

## Posterior Spinal Stabilisation Using Pedicle Screw fixation in Thoracolumbar Vertebral Fractures

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### Abstract

**Introduction:** Pedicle screw provide good control over the three spinal columns of spine and their usage has been diversified from lumbar spine to thoracolumbar and thoracic spine. We evaluated the early results of posterior spinal stabilisation using pedicle screw fixation in twenty patients with thoracolumbar vertebral fractures. **Material and Methods:** Posterior spinal stabilisation using Pedicle screw construct was done along with laminectomy whenever needed in twenty patients with thoracolumbar vertebral fractures. Patients were followed up for minimum six months. **Results:** Mean age of the study group was 34.8 years. The most common mode of injury was fall from height (60%). Preoperatively 85% (n=17) of the patient had useless paraplegia (Frankel Grade C and below) whereas 15% (n=3) of the patients had useful paraplegia i.e. Frankel Grade D & E. Post-operatively 60% (n=12) patients had useful paraplegia (Frankel D & E), whereas 40% (n=8) patients had useless paraplegia (Frankel Grade C & below). 30% of the patients were able to return to their previous work or physically challenging job, 25% were able to return to previous employment to heavy labor with some restriction, 35% of the patients were unable to return to their previous employment but worked for full time in their new employment and 10% of the patients were unable to return to their work. **Conclusion:** Posterior pedicular screws fixation is a effective option for treatment of single-level traumatic thoracolumbar fracture, provided satisfactory functional outcome with preservation of cobb's angle and vertebral height postoperatively without loss of more motion segments.

**Keywords:** Thoracolumbar Fractures, Posterior spinal stabilisation, Pedicle Screw, Frankel Grading, Paraplegia

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### Introduction

Pedicle screw fixation of spine has evolved over many years. The usage has been diversified from lumbar spine to thoracolumbar and thoracic spine. Pedicle screw provide good control over the three spinal columns of spine as well as better deformity correction to the previously used hook and rod construct. [1-3]

Other advantages include: First, the spinal canal remains free from any instrumentation thus decreasing the risk of neurologic injury. Second, Pedicle screw anchorage is independent of facet and laminar integrity and is extremely useful in cases of trauma or a previous posterior decompression. Finally, the increased biomechanical strength of pedicle screw fixation allows, in most clinical situations, fewer segmental levels to be incorporated into the fusion.

These advantages are given a downfall by safety concerns in using pedicle screw instrumentation in thoracic spine. The aorta, esophagus and lungs, are in close proximity to thoracic spine and any

suboptimal placement of pedicle screw remains a concern, especially on the left side of the spine due to the posterior lateral position of the aorta.[4]

Despite the risk associated the pedicle screw instrumentation has achieved a great reputation in fixation of thoracolumbar spine disorders. [1] We aimed to evaluate the early results of posterior spinal stabilisation using pedicular screw and rod fixation in thoracolumbar vertebral fractures.

#### Material and Methods

This prospective study was conducted in a tertiary health care facility in India from Dec 2016 to Dec 2018 in the Department of Orthopaedics. Twenty patients with thoracolumbar fractures were included in the study who presented to emergency and fulfilled the inclusion criteria. Written informed consent was taken from each patient before commencement of the study. The study was approved by Institutional review board. The criteria for selection of the patients were as follows: All post traumatic thoraco-lumbar fractures and fracture dislocations with associated neurological involvement, Thoraco-lumbar compression fractures with loss of more than 50% of vertebral body height with or without neurological deficit, Thoraco-lumbar compression fractures at multiple levels. All those patients not following above mentioned criteria were excluded from the study.

