

Original Research Article

Evaluation of correction of kyphotic deformity in dorso-lumbar spinal injuries by posterior stabilization with pedicular screw rod fixation

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ABSTRACT

Background: Acute injury to dorso-lumbar spine is the second most frequent site after cervical spine in adults. The injury, although not associated with high mortality, causes severe morbidity. The management of the traumatic dorso-lumbar spine injuries has improved considerably in the last few years. The objective of the study was to evaluate correction of kyphotic deformity in dorso-lumbar spinal injuries by posterior stabilization with pedicular screw rod fixation.

Methods: The study includes 52 patients with dorso-lumbar spinal injuries with or without neurological deficit treated between 2006 and 2014. Pre and postoperative kyphosis was measured by Cobb's method on plain radiographs. Pre and postoperative neurological status was evaluated based on Frankel's classification. All un-stable dorso-lumbar spine injuries where two or more columns are involved on X-ray and CT scan were included in the present study.

Results: Majority of the patients were in the age group of 20-30 years (38.5%) followed by 31-40 years (30.8%). Males were more than females. The most common mode of injury was road traffic injury in 71.2% of the cases. The most common level of injury was at L1 in 28.8% of the cases followed by at level D12 in 25% of the cases. In all the groups the mean kyphosis angle is reduced significantly. Overall the improvement rate was 94.2% and failure rate was only 5.8%.

Conclusions: In conclusion the posterior reduction and internal fixation is a useful procedure in the treatment of the acute injuries of the dorsolumbar spine.

Keywords: Posterior reduction, Internal fixation, Acute injuries, Spine

INTRODUCTION

Acute injury to dorso-lumbar spine is the second most frequent site after cervical spine in adults. The injury, although not associated with high mortality, causes severe morbidity.

The management of the traumatic dorso-lumbar spine injuries has improved considerably in the last few years. The advent of Moss-Miami screw and rod system has improved the out come of these patients. The Moss-

Miami screw and rod system not only stabilizes the three columns of the spine but also corrects the deformity in sagittal and coronal planes.¹

Injury to dorso-lumbar spine segment is frequent. It is not associated with mortality but morbidity is not unusual.¹ Majority of injuries are unstable burst fractures due to axial loading.² More than three fourths of the fractures are associated with neurological damage.³ Decompression followed by stabilization is advised to prevent progressive kyphosis and neurologic deficit.^{2,4}

The management of injuries to dorso-lumbar spine is controversial. Both anterior and posterior approaches to spine are equally effective and there are no differences in the neurological, economic activity or functional pain outcome with either of approaches.^{5,6} The anterior approach achieves more complete and reliable decompression with inter body fusion. It has better canal clearance than the posterior approach. However, it needs a trans-thoracic and retroperitoneal approach which causes more morbidity with greater risk to the patient.

Posterior approach with internal fixation is a standard procedure for stabilizing the dorso-lumbar spine injuries.^{7,8} It uses the simple principle of distraction or compression on cantilever bending construct. It is recommended for emergency decompression and fixation of unstable fractures. It has shorter duration of surgery and lesser blood loss.⁵ Posterior approaches are also used for repair of dural lacerations.² This has lower hospital cost, and lower complication rate.⁵

Two major disadvantages of posterior approach are insufficient spinal canal clearance, and frequent failure of the pedicular screw fixation.^{9, 10} The rate of pedicular screw fixation failure has come down substantially with the improvement in the design of the screw and surgeons technique.

The long rod and short fusion construct are more effective for all fracture types than short rod and fusion construct. But it leads to wider immobilization of normal segment.¹¹ It also requires a longer surgical exposure and more surgical time.

This article evaluates the amount of kyphosis correction obtained with the Moss Miami pedicular screw and rod system in post-traumatic kyphotic deformity of dorso-lumbar spine.

METHODS

The study includes 52 patients with dorso-lumbar spinal injuries with or without neurological deficit treated between 2006 and 2014 at Department of Orthopedics, Gandhi Medical College Secunderabad and Malla Reddy Institute of Medical Sciences Hyderabad.

Sample size

During the study period, it was possible to include 52 patients as per the criteria.

Pre and post operative kyphosis was measured by Cobb's method on plain radiographs. Pre and post operative neurological status was evaluated based on Frankel's classification. All un-stable dorso-lumbar spine injuries where two or more columns are involved on x-ray and CT scan were included in the present study.

The patients were categorized into three groups based on the pre-operative kyphotic angle. Group 1: Kyphosis >20 degrees,

Group 2: Kyphosis 10 to 20 degrees

Group 3: Kyphosis <10 degrees

Correction and stabilization using MOSS-MIAMI rod and screw system was done between 7 and 10 days from the day of injury depending on the patient's general condition.

Surgery was done in prone position, under general anaesthesia. A midline incision was given and para spinal muscles separated from spinous processes and laminae. Pedicular screws were introduced in the normal vertebra above and below the injured vertebra. Decompressive laminectomy was performed when there was internal gibbus at the injured level after connecting a connecting rod to pedicle screws on one side to prevent instability while doing decompression. The internal gibbus was corrected by gently pushing the fractured fragments forward with dural retractor. The kyphosis was corrected by application of connecting rods in distraction mode. No bone grafting procedures were done. In all cases, no dural suturing was done as there was no dural tear and CSF leak in any of the cases. Wounds were closed after keeping a closed suction drain. Patients were mobilized as soon as they were comfortable using Taylor's brace. Initial few surgeries were done using stainless steel pedicular screw rods of make Adlers, because of the low cost. Later titanium screw rods of GESCO were used as the authorities' permitted higher expenditure. Initial pedicular screws of Adlers make had innie-outie double locking set screws for connecting rods to the screws. Titanium pedicular screws, make GESCO were having single locking set screws. The patients were followed up at 6 weeks, 3 months 6 months and 1 year. The kyphotic angle and neurological deficit were evaluated at each visit.

Statistical analysis

The data was entered in the Microsoft Excel worksheet and analyzed using proportions.

RESULTS

Maximum patients were in group I i.e. 42.3% followed by group II i.e. 34.6% and least was in group III i.e. 23.1%. There were no patients in Frankel grade A and Frankel grade E for all the groups of patients. From Group I there were 10 patients in Frankel grade A, 8 patients in Frankel grade C and 4 patients in Frankel grade D. From group II there were 6 patients in Frankel grade A, 9 patients in Frankel grade C and 3 patients in Frankel grade D.

Table 1: Group wise and grade wise distribution of patients

Group	No of patients (%)	Frankel grade A (%)	Frankel grade B (%)	Frankel grade C (%)	Frankel Grade D (%)	Frankel grade E
I > 20^o	22 (42.3)	10 (45.5)	0	8 (36.4)	4 (18.2)	0
II 10 to 20^o	18 (34.6)	6 (33.3)	0	9 (50)	3 (16.7)	0
III < 10^o	12 (23.1)	0	0	6 (50)	6 (50)	0

Table 2: Age wise distribution of study subjects.

Age (years)	Group I		Group II		Group III		Total	
	Number	%	Number	%	Number	%	Number	%
20-30	9	40.9	5	27.8	6	50	20	38.5
31-40	7	31.8	6	33.3	3	25	16	30.8
41-50	5	22.7	5	27.8	3	25	13	25
51-60	1	4.6	2	11.1	0	0	3	5.7
Total	22	42.3	18	34.6	12	23.1	52	100

Table 3: Sex wise distribution of study subjects.

Sex	Group I		Group II		Group III		Total	
	Number	%	Number	%	Number	%	Number	%
Male	12	54.5	12	66.7	6	50	30	57.7
Female	10	45.5	6	33.3	6	50	22	42.3
Total	22	42.3	18	34.6	12	23.1	52	100

Table 4: Mode of injury wise distribution of study subjects.

Mode of injury	Group I		Group II		Group III		Total	
	Number	%	Number	%	Number	%	Number	%
Road traffic injury	15	68.2	13	72.2	9	75	37	71.2
Fall	7	31.8	5	27.8	3	25	15	28.8
Total	22	42.3	18	34.6	12	23.1	52	100

Table 5: Level of injury wise distribution of study subjects.

Level of injury	Group I		Group II		Group III		Total	
	Number	%	Number	%	Number	%	Number	%
L1	6	27.3	5	27.8	4	33.3	15	28.8
L2	4	18.2	3	16.7	3	25	10	19.2
L3	3	13.6	1	5.6	3	25	7	13.5
L4	0	0	1	5.6	0	0	1	1.9
D6	1	4.5	0	0	0	0	1	1.9
D9	0	0	1	5.6	0	0	1	1.9
D11	2	9.1	2	11.1	0	0	4	7.7
D12	6	27.3	5	27.8	2	16.7	13	25
Total	22	42.3	18	34.6	12	23.1	52	100

Majority of the patients were in the age group of 20-30 years (38.5%) followed by 31-40 years (30.8%). As the age increased number of patients decreased. Only 3 patients were present in the age group of 51-60 years. Similar trend was found for all patients from all groups.

Males were more than females. In group I there were 12 males and 10 females. In group II there were 12 males and only 6 females. In group III there were equal number of males and females i.e. six each.

Table 6: Mean kyphosis angle changes (values in mean±2SD).

