planned. Analysis of fracture, patient condition, limitations of working environment and shortcomings of instrumentation, a rationale decision making process should be used to maximize benefits and diminish risks.

This report describes the surgical management of burst thoracolumbar vertebral fractures.

METHODOLOGY

All surgically managed cases of burst thoracolumbar vertebral fractures were reviewed. Patients were identified through computerized medical record system. The criteria for instability was neurologic instability, a three column injury or a two column injury with major comminution (kyphosis > 30^{o}).[3] Stable fractures managed conservatively or pathologic fractures with operative intervention were excluded. Ten patients fulfilled the criteria. Outcome measures included, functional assessment by Hannover spine score.[4] Frankle grades of neurology were used as part of the Hanover spine score. Data before fracture were obtained to establish a pre-trauma functional level. At each follow-up, AP and lateral radiographs were obtained for radiological assessment. Degree of kyphosis was measured as described by Knight *et al.*[5]

Data were summarized using mean and standard deviation. Since most of the variables were not normally distributed, comparison of means was done using non-parametric test, i.e. Wilcoxon sign ranks test for two related samples. P-value < 0.05 was considered significant.

RESULTS

Patients and injury details along with surgical procedure are mentioned in Table I. The mean operative time was 4.2 hours with average blood loss of 900 ml. No intra-operative or immediate postoperative complications were noted. Mean hospital stay was 19 days. The range of follow-up was from 5 months to 60 months. One patient lost to follow-up in the immediate postoperative period. There was statistically significant difference (p=0.008) between mean pre-operative and post-operative Hanover spine score. Likewise, there was significant difference (p=0.006) between mean immediate postoperative and final follow-up kyphosis.

1 *Department of Orthopaedics, Russell's Hall Hospital, Dudley, West Midlands, Birmingham, United Kingdom.*
2 *Departmentnt of Orthopaedics. The Aga Khan University Hospital, Karachi.*

Correspondence: *Dr. Mujahid Jamil Khattak, Flat No.78, Isis House, Bushey Fields Road, Dudley, West Midlands, UK: DY12LU. E-mail: mujahid.jamil@dgoh.nhs.uk*

Received December 19, 2008, accepted January 14, 2010.

Figure 1 (a): MRI (case 5) showing injury to all three columns. Patient had incomplete conus medullaris lesion.

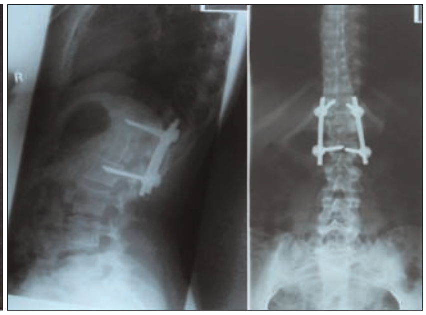

Figure 1 (b): Anterior decompression, fibular grafting and posterior stabilization.

DISCUSSION

The goals of operative intervention for thoracolumbar trauma are anatomic reduction rigid fixation and stabilization and neural decompression, whenever indicated. Different operative approaches were employed to obtain these goals in this series. Although mean postoperative drop in the Hanover spine score was significant, postoperative score was fairly high in most of the cases, except a few.

Case number 9 and 2 in Table I, had similar injuries, but the postoperative Hanover scores are different (86 versus 45). Although both patients had posterior instrumentation, the difference was short segment pedicle screws fixation, single level above and below the injured vertebra, in case 9, as compared to two levels above and below in case 2. Fixation levels need to be considered critically. Short segment fixation can attribute to loss of correction in the absence of anterior reconstruction (bone graft or cage) and high fatigue failure rates. Also, the case 9 had some residual pain in L2 dermatome, which was noted in the follow-up clinic. Pedicle screw fixation is technically demanding and has limitations and problems.[6] One should have reasonable training and expertise before practicing this system.

Another case with low functional score was case 7 in Table I. This patient had L1 burst fracture with neurogenic bladder (Frankle grade C). He was managed by short segment pedicle screw instrumentation only (D12-L1: one level above and below the injured level). Per operative kyphosis correction achieved was from 39 to 3 degrees. He had kyphosis of 8 degrees in the final follow-up evaluation (loss of 5 degrees). This patient still has bladder problem and his postoperative score at final follow-up was 42 (base line: 98). On retrospective review, we believe that anterior surgical approach might have resulted in a better outcome. The amount of bony comminution with the primary injury was extensive and failure to support the anterior column after posterior correction is associated with higher risk of loss of kyphosis as well as instrumentation failure when compared to a combined approach or anterior approach

Table I: Injury details, treatment and outcome of the patients.

