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Original Research Article

Study of functional outcome of dorsolumbar spine fractures treated with minimal invasive spine surgery

Anant Nathrao Gaikwad[1], Pravin D Deokate[1,*], Minish Katkar[1], Sushilkumar Mane[1]

[1]*Dept. of Orthopedics, B.J. Govt. Medical College, Pune, Maharashtra, India*

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ABSTRACT

Background: Spinal trauma is a common problem in modern Orthopedics. Spine surgery has recently been transformed significantly by the growth of minimally invasive surgery (MIS). Easily acceptable to patients as less invasive with smaller incisions, MIS is often perceived as superior to traditional open spine surgery. This study aims to study the functional outcome of minimally invasive surgery (MIS) in posterior thoracolumbar instrumentation in spine fractures.

Materials and Methods: Present study was prospective in nature conducted among 35 patients. All patients fulfilling inclusion criteria and exclusion criteria were taken up for the study. Study was carried out over a period of 1.5 years.

Results: Majority of the patients was in the age group of 30-50 years and most of them were male. Mean VAS score & ODI functional outcome scores significantly reduced after MIS. Incidence of complications after MIS was 5.71%. 86% patients had excellent to good outcome after MIS according to McNab criteria.

Conclusion: Minimal invasive surgery is safe and effective procedure with minimal complications and good post-operative outcome.

1. Introduction

Spinal trauma is a common problem in modern Orthopedics.[1] Traumatic fractures of the thoracolumbar spine, especially the thoracolumbar junction (T10–L2), are the most common fractures of the spinal column. Thoracolumbar fractures constitute about 30-60%[2] of all spinal injuries. Among this 60% of injuries are between T12-L2.[2]

The characteristic findings associated with the fractures include vertebral body comminution, kyphotic deformity, and canal occlusion caused by retropulsion of the fracture segment, edema of spinal cord which may produce a neurological deficit. Radiographs are the basic investigation while computed tomography (CT) scan provides information on the extent of bony injury and magnetic resonance imaging (MRI) shows injury to the spinal cord and soft tissue structures.

There are both operative[3,4] and non-operative approach[5–7] for the management of such cases. Prompt surgical stabilization allows immediate mobilization, earlier rehabilitation and better restoration of sagittal alignment.[8] Surgical management of unstable thoracolumbar fractures traditionally involves posterior pedicle screw fixation, with pedicle screws at the levels immediately adjacent to the fractured vertebral body. A common surgical goal is to obtain the most stable fixation with fusion of few segments possible.

Spine surgery has recently been transformed significantly by the growth of minimally invasive surgery (MIS). Easily acceptable to patients as less invasive with smaller incisions, MIS is often perceived as superior to traditional open

* *Corresponding author*.
E-mail address: anantgaikwad34@gmail.com (P. D. Deokate).

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spine surgery. This study aims to study the functional outcome of minimally invasive surgery (MIS) in posterior thoracolumbar instrumentation in spine fractures and to evaluate the perioperative outcome and complications of minimal invasive spine surgery.[9–11]

2. Objectives

1. To evaluate the functional outcomes of dorsolumbar spine fractures treated with minimal invasive surgery.
2. To determine the complications of post minimal invasive spine surgery.

3. Materials and Methods

This was a facility based prospective observational study, protocol of which was approved by the Institutional Ethical committee of the medical college. Written informed consent was taken from all study subjects.

Patient of Skeletally mature men and women (> 18 years), Traumatic fractures of the thoracolumbar junction without neurodeficency, & willing to participate in the study were included. All consecutive patients fulfilling inclusion and exclusion criteria were taken up for the study until the required sample size was fulfilled. Sampling method used was universal. Study was carried out over a period of 1.5 years from January 202 to June 202. Exclusion criteria were Children and adolescent patients <18 years, patients treated conservatively without surgery or fractures with neurodeficency, patients who are medically unfit for surgery & with other injuries interfering with rehabilitation, patients with head injury or cervical spine fractures.

All cases were analyzed as regard to the history, clinical presentation, routine investigations were carried out in order to get fitness for surgery. History of trauma was evaluated and also any significant medical and surgical history. Detail neurological examination was done after which the patient was subjected to radiograph- cervical / thoracic / lumbar spine, CT — cervical / thoracic / lumbar spine & MRI spine—cervical / thoracic / lumbar spine based on history.

Data was collected in pre-structured proforma (Annexure I- case record sheet) which was pilot tested and after ensuring it's validity. The data collected was then analyzed by appropriate test of significance.

Sample size was calculated with n = [DEFF*Np(1-p)]/ [$(d^2/Z^2_{1-\alpha/2}$*(N-1)+p*(1-p)] using OPENEPI software version 3.

In a study by Babak Saravi et al[12] (2022) titled One-Year Clinical Outcomes of Minimal-Invasive Dorsal Percutaneous Fixation of Thoracolumbar Spine Fractures, found the incidence of complication was 13.2%, considering this proportion & 12% absolute error, at 95% confidence interval, sample size came out to be 31 but for convenience of calculation we have rounded up the figure to 35.

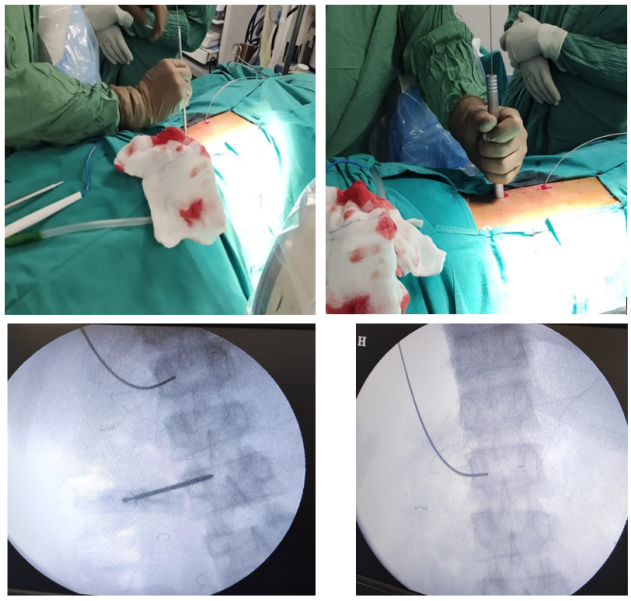

Fig. 1: Guide wire placement after identification of pedicle

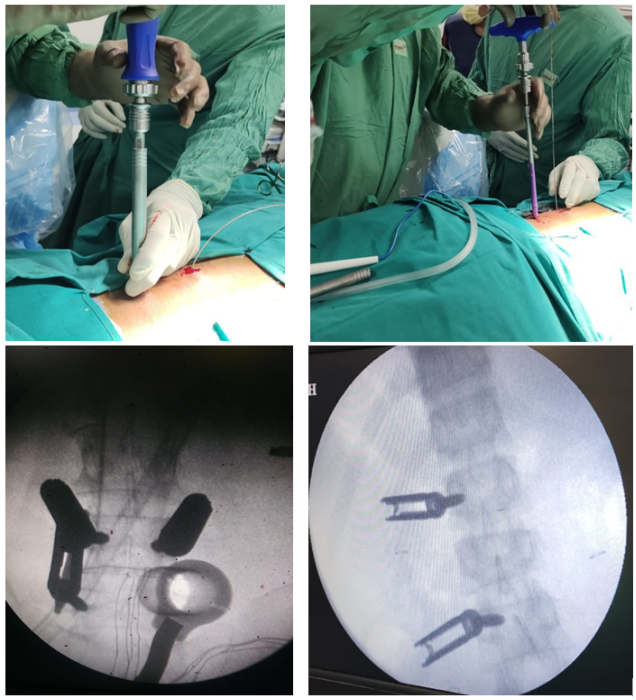

Fig. 2: Pedicle screw placement

Fig. 3: Distraction and rod placement

Fig. 4: Multiple minimal incisions taken for surgery

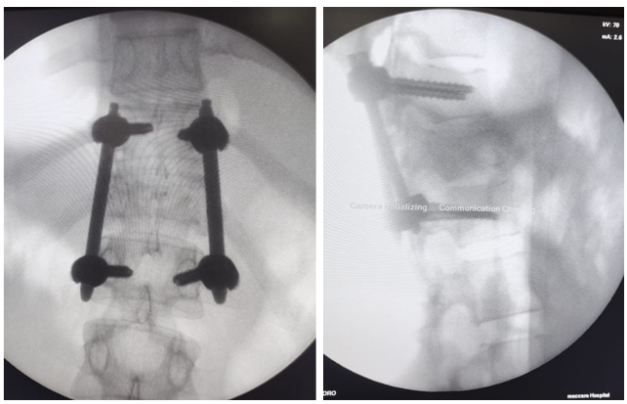

Fig. 5: Pedicle screws inserted and fixed with longitudinal rods

4. Surgical Procedure

All the surgeries were performed under general anesthesia with endotracheal tube taped securely. Patients positioned prone over the bolsters under the chest and pelvis, with the abdomen hanging free, to reduce excessive intra-operative bleeding and to achieve a significant initial reduction of the spinal fracture. Image intensifier is used to identify the fracture level and fracture reduction.

4.1. Technique for Minimal Invasive Pedicle Screw Placement

Sterile draping done, epinephrine 1:500,000 infiltrated in the paraspinal muscle region to achieve hemostasis. The fractured level is identified using C-arm fluoroscopy. The anteroposterior (AP) view is then used. A good AP image would show the spinous process in midline and a well-demarcated superior end plate above the pedicles of interest. A 1- to 2-cm incision is proposed and marked just lateral to the lateral border of the pedicle.

The incision is then made down to the fascia. The dorsolumbar fascia is then incised with scissors or monopolar cautery. With help of tubular retractor para spinal muscles separated sub-periosteally by an electro-cautery to expose the transverse process. Pedicle of the normal vertebra above and below is identified and confirmed over an image intensifier. The entry point is usually selected to be at or just lateral to the lateral border of the pedicle in the AP view. With help of guide for all subsequent instruments, including the pedicle screw. Thus, it is necessary to keep the guide wire in place without inadvertently withdrawing or advancing it. A tubular dilator is then advanced along the guide wire, followed by a cannulated awl to penetrate the cortical bone at the point of entry. The awl is withdrawn, and an appropriately sized cannulated tap is introduced through the guide wire and used to create the path for the screw in a direction parallel to the end plate. Tap the pedicle and the vertebral body to at least one half of the depth of the vertebral body using a tap for the screw diameter chosen from pre-operative pedicle measurements. Insert the pedicle screw; 6.5 mm (diameter)*40/45 mm (length) poly-axial screws are used. Confirm the screw placement on the image intensifier. Once all the screws have been placed, select the proper length of the rod and contour it to maintain normal lumbar lordosis and cut it slightly longer than needed to accommodate distraction. Rod inserted and reduction of fracture achieved by distraction technique and assembly fully tightened.

All standard post-operative follow up precautions like antibiotics, LMWH, patients ambulation etc. were taken. Patients were followed up at 6, 12 and 24 weeks. At every follow-up history was taken pertaining to pain relief, level of activities and bowel-bladder function. Results were evaluated with Modified Mcnab criteria, VAS and ODI.

Radiographs were taken for the evaluation of cobb angle, kyphotic deformation and pedicle screw instrumentation.

5. Results

In the present prospective study, there was no lost to follow up, and we could analyze all 35 patients giving the response rate of 100%. The number of patients in the age group of ≤ 30 years were 14.29%, 30-50 years were 62.86%, and above 50 years were 22.86%. Majority (62.86%) of the patients were between 30-50 years of age group. Male predominance was seen in the current study with 77.14% males & 22.86% females. In this study, we had 21 (60%) patients having fall from height as the most common mode of injury followed by 14 (40%) due to road traffic accident. Type of injury was incomplete burst in 3 cases (8.57%) followed by wedge fractures in 31 (88.57%) cases and split injury in 1(2.85%) case. Most common level of fracture was L1 in 12 (34.28%) patients followed by T12 level among 7(20%) patients, 6(17.14%) patients with fracture at L2 level, 4 (11.42%) patients had fracture at L1L2, 3 (8.57%) patients had fracture at T12L1, and at L3 level each. (Table 1)

The mean pre-operative kyphosis angle in the present study was 25.35 which decreased to 12.00 at 6 weeks follow up. The mean kyphosis angle at the final follow up was 7.95 which indicates that there is progression of kyphosis angle (to a mean of 5.95) over a period of 6 months with the p value of <0.001 which is strongly significant statistically. The mean VAS in the present study group was 8.40 at presentation which came down to 1.65 at 6 months follow up which was statistically significant (p value= <0.001). The mean ODI score in the present study was 61.00% pre-operatively which gradually decreased to 24.3% at the end of 6 months which was statistically significant (p <0.001). In the present study, according to the modified Mcnab criteria at the final follow up at 6 months, 9 (25.71%) patients were excellent, 15 (42.85%) were good,6 (17.14%) were fair, 5 (14.28%) patients were poor. The mean duration of return to work in the present study group was 5.26 months. 60% patients (n=12) returned to their pre injury work and 25% (n=9) patients returned to a less demanding work. 15% (n=5) patients did not return to any work, the main reason for which was incomplete neurological recovery. The duration of hospital stay in present study was less than 10 days in 86% (30) patients and more than 10 days in 14% (5) patients. In the present study, one (2.85%) patient had superficial surgical site wound infection and was managed accordingly while another one (2.85%) patient had hardware failure of the screw but patient did not develop any neurological complications due to it. (Table 2)

Table 1: Distribution of patients according to baseline characteristics

Baseline characteristic		Frequency (no.)	Percentage (%)
Age groups	<30	05	14.29
	30-50	22	62.86
	>50	08	22.86
Gender	Male	27	77.14
	Female	08	22.86
Mode of injury	RTA	14	40
	Fall from height	21	60
Type of fracture	Incomplete burst	03	8.57
	Split	01	2.85
	Wedge	31	88.57
Level of fracture	T12	07	20
	L1	12	34.28
	T12L1	03	8.57
	L1L2	04	11.42
	L2	06	17.14
	L3	03	8.57

6. Discussion

In the present prospective study, we tried to evaluate the functional outcomes and complications of dorsolumbar spine fractures treated with minimal invasive surgery. Most (62.86%) of the patients were between 30-50 years of age group with the mean age of 41.6 years. Consistent mean age was reported by Wang et al[13] (41.6 years), Wen Fei Ni et al[14] (43.2 years) & Bowen Wang[15] (40.3 years). Male predominance was seen in the current study which is similar to Alessandro et al[16] (66.33% males), Peng Yng et al. (69.44% males). In this study, most common mode of injury was fall from height (60%) followed by road traffic accident (40%) which is similar to M Palmisani et al.[17] Most common type of injury was wedge fractures (88.57%) followed by incomplete burst (8.57%) and split injury (2.85%). Level of fracture was L1 in majority (34.28%) of the patients followed by T12 (20%), L2 (17.14%), L1L2 (11.42%), T12L1 (8.57%), and L3 (8.57%). Consistently, in the study conducted by Wang et al.[13] they had 10 (58%) patients with fracture at L1 level, 3(17%) patients with fracture at T12 level, 4 (23%) patients had fracture at L2 level & in the study conducted by Wen Fei Ni et al,[14] they had 17 (36%) patients with fracture at L1 level, 17 (36%) patients with fracture at L2 level, 8 (17%) patients had fracture at T12 level, 4 (8%) patients had fracture at T11 level.

The mean pre-operative kyphosis angle was 25.35 which was decreased to 12.00 at 6 weeks follow up and 7.95 at the final follow up. Mean decline in angle of kyphosis was 5.95 over a period of 6 months with the p value of <0.001 which is significant statistically. Wang et al[13] (41.6

Table 2: Distribution of patients according to outcomes

Outcome		Frequency (no.)	Percentage (%)	P
Kyphotic Angle variation (Mean ± SD)	At presentation	25.35 ± 10.38		<0.001
	6 weeks	12.00 ± 7.29		
	12 weeks	13.65 ± 7.19		
	24 weeks	7.95 ± 6.94		
VAS variation (Mean ± SD)	At presentation	8.40 ± 0.82		<0.001
	6 weeks	5.55 ± 0.89		
	12 weeks	4.15 ± 1.09		
	24 weeks	1.65 ± 1.09		
Oswestry disability index (Mean ± SD)	At presentation	61.00 ± 6.09		<0.001
	6 weeks	56.00 ± 6.7		
	12 weeks	45.05 ± 10.13		
	24 weeks	24.3 ± 6.51		
Modified Mcnab criteria	Excellent	09	25.71	–
	Good	15	42.85	
	Fair	6	17.14	
	Poor	5	14.28	
Return to Work	Same work	21	60	–
	Different Work	9	25	
	Didn't return to work	5	15	
Hospital stays	<10	30	86	–
	>10	5	14	
Complications	Superficial surgical site infection	1	2.85	–
	Hardware failure	1	2.85	

years), Wen Fei Ni et al[14](43.2 years) & Peng Yang et al[18] also in their studies reported significant decline in kyphotic angle post-operatively. The mean pain score as per visual analogue scale was 8.40 at presentation which came down significantly to 1.65 at 6 month follow up (p value= <0.001). Similar observations in pain score were noted by Bowen Wang et al[15] who reported pain score reduced from 8.3±1.8 to 1.4±0.5 and Peng Yang et al.[18] reported change in pain score from 8+/-1.5 to 2.2+/-0.6. The mean ODI score in the present study was 61.00% pre-operatively which significantly decreased to 24.3% at the end of 6 months (p <0.001). Bowen Wang et al[15] noticed that mean ODI score reduction from 65.7 ± 7.8 to 6.0 ± 1.6 & Giorgi et al[19] from 44.9 ± 15.9 to 18.7±15.5. In the present study, according to the modified McNab criteria at the final follow up at 6 months, 25.71% patients had excellent results, 42.85% had good, 17.14% had fair, 14.28% patients had poor results. In a study by Wang et al[13] 15/17 patients had good (9) to excellent (15) results 2 patients had fair results. The mean duration of return to work in the present study group was 5.26 months. 60% patients returned to their pre injury work and 25% patients returned to a less demanding work. 15% patients did not return to any work, the main reason for which was incomplete neurological recovery. Majority patients (86%) had hospital stay was less than 10 days and 14% patients had more than 10 days. Mean duration of stay was 10.2 days in this study. Peng Yang et al[18] reported mean duration of hospital stay was 10.8 ± 2.5 days. In our study, 5.71% patients developed complications of which one (2.85%) patient had superficial surgical site wound infection and was managed accordingly while another one (2.85%) had hardware failure of the screw. In the study conducted by Alessandro et al. 15% patients had complications. 5% patients had intraoperative (screw and rod disconnections) complications, 10% patients had postoperative (screw disconnections, pedicle screw pullout, paraplegia with cauda equina, septic surgical wound dehiscence) complications. In a study conducted by Giorgi et al[19] 6% patients had complications. 5% patients required surgical revision; 1 (0.6%) patient had surgical site infection. In the study by Wen Fein Ni et al[14] 1 (2.1%) patient had surgical site infection, 1 (2.1%) patient had loosening of screw.

7. Conclusion

Minimal invasive surgery is safe and effective procedure with minimal complications and good post-operative outcome as measured by Oswestry disability index, VAS pain scores & McNab criteria which identified good to excellent results in 85% patients while poor outcome in 14% cases.

8. Source of Funding

There was no source of funding in our study.

9. Conflict of Interest

None.

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Author biography

Anant Nathrao Gaikwad, Orthopedics Postgraduate Student

Pravin D Deokate, Associate Professor

Minish Katkar, Junior Resident

Sushilkumar Mane, Senior Resident

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