Stage	Group I (n=22)	Group II (n=18)	Group III (n=12)
Pre-operative	24.3±2.8	14.2±2.1	8.3±1.2
Post operative	7.3±4.2	4.2±0.9	2.8±1.1
Mean change	16.7±5.3	10±2.3	5.4±1.8
Final angle	7.3±4	4.2±0.9	2.9±0.9

Table 7: Improvement in the patient in each group.

Improvement	Group I		Group II		Group III		Total	
	Number	%	Number	%	Number	%	Number	%
Yes	19	86.4	18	100	12	100	49	94.2
No	03	13.6	0	0	0	0	03	5.8
Total	22	42.3	18	34.6	12	23.1	52	100

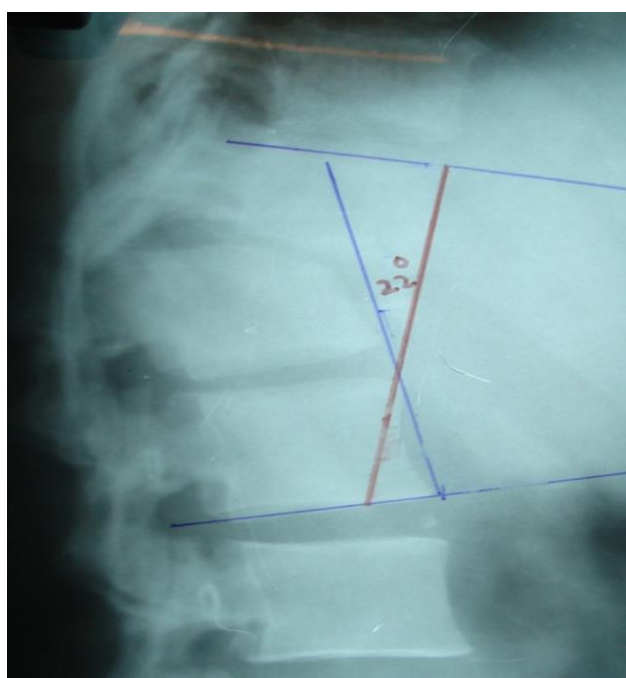


Figure 1: Pre-operative DL spine injury.

The most common mode of injury was road traffic injury in 71.2% of the cases, while fall constituted only 28.8% of the total cases. In group I also there were 68.2% of injuries due to RTA, in group II there were 72.2% of the injuries due to RTA and in group III there were 75% of the injuries due to RTA.

The most common level of injury was at L1 in 28.8% of the cases followed by at level D12 in 25% of the cases. Third most common level of injury was at the level of L2. There was one case each of injury at levels of L4, D6, D9. In group I, there were no cases of injury at L4 level. In group II there were no cases of injury at D6 level and in group III, there were no cases of injury at levels of L4, D6, D9 and D11.

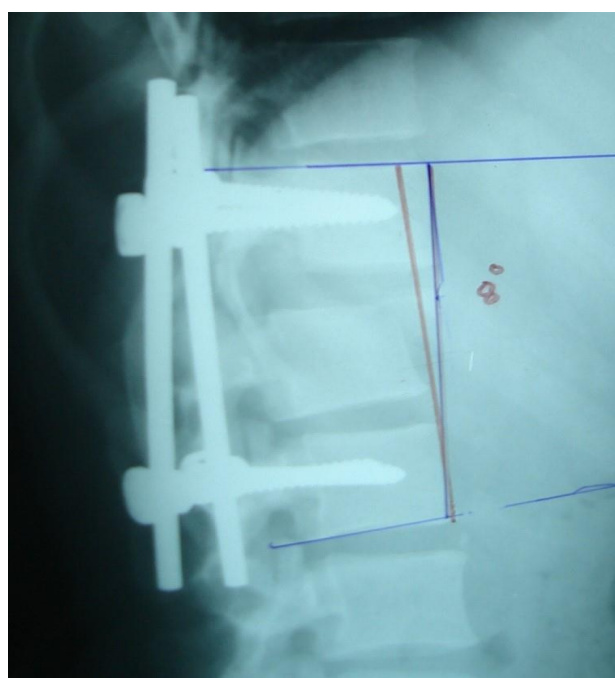


Figure 2: Post-operative DL spine injury.

In all the groups the mean kyphosis angle reduced to significantly. The mean change was more in group I patients compared to the patients in group II, and group III. Least mean change was found in group III patients. But the final angle was significantly lesser in group III patients.

There was 100% improvement in the patients from group II and III. In group I patients 3 patients (13.6%) did not show any improvement. Overall the improvement rate was 94.2% and failure rate was only 5.8%.

DISCUSSION

In the present study the kyphosis is corrected and maintained by posterior approach, pedical screws and

application of connecting rods in distraction mode. The intermediate articular process is used as fulcrum.

We used pedicular screw rod system of MOSS-MIAMI because of the biomechanical stability it gives to the construct, by stabilizing the three columns of the spine and correcting the spinal deformity in both coronal and sagittal planes. This system is a low profile, smaller dimension instrumentation with top opening in the pedicular screws for easy application of rods

In our study a 'posterior alone' approach with short segment fixation in majority of the cases was used, but in two cases, long segment fixation was used where more than one adjacent vertebra were involved. We did not use combined anterior and posterior fixation in any of our cases. Though we stabilized one case of L1 and one case of L2 fractures by corpectomy and cylindrical mesh cage fixation and supported by pedicular screws applied to the proximal and distal vertebral bodies anteriorly and connected by rods as they presented late (about 2 to 3 months after injury and with cauda equina syndrome). These two cases are not included in the study.

The short segment fixation has the advantage of immobilizing minimal motion segment; specially an advantage in lumbar segment, where with long segment fixation one may develop flat back syndrome. The pedicular screw rod fixation is a rigid construct that permits short segment fixation. Operative time, blood loss and radiation exposure under C arm are also minimized with short segment fixation. Moon et al demonstrated the advantage of short segment fixation without posterolateral fusion.¹¹

We found no difference in long and short segment fixation regarding correction of kyphosis at the fractured level. Two cases where short segment fixation was used using one pedicular screw in indexed vertebra achieved increase in vertebral height and good correction of kyphosis. Baaz et al observed "Adding an index-level screw to the short-segment construct significantly improved stability during flexion and lateral bending; there was no significant improvement in stability when an index-level screw was added to the long-segment construct."¹²

Bruno et al in their biomechanical study on thoracic spine fixation observed –"Thoracic short-segment fixation provides significantly less stability than long-segment fixation for the injury studied.¹³ Adding a cross-link to short fixation improved stability only during axial rotation. Adding a screw at the fracture site improved short-segment stability by an average of 25%.¹³

We did decompressive laminectomy at fractured level whenever there was neurological deficit and canal encroachment. We pushed forward the retro pulsed bone with dural retractor gently whenever feasible. In all these cases a crosslink was used to further strengthen the

construct. Remodeling will occur if there is residual narrowing.¹⁴

We did not use any additional bone graft in any of these cases. When the surgery is performed in the first few days with minimal stripping of soft tissue no additional bone grafting is necessary. Bone grafting has its own disadvantages such as donor site pain; transpedicular bone graft may further compromise canal by displacing fragment. Preparation for bone grafting bed may strip the facet capsule and other soft tissue adjacent to the fractures site causing instability. Minimal soft tissue stripping has the advantage of preserving vascularity around the fractured vertebra contributing for healing.²

Lee et al concluded that postoperative compliance for delayed ambulation is the key stone to the success of short- segment fixation of thoraco-lumbar spine fractures treated by pedicle screw instrumentation without bone grafting.¹⁵ We mobilized the patients to sitting and standing usually after 10 days after suture removal, though turning in bed was allowed from the same PO day.¹⁵

There were two implant failures during follow up with loss of correction in one year. The implant failure was seen in our earlier cases where we use steel implants. In these two cases the failure was at screw rod junction.

The rate of correction was greater in group III which had least initial kyphosis than in group I and II. Neurologic deficit also was less severe in group III and improved to normal functionality in majority of the cases. Zhouming Deng et al¹⁶ in their study of burst fractures of thoraco-lumbar spine treated with short segment fixation without fusion obtained kyphotic correction from pre-op level of 17.2 degree (± 6.87 degrees) to post- op level of 8.42 degree (± 4.99 degrees)- $p < 0.01$ which was significant.¹⁶

In our study, we found that rate of correction was better in group III than in other groups indicating lesser the initial kyphosis better is the correction. Also in the group III neurological deficit was not severe and prognosis is better because of more number of patient's recovered normal function. Majority of group were burst fractures with two column involvements and were classified as unstable even though they were having less pre-op kyphosis. We have not found any loss of correction in the follow up since we did not remove the implant in any case unless there was failure of the implant.

Jeon et al in their study observed the beneficial effects of implant removal once the fusion has been established as it alleviated pain and disability due to restoration of segmental movement angle after implant removal.¹⁷

CONCLUSION

The 'posterior alone' approach, with short segment fixation gives satisfactory results. There was no

difference in long segment fixation and short segment fixation in correction of kyphosis. Cross-linking of the connecting rods was found to increase the strength of the construct. The rate of correction was more in group III patients where the initial kyphotic angle was less. In conclusion the posterior reduction and internal fixation is a useful procedure in the treatment of the acute injuries of the dorsolumbar spine.

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Ethical approval: The study was approved by the institutional ethics committee

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