Case No.	Age	Gender	Injury	Surgical procedure	Pre-operative Hanover spine score	Postoperative score-final follow	Pre-op Kyphosis	Immediate post-op Kyphosis	Final follow-up Kyphosis	Loss of Kyphosis
1	30	F	L2 burst fracture, incomplete parapresis below L3	Anterior decompression and instrumented fusion with iliac crest bone graft	98	85	30	-1	2	3
2	34	F	L1 burst fracture, normal neurology	Reduction and stabilization by posterior instrumentation	96	86	30	0	3	3
3	35	M	Double burst fracture at D12 and L1, with conus medullaris syndrome	Posterior stabilization, anterior decompression and fusion with bone graft	96	64	30	0	2	2
4	40	M	L1 burst fracture, normal neurology	Posterior stabilization and anterior reconstruction with bone graft	96	86	30	-2	1	2
5	24	F	L1 burst fracture with incomplete conus medullaris lesion	Posterior stabilization and anterior decompression and fusion with bone graft	96	88	35	0	3	3
6	48	M	L1 fracture with paraplegia	Posterior reduction and instrumentation D11-L3	97	64	45	4	7	3
7	26	M	L1 burst fracture with neurogenic bladder	Posterior reduction and instrumentation D12-L2	98	42	39	3	8	5
8	31	M	L3 burst fracture, normal neurology	Posterior reduction and instrumentation L2-L4	95	60	35	2	5	3
9	26	M	L1 burst fracture, normal neurology	Posterior reduction and instrumentation D12-L2	95	45	38	2	4	2
10	16	M	L1 burst fracture, normal neurology	Posterior reduction and instrumentation D12-L2	95	Lost to follow-up	41	4	Lost to follow-up	-

only for instrumentation and bone grafting.[7] To address the issue, load-sharing classification was developed, which quantify the amount of comminution of the injured vertebral segment.[8] This classification has been validated also in the clinical practice.[9] Another reason in this case is associated neurologic injury. Motor recovery and return of bowel and bladder function is more reliable after direct anterior decompression. The ligamentotaxis effect of indirect posterior decompression is based on integrity of Sharpey, fibers or annular ligament attachments to the displaced fracture fragments.[10] This technique may also be ineffective in the setting of higher canal compromise.[11] Considering the degree of comminution and the significant canal compromise (70%) in this patient, direct anterior decompression and reconstruction of the anterior column might have resulted in a better outcome. The outcome of this case can be compared with other cases in this series. Cases number 3 and 5, had better neurological outcome and therefore, higher postoperative functional scores after direct anterior decompression.

Another case to consider is case 4; this patient with normal neurology had anterior reconstruction by bone graft in addition to posterior instrumented stabilization. Anterior surgery was done for comminuted injured vertebral segment mentioned in load sharing classification. This patient had good functional score (86) postoperatively. Kyphosis is well-known criteria for the outcome assessment of spinal injuries. As it is balanced by lumbar hyperlordosis, this causes muscle strain and pain and loss of kyphosis with posterior instrumentation alone is well recognized.[12]

CONCLUSION

The treatment of thoracolumbar fractures is still evolving. Evolution is based on the understanding of spinal mechanics and instrumentation. Although, techniques may change, but treatment should be guided by well founded principles and detailed structural and neurological assessments. Surgical intervention should be used to preserve or improve neurologic function, reduce bone deformity and stabilize the spine for early mobilization of patients.

REFERENCES

1. Dai LY, Jiang LS, Jiang SD. Anterior-only stabilization using plating with bone structural autograft versus titanium mesh cages for two- or three-column thoracolumbar burst fractures: a prospective randomized study. *Spine* 2009; **34**:1429-35.
2. Zdeblick TA, Sasso RC, Vaccaro AR, Chapman JR, Harris MB. Surgical treatment of thoracolumbar fractures. *Instr Course Lect* 2009; **58**:639-44.
3. McCullen G, Vaccaro AR, Garfin SR. Thoracic and lumbar trauma: rationale for selecting the appropriate fusion technique. *Orthop Clin North Am* 1998; **29**:813-28.
4. Knop C, Fabian HF, Bastian L, Blauth M. Late results of thoracolumbar fractures after posterior instrumentation and transpedicular bone grafting. *Spine* 2001; **26**:88-99.
5. Knight RQ, Stornelli DP, Chan DP, Devanny JR, Jackson KV. Comparison of operative versus non-operative treatment of lumbar burst fractures. *Clin Orthop* 1993; **293**:112-21. Comment in: *Clin Orthop Relat Res* 1994; **306**:286.
6. Yuan HA, Garfin SR, Dickman CA, Mardjetko SM. A historical cohort study of pedicle screw fixation in thoracic, lumbar, and sacral spinal fusions. *Spine* 1994; **19**:2279S-2296S.
7. Kaneda K, Taneichi H, Abumi K, Hashimoto T, Satoh S, Fujiya M, *et al.* Anterior decompression and stabilization with the Kaneda device for thoracolumbar burst fracture associated with neurological deficits. *J Bone Joint Surg* 1997; **79**:69-83.
8. Moore KD, Gaines RW. Intraobserver reproducibility and interobserver reliability of the load sharing classification of spine fractures. *Spine* 1998.
9. Parker JW, Lane JR, Karaikovic EE, Gaines RW. Successful short-segment instrumentation and fusion for thoracolumbar spine fractures: a consecutive 41/2- year series. *Spine* 2000; **25**:1157-70.
10. Crutcher JP Jr, Anderson PA, King HA, Montesano PX. Indirect spinal canal decompression in patients with thoracolumbar burst fractures treated by posterior distraction rods. *J Spinal Disord* 1991; **4**:39-48.
11. Gertzbein SD, Crowe PJ, Fazl M, Schwartz M, Rowed D. Canal clearance in burst fractures using the AO internal fixater. *Spine* 1992; **17**:558-60.
12. Wang XY, Dai LY, Xu HZ, Chi YL. Kyphosis recurrence after posterior short-segment fixation in thoracolumbar burst fractures. *J Neurosurg Spine* 2008; **8**:246-54. Comment in: *J Neurosurg Spine* 2008; **9**:511.

.....☆.....