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A detailed history, general physical examination, neurological examination (Frankel grading) [5] and necessary investigations were done for each patient at the time of admission to determine the mode of injury, level of injury and the extent of neurological deficit. Associated injuries and / or medical problems were managed as required. Patients with bladder involvement were catheterized under full aseptic precautions. The self retaining catheters were changed at 2 weekly intervals. Two hourly change of bed posture, passive mobilisation of all limbs along with chest physiotherapy were started. Cleansing with spirit and applying powder to the back was done regularly. Those patients who were admitted with bed sores or who developed bed sores were treated with regular dressings and debridements. Air Mattresses were used for prevention of bed sores. Following stabilization of hemodynamic studies and associated injuries, the patients were taken up for surgery after routine pre-anaesthetic check up.

### Surgical Technique

After administering general anaesthesia patient was kept in prone position. Patient was catheterised beforehand to monitor the input and output chart. Abdomen should hang freely to indirectly decompress the epidural venous plexus. After proper draping, infiltration of the subcutaneous tissue and muscles with epinephrine 1 : 5,00,000. A midline incision was made from one spinous process above the area to be instrumented to one below the area to be instrumented. Sub-periosteal dissection was done to expose the spinous process, the laminae to the tips of the transverse process. Next, the facet joints and the transverse processes are identified to delineate the entry point.

The intersection technique [6] (Fig 1A-1B) is the most commonly used method for identification of pedicle and this method has been used in our study. It involves the intersection of an imaginary vertical line at the lateral aspect of the superior facet joint and an imaginary horizontal line that bisects the transverse process of the corresponding vertebra. After localization of the entry point cortical bone was nibbled and guide pins were inserted under image intensifier guidance through the pedicle to the vertebral body. Guide

pins were removed and the continuity of the pedicle wall and rod was confirmed with a small ball tipped probe. Pedicle was probed in all four quadrants to ensure that a solid tube of bone exists and that violation into spinal canal or inferiorly in the neural foramen did not occur. A 'starter' was then placed at the entry point to enlarge it, following which the pedicle and atleast one half of the depth of the vertebral body were tapped using a tap for a screw diameter chosen.

Pedicle screw of appropriate length was inserted with a screw driver. The purchase insertional torque inserted between 50-80% of the body width in lateral view is ideal in length and must progressively increase until final seating. After placement of screw in all the segments to be instrumented the rod was bent to the required shape and was slightly longer than needed to accommodate distraction. Rod was inserted using a polygrip rod holder and a rod pusher. Rod was fixed to the screw head with a cap nut and a set screw.

Initially rod was inserted on one side and fracture is reduced by segmental distraction. Final tightening was done after the correction was confirmed. In presence of posterior laminar defect or compression of the spinal cord at or near the fracture site, total laminectomy was done to decompress the spinal cord.

Laminectomy was done using a burr to decorticate the remaining lamina and transverse processes. Through a separate incision the posterior iliac crest was exposed to harvest morcellized bone grafts. The grafts were then put against the decorticated spinal segments. The surgical site was washed with normal saline before bone grafting. The wound was closed in layers over a closed suction drain. Surgical wound site was covered with adhesive bandage after application of antiseptic lotion.

Post-operative analgesia was maintained. Check radiographs was done on 2<sup>nd</sup> postoperative day. Antibiotic cover was given till removal of the stitches at two weeks. Removal of suction drain was done at 48 hours post operatively. Patients were allowed to sit wearing a thoracolumbar brace on 2<sup>nd</sup> postoperative day. Thoracolumbar brace worn for 12 to 18 weeks. Detailed and regular neurological charting was done as soon as pain permitted. Nutrition, bladder, bowel and skin care monitored. Physiotherapy and DVT prophylaxis continued as before. Post-operative pain evaluation was done by using Denis Pain Scale [7] [Table 1].

**Table 1: Denis Pain Scale [6]**

Score	Pain scale criterion
1	No Pain
2	Occasional minimal pain; no need for medication
3	Moderate pain, occasional medications and no interruption of work or activities of daily living
4	Moderate to severe pain, occasionally absent from work, significant changes in activities of daily living
5	Constant, severe pain; chronic pain medications

Patient followed up regularly on monthly intervals with minimum six month follow up for every patient. Clinical and radiological examination was done on each follow up.

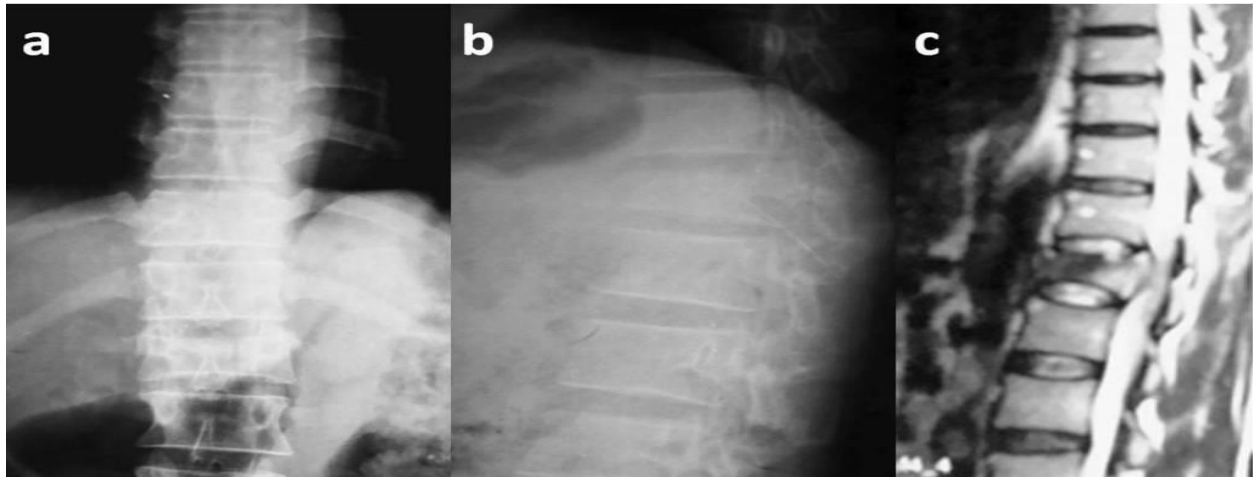
### Results

All the patients were in the age range of 20-55 years (mean, 34.8 years) with sex ratio of 18 (males) : 2 (females). The most common mode of injury was fall from height (60%, n=12), followed by road traffic accident (25%, n=5) which was followed by weight on back

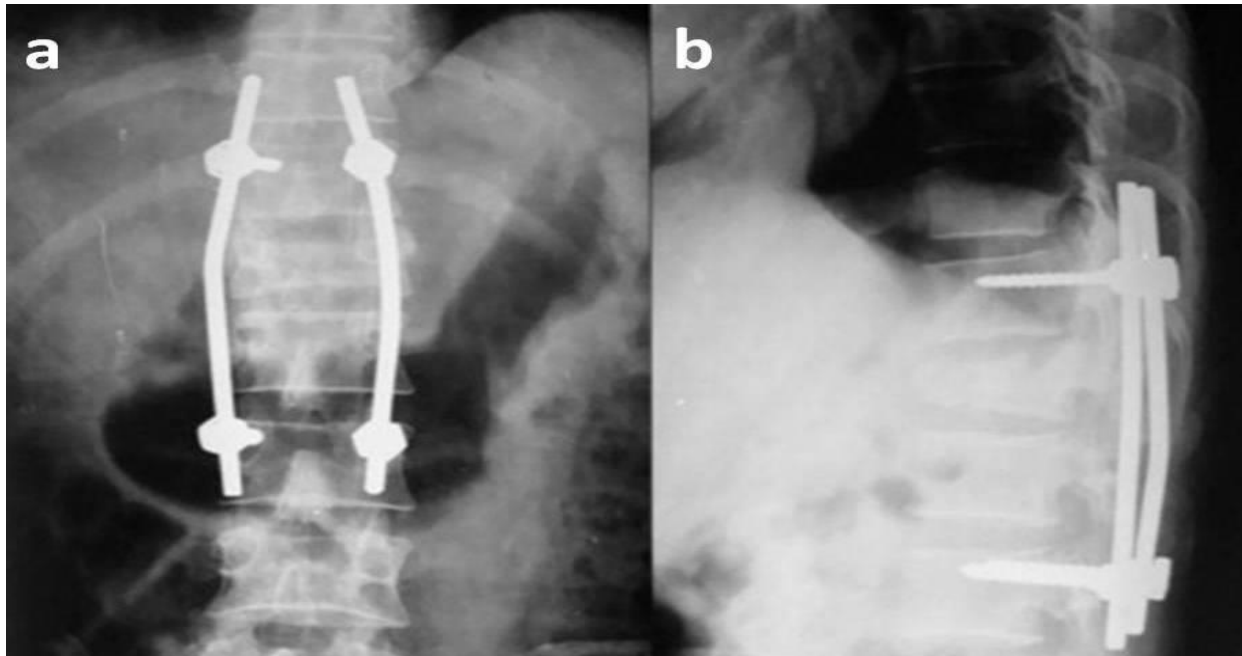
(15%, n=3). Three patients had associated calcaneal fracture, two patients had rib fracture and Colles fracture was seen in two patients. , 8 fractures (40%) were at D12 level, 6 fractures (30%) were at L1 level, one (5%) each was at D10, D11, L2, L5 level respectively, two cases (10%) were at L4 level. As per Magerl classification [8] Nine patients (45%) had type A3 fracture followed by four patients (20%) with type B2 fracture and two patients (10%) each suffered type A1, type B1, type C1 fracture respectively. One patient (5%) had type C2 fracture. Preoperatively 85% (n=17) of the patient had useless paraplegia (Frankel Grade C and below) whereas 15% (n=3) of the

patients had useful paraplegia i.e. Frankel Grade D & E. Post-operatively 60% (n=12) patients had useful paraplegia (Frankel D & E), whereas 40% (n=8) patients had useless paraplegia (Frankel Grade C & below). Postoperatively neurological status remained same in Eight patients (40%). The average kyphotic angle measured pre-operatively by Cobb's method [9] was  $19.25^{\circ}$ . 95% (n=19) patients had significant angulation of the spine ( $>10^{\circ}$ ) of which 65%

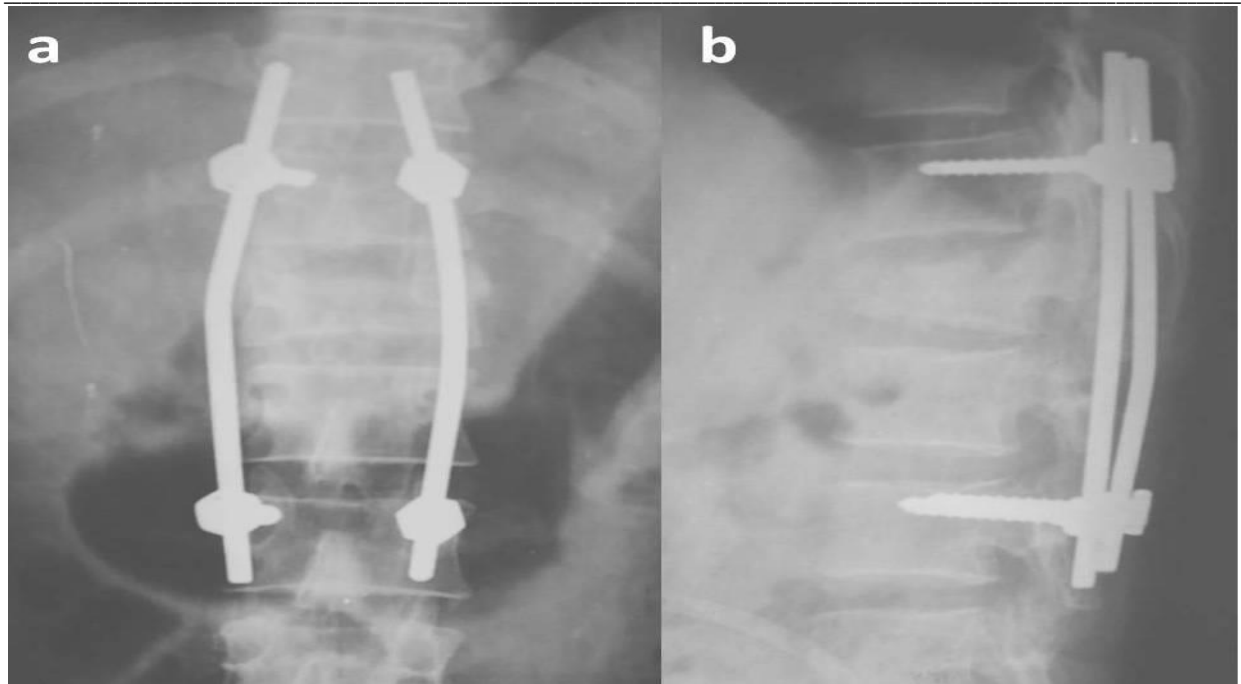
(n=13) of patients had kyphotic angle in the range of  $11-20^{\circ}$ . Kyphotic angle was measured immediate post-operatively and at 6 months. 65% (n=13) of patients had kyphotic angle in the range of  $0^{\circ} - 10^{\circ}$  post-operatively. The mean post-operative kyphotic angle immediate post-operatively was  $8.7^{\circ}$  and at 6 months was  $9.7^{\circ}$  (Figure



**Fig 1a-c: Anteroposterior and lateral radiograph of thoracolumbar spine of a 35 year old male patient showing fracture of L1 vertebra. The MRI (Image "c") also showing the compression of the spinal cord at the level of fracture.**



**Fig 2a-b: Anteroposterior and lateral radiograph of thoracolumbar spine of same patient showing posterior stabilisation of spine with pedicle screws and rod construct in D12 and L3 vertebra.**



**Fig 3a-b:** Anteroposterior and lateral radiograph of thoracolumbar spine of same patient after 6 months follow up showing well maintained height of L1 vertebra and curvature of spine along with stable pedicle and rod construct.

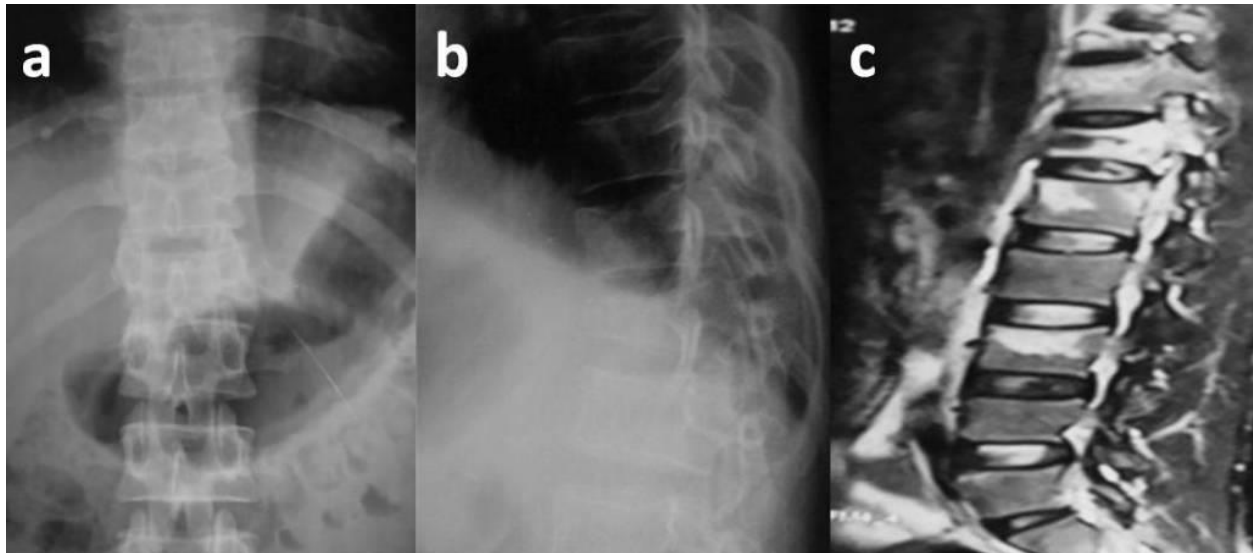


**Fig 4a-c:** Clinical pictures of the patient after six months showing good neurological and functional recovery.

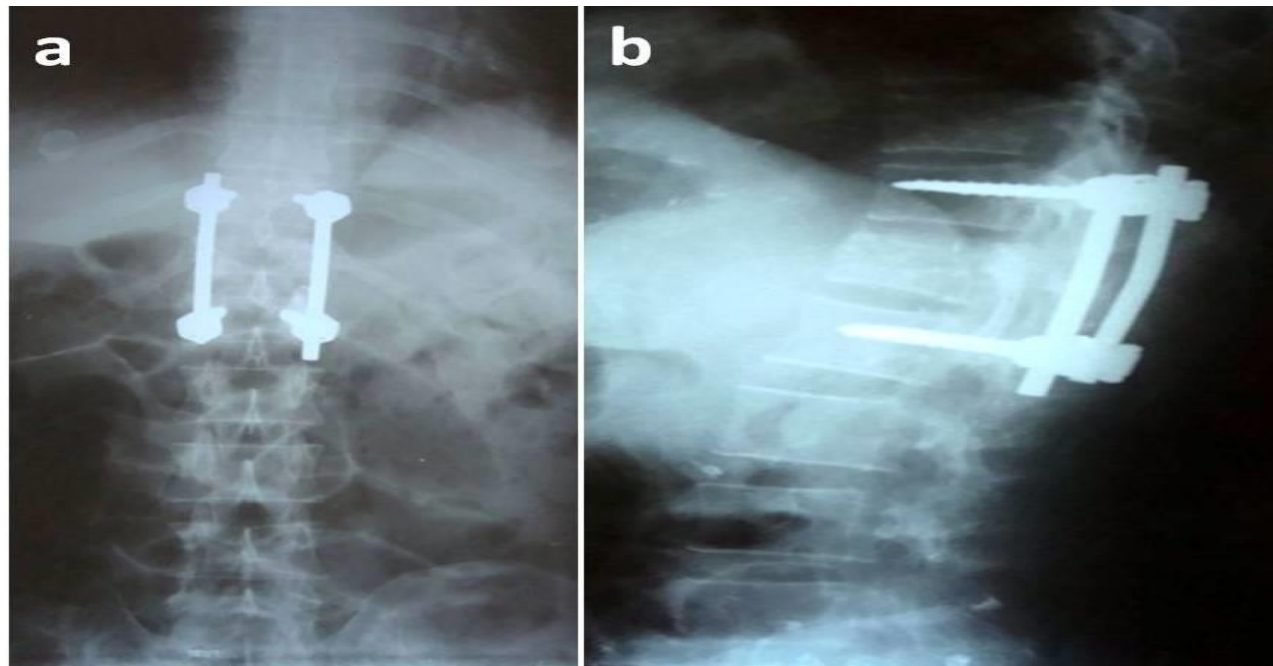
The average pre-operative vertebral height in the study was 57.75% of the normal vertebral height, mostly in the range of 41-60%. The average post-operative vertebral height at 1 month was 81% whereas at 6 months it was 79.7%. Fifty-five percent (55%) cases had



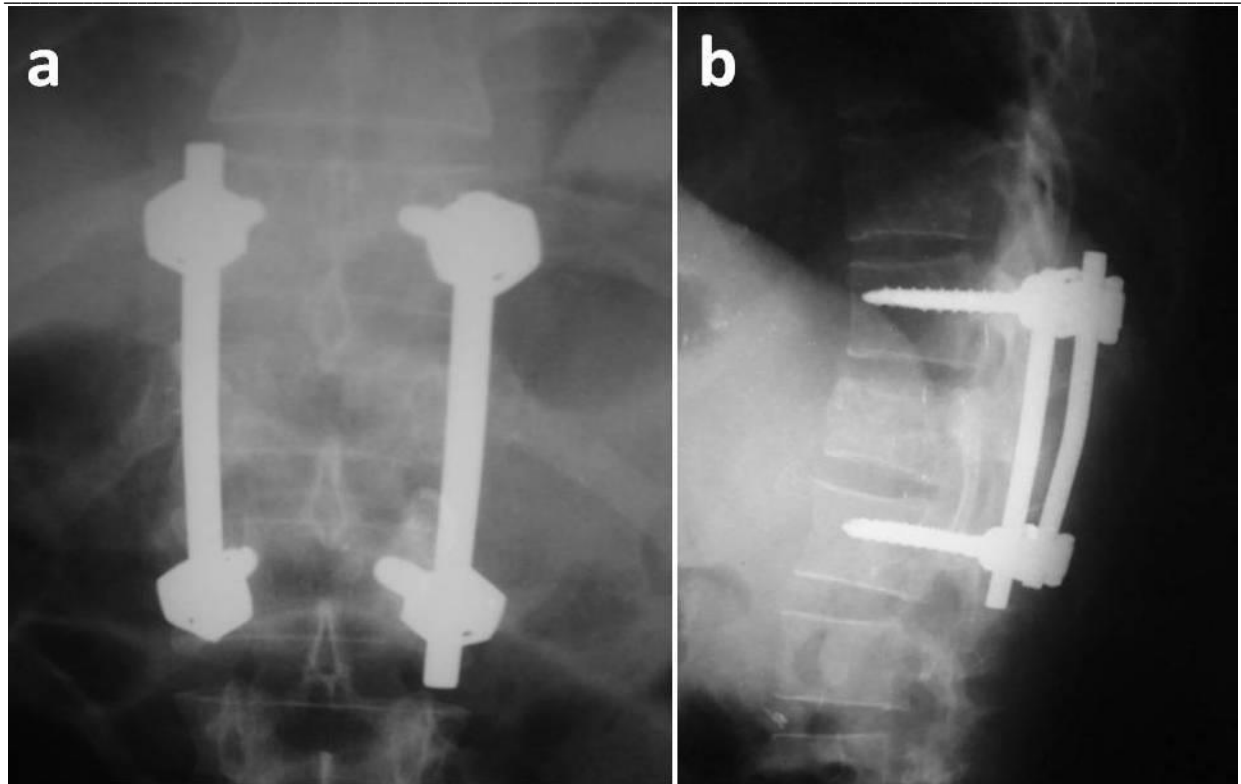
post-operative vertebral height in the range of 81-100%. Pain evaluation according to Denis pain scale at 6 months post-operatively revealed no pain (P1) in seven patients (35%), occasional pain (P2) needing no medication in 11 patients (55%) and moderate pain (P3) needing occasional medication in two patients (10%). At six months follow up and rehabilitation, the level of activity was assessed and Six patients (30%) in our study could walk without support. Four (20%) patients could stand without support and two patients (10%) could stand with support. Four patients (20%) could sit without support and an equal number (20%) of patients could sit with support (Figure 5-8).



**Fig5a-c:** Anteroposterior and lateral radiograph of thoracolumbar spine of a 42 year old male patient showing fracture of D12 vertebra. The MRI (Image "c") also showing the compression of the spinal cord at the level of fracture.



**Fig 6a-b:** Anteroposterior and lateral radiograph of thoracolumbar spine of same patient showing posterior stabilisation of spine with pedicle screws and rod construct in D11 and L1 vertebra.



**Fig7 a-b:** Anteroposterior and lateral radiograph of thoracolumbar spine of same patient after 6 months follow up showing well maintained height of D12 vertebra and curvature of spine along with stable pedicle and rod construct.



**Fig 8a-b:** Clinical pictures of the patient after six months showing good neurological and functional recovery.

Complications are depicted in Table 2. In two patients, one screw in each case was misdirected. One was misdirected which entered the disc space above and the other was outside the pedicle breaking its lateral wall. Both the screws were later reinserted in correct direction. Screw loosening was seen in post-operative X-Rays of one case.

**Table 2: Complications**

Complication	No. of cases (%)
Misdirected Screw	2 (10%)
Screw loosening	1 (5%)
Bed Sore	3 (15%)
Wound Infection	1 (5%)

The patient was advised to use thoracolumbar brace for longer period and regular follow up X-Rays were done. One patient had superficial wound infection which healed on oral antibiotics and daily dressings. Sacral bedsores occurred in 3 patients, 2 of which required flap surgery and one healed by regular dressing.

#### Discussion

The transitional anatomy of the thoracolumbar spine makes it vulnerable to injury from high energy vehicular crashes and falls. One-third of all fractures occur in the thoracolumbar region, a vast majority of which are unstable and are usually associated with neurological deficit, which may be aggravated by their being managed conservatively. [10] Unstable thoracolumbar spinal injuries were fixed with pedicular screw and rod instrumentation along with decompression of cord was done in this interventional prospective study. The mean age in our study was 34.8 which is similar to the other studies in literature by Razak M et al [11] and Defino HLA et al.[12] In this study group, 60% of the patients had injury due to fall from height. Razak et al.[11] noted 69% and Alvine et al.[13] noted it as 52% of the injuries due to fall from height. 30% of the patients were able to return to their previous work or physically challenging job, 25% were able to return to previous employment to heavy labor with some restriction, 35% of the patients were unable to return to their previous employment but worked for full time in their new employment and 10% of the patients were unable to return to their full time work. Our study has similar incidence of fracture pattern type as described by. Alvine et al.[13] Sasso et al. [14] Total 55% of the patients had Type A fractures, 30% had Type B fractures, and 15% had Type C fractures in this study. Most of the patient in our study had fracture at D12-L1 level (70% cases). The reasons for this much high incidence in this region are : a) Maximum mobility at this region, b) Change in the line of weight bearing from thoracic kyphosis to lumbar lordosis, c) Lack of support of rib cage, d) Change in direction of the articular facets from pointing backwards and forwards in the thoracic spine to inwards and outwards in lumbar spine. Eighty percent of the study group had shown no complications, Pressure sore, screw fracture and screw misplacement were observed as depicted in Table 2. Razak et al [11] noted two instances of hardware loosening and three misplaced pedicle screws. There are certain limitations of this study. In this interventional study we did not compare the pedicle screw fixation with other methods of fixation for thoracolumbar fractures. However as pedicle screw fixation has gained so much popularity among spine surgeons that we avoided its comparison with other older fixation methods. Power analysis for sample size calculation was not done. However, This study will add knowledge of pedicle screw fixation in thoracolumbar fractures with decompression of cord and will support the future research in this aspect of spine injuries. We were able to achieve satisfactory results for fixation of thoracolumbar fractures with pedicle screw and rod instrumentation.

#### Conclusion

Posterior pedicular screws with rod fixation is a effective option for treatment of single-level traumatic thoracolumbar fracture, provided

satisfactory functional outcome with preservation of cobb's angