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Research Article

Functional outcome of minimally invasive posterior stabilisation in dorsal and lumbar spine fractures

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ABSTRACT

Background: Minimally invasive spinal surgery will be a highlight of operative approaches in the twenty-first century and already has been popularized worldwide. This procedure will provide surgical options that address several pathological conditions in the spinal column without producing the types of morbidity commonly seen in open surgical procedures. The objective was to assess the outcomes of minimally invasive posterior stabilization of dorsal and lumbar spine fractures.
Methods: This was a prospective study of twenty patients with dorsal or lumbar fractures who were admitted at Sri Ramachandra University. All patients having dorsal and lumbar spinal fractures with intact neurology were included in the study. All the patients underwent minimally invasive posterior stabilization by freehand technique. Functional outcomes were measured by VAS scale, ASIA scoring (neurology), and their ability to mobilize.
Results: The average duration of surgery was 85.50 minutes. The average blood loss in our study group was 77 ml. The average operation to mobilization time was 2.2 days. The average post-operative Cobb's angle was 0.6 degree of kyphosis. The average post-operative gain was 12 degree.
Conclusion: Minimally invasive percutaneous stabilization of the spine helps to minimize approach related morbidity and secondary iatrogenic soft tissue trauma. It enables early mobilization, which contributes to improved outcome.

Keywords: Minimally invasive, VAS, Cobb's index, Posterior stabilisation

INTRODUCTION

Minimally invasive spinal surgery will be a highlight of operative approaches in the twenty-first century and already has been popularized worldwide. This procedure will provide surgical options that address several pathological conditions in the spinal column without producing the types of morbidity commonly seen in open surgical procedures. We now are able to perform with minimally invasive techniques the same types of procedures that traditionally were performed as open surgery. These advanced procedures bring about important benefits in the patients' quality of life, which we believe to be the main goal of therapy. Aim of this study is to assess the outcomes of minimally invasive posterior stabilization of dorsal and lumbar spine fractures.

METHODS

This was a prospective study of patients with dorsal or lumbar fracture treated in Sri Ramachandra medical college. The inclusion criteria were patients having dorsal and lumbar spinal fractures with intact neurology. The exclusion criteria were patients with pathological fractures (Infective / neoplastic) patients with

neurological deficit and patients having fractures of the spine other than dorsal and lumbar region. Twenty two patients satisfied the above criteria's. Minimum follow up was two year. Two patients lost to follow up. Hence, we had twenty patients for observation and evaluation in this study.

Ages of the patients included in our study were from 19 years to 70 years with a mean age of 40 years. We have 14 male and 6 female patients. 6 patients had RTA, 11 had fall from height and 3 had miscellaneous (slip and fall, crush injury). In our study group, two patients had injury at D11, four patients at D12, six patients at L1, two patients each with at L2, L3 and L4. One patient had injury at D11 and D12, and one patient had injury at L2 and L3. Of the twenty patients, eleven patients (55%) had one or more associated injury. 3 patients had head injury, 2 had distal radius fracture, 1 had burns, while 5 had rib fracture.

Neurological evaluation done based on ASIA impairment scale.[1] All the patients in our study group were ASIA E. No neurological deterioration was observed in any patients. Standard radiographic workup of these patients consisted of plain antero-posterior and lateral radiographs in focus with the injured spinal segment extending at least two spine segments cranially and caudally and complete trauma series radiographs. Patients also underwent CT scan or MRI scan of the spine. Fractures were classified based on anatomical three-column model of spinal stability described by Denis.[2] Segmental Kyphosis was determined by measuring the Cobb's angle.[3] On admission, all patients indicated their preexisting and actual severity of pain on a Visual Analogue Scale (VAS pain score).

All the patients underwent minimally invasive posterior stabilization by freehand technique. The patients were followed up at 6 weeks, 3 months, 6 months, 12 months and annually thereafter. Functional outcomes were measured by VAS scale, ASIA scoring (neurology), and their ability to mobilize. Post-operative Kyphotic correction and its maintenance were assessed by comparing pre and post-operative radiographs.

RESULTS

The average duration of surgery was 85.50 minutes. The minimum time taken was 60 minutes and the maximum is 120 minutes. The average blood loss in our study group was 77 ml with a minimum of 50 ml and a maximum of 120 ml. The average operation to mobilization time was 2.2 days. The average pre-operative Cobb's angle in our study was 12.1 degree of kyphosis and the average post-operative Cobb's angle was 0.6 degree of kyphosis but these values were not taken into much consideration as the level of injury is not consistent at a single vertebral level (Table 1). The average post-operative gain was 12 degrees with a minimum gain of 5 degrees to a maximum gain of 21 degree.

Table 1: Cobb's angle and correction (in degrees).

Sr. No.	Pre op	Imm post op	12 month post op	24 month post op	Post op gain	Loss of gain
1	15	5	5	5	10	0
2	12	5	5	5	7	0
3	-13	-28	-28	-28	15	0
4	20	10	10	10	10	0
5	13	6	6	6	7	0
6	24	18	18	28	6	10
7	8	-4	-4	-4	12	0
8	12	0	0	0	12	0
9	9	-5	-5	-5	14	0
10	20	5	5	5	15	0
11	-16	-26	-26	-26	10	0
12	4	9	9	9	5	0
13	30	9	9	9	21	0
14	15	0	0	0	15	0
15	10	-10	-10	-10	20	0
16	16	2	2	2	14	0
17	20	4	4	4	16	0
18	10	0	0	0	10	0
19	3	-10	-10	-10	13	0
20	30	22	22	22	8	0
Average	12.1	0.6	0.6	1.1	12	0.5

Table 2: Visual analogue scale (VAS).

	Maximum	Minimum	Average
Pre op	8	6	7.3
Post op (2nd day)	3	1	1.95
Post op (6 months)	1	0	0.1
Post op (12 months)	1	0	0.05

Table 3: Complications.

Complication	No. of patients
Skin necrosis	1
Superficial infection	1
Screw pull out	1
Nil	17

DISCUSSION

The average intra operative blood loss in our study group was 77 ± 20.8 ml (range 50 - 120 ml). Isolated dorsal and lumbar fractures were associated with minimal blood loss (less than 70 ml) compared to those patients with associated injuries (more than 80 ml). Similar result was seen in a study done on minimally invasive techniques in dorsal and lumbar fracture management by Ringel et al.[4] where the average blood loss less than 100 ml whereas K Wood et al.[5] in his study had an average blood loss of 194 ml. In comparison with open techniques in the

management of dorsal and lumbar fractures, Li Yang Dai[6] in his study showed an average blood loss of 423.7 ± 72.8 ml (160 to 1200 ml). Similarly, in a study conducted by Rex AW et al.,[7] the mean blood loss was 316 ml (range 50 to 1200 ml). From this, it is clearly evident that minimally invasive techniques in the management of dorsal and lumbar fractures have significantly low blood loss as compared to open techniques.

The average duration of surgery in our study was 85.5 ± 17.006 minutes, the minimum time taken being 60 minutes and the maximum being 120 minutes. This variation in time duration was attributed to the technical difficulties encountered during some of the procedures. Similarly, in a study by Wild et al.,[8] the mean operative time was 87 minutes and in another study, Oliver I Schmidt et al.[9] showed a mean operative time of 47 minutes (SD 14.4) Studies on open techniques in the management of dorsal and lumbar fractures, Li Yang Dai et al.[6] and Rex AW et al.[7] have shown an average of 152 minutes (78 - 210 min) and 116 minutes (80 - 165 min) respectively. Wild et al.[8] reported (n=21) on consecutive non-randomized patients with dorsal and lumbar vertebral body fractures without neurological symptoms, which had been stabilized without any intervertebral body fusion and were examined retrospectively more than five years after trauma. He reported significantly lower blood loss in minimally invasive surgery. We, in our study found the mean operating time (85.5 min ± 17.006) to be lower in the minimal-invasive approach than the conventional pedicle screw instrumentation ranging from 81 min[8] to 240 min.

In our study, most of the patients are mobilized on the second post-operative day. The average time from operation to walking is 2.2 days. In the study conducted by Li Yang Dai[6] in a group of 36 patients, the mean operation to walking time is 3.7 ± 1.6 days (range 1 to 7 days). No significant difference was noted between minimally invasive and open procedures with respect to mobilization of patients. The average pain score before treatment of the injury as measured on the visual analogue score in our study was 7.3 (range 6 to 8). The mean pain score reduced to an average of 1.95 on the second post-operative day and at the final follow up, the mean VAS pain score was 0.05 (Table 2). At the final follow up, only one patient who had pullout of screw had a pain scale score of 1. In a study conducted on minimal invasive techniques, Rex AW et al.[7] found the mean pain level to be 2 of 10 on a Visual analogue scale at the time of last follow-up. In a study conducted by Li Yang Dai[6] on open short segment instrumentation for dorsal and lumbar fractures, the mean pain score at the last follow up as per VAS was 1.5 ± 1.3, (range 0 - 4)

The average Cobb's angle at the time of admission in our study group is 12.1° ± 11.7° (range -16° to 30°) (negative value indicates lordosis). The Cobb's angle was reduced to 0.6° ± 12.3° (-28° to 22°) immediately after surgery which increased to 1.1° ± 13.25° (-28° to 22°) at the time of last follow up. The average post-operative gain in Kyphotic angle was 12° (range 5° to 21°) and the mean loss of correction was 0.5° (range 0° - 10°). As per K Wood et al.[5] in their study, the average amount of Kyphosis is 10.1° (range, -10° to 25°) on admission and 5° (range -10° to 25°) at the time of discharge from the hospital. During the follow up period, this group lost an average of 8° (range -4° to 22°), resulting in an average Kyphosis at the time of the final follow-up examination of 13° (range, -3° to 42°).

In another study conducted by Li Yang Dai,[6] the average local Kyphosis angle at the time of admission is 18.7 ± 10.7° (range 2° to 30°). It was reduced to 0.5° ± 1° immediately after surgery which increased to 1.7° ± 1.3° (range -3° to 6°) at the time of latest follow up. The results of these studies were comparable with that of ours. Analyzing the results of our study and the above mentioned studies, it is clear that the results of minimal invasive and open techniques with respect to Kyphotic correction were comparable.

In our study, even though most of the patients were planned for discharge on the third post-operative day, patients' preference played a major role in determining their duration of stay in the hospital. Hence, this parameter is not taken for analysis in our study. Three of the twenty patients (15%) who were followed up for a minimum of two years had development of treatment related complications. One patient had development of marginal skin necrosis. The skin necrosis could have occurred as a result of soft tissue retractor usage in this patient. The problems associated with application of retractors have been documented in literature and the incidence of retractor related complications are high in open procedures of the spine (Kawaguchi et al.).[10,11] One patient developed superficial wound infection which necessitated iv antibiotics and delayed skin closure. In a study conducted by John E. O'Toole et al.,[12] it is shown that the incidence of surgical site infection can be more than 10% following open procedures and about 0.74% following minimally invasive posterior spinal fixation. Our study has revealed in infection rate of 5%.

One patient had screw pull out (Table 3) during the final follow-up and progression of Kyphosis of about 10^0 leading to loss of correction but no intervention (surgical or medical) was carried out for this patient since the screw pull out did not have any clinical consequence. None of our patients developed systemic complications as a result of the surgery or anesthesia. No patient developed deep infection or implant breakage and none of the patients required repeat surgery for any indication. Kim et al.[13] enrolled 19 patients in a prospective study to evaluate the morbidities related to minimally invasive spinal surgery. He observed less paraspinal muscle damage in percutaneous pedicle screw fixation techniques compared to open pedicle screw fixation to support the positive effects on postoperative trunk muscle performance. Assaker[14] reported (n=40) exceptionally

good results considering implant behavior and patient outcome during a mean follow up of 12 months in patients suffering from dorsal and lumbar fractures treated by minimally invasive posterior stabilization.

Although our outcome shows encouraging results and with easy intra operative handling of the sophisticated implant, some drawbacks have been detected. The minimal-invasive approach does not allow placement of cross-links, which would be the precondition for stabilization of longer-ranging and seriously unstable segments. Although compression handles allow for distraction and compression of the instrumented segment, the poly axial screw design directs compression / distraction forces to the posterior column, only. Therefore excessive reposition maneuvers were not feasible and sufficient reduction of the fracture should be achieved using optimized posture and manual reduction including e.g. axial leg tension or direct sagittal manipulation of the injured segment.

CONCLUSION

Minimally invasive percutaneous stabilization of the spine is a very useful technique. It helps to minimize approach related morbidity and secondary iatrogenic soft tissue trauma thereby providing good pain relief in the immediate postoperative phase as evidenced by VAS score. It enables early mobilization, which contributes to improved outcome regarding pulmonary or thrombo-embolic complications, especially in geriatric patients. Local wound infection (1 out of 20) and implant failure (1 out of 20) rates with this technique are lower than or in the range of reports using conventional posterior spinal instrumentation.

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REFERENCES

1. Dewald RL. Burst fractures of the thoracic and lumbar spine. Clin Orthop. 1984;189:150-61.
2. Heyde CE, Ertel W, Kayser R. Management of spine injuries in polytraumatized patients. Orthop. 2005 Sep;34(9):889-905.
3. Levin PE. Fractures, dislocations, ligamentous injuries. In: Browner BD, Jupiter JB, Levine AM, Trafton PG, eds. Skeletal Trauma. 2nd ed. Philadelphia: WB Saunders Co; 1998: 841-842, 947-1027.
4. Ringel F, Stoffel M et al. minimally invasive transmuscular pedicle screw fixation of the thoracic and lumbar spine. Neurosurg. 2006;59:361-7.
5. Wood K, Butterman A et al. Operative compared with non-operative treatment of a thoracolumbar burst fracture without neurological deficit: a prospective, randomized study. J Bone Joint Surg Am. 2003;85:773-81.
6. Li-Yang Dai, Lei-Sheng Jiang et al Posterior Short-Segment Fixation with or without fusion for thoracolumbar burst fractures. A five to seven-year prospective randomized study. J Bone Joint Surg Am. 2009;91:1033-41.
7. Rex AW, Marco et al. Thoracolumbar burst fractures treated with posterior decompression and pedicle screw. J Bone Joint Surg. 2009 Jan;91A(1):20-8.
8. Wild MH, Glees M, Plieschnegger C, Wenda K. Five-year follow-up examination after purely minimally invasive posterior stabilization of thoracolumbar fractures: a comparison of minimally invasive percutaneously and conventionally open treated patients. Arch Orthop Trauma Surg. 2007;127:335-43.
9. Oliver I Schmidt, Sergej Strasser et al. Role of early minimal-invasive spine fixation in acute thoracic and lumbar spine trauma. Indian J Orthop. 2007 Oct-Dec;41(4):374-80.
10. Kawaguchi Y, Matsui H, Tsuji H. Back muscle injury after posterior lumbar spine surgery part 2: histologic and histochemical analyses in humans. Spine. 1994;19:2598-602.
11. Kawaguchi Y, Matsui H, Tsuji H. Back muscle injury after posterior lumbar spine surgery: a histologic and enzymatic analysis. Spine. 1996;21:941-4.
12. John E. O'Toole, Kurt M. Eichholz. Surgical site infection rates after minimally invasive spinal surgery. J Neurosurg Spine. 2009 Oct;11(4):471-6.
13. Kim DY, Lee SH, Chung SK, Lee HY. Comparison of multifidus muscle atrophy and trunk extension muscle strength: Percutaneous versus open pedicle screw fixation. Spine. 2005;30:123-9.
14. Assaker R. The use of minimal access spinal techniques for the management of thoracolumbar trauma. In: Assaker R, eds. Eurospine. Spain: Barcelona; 2005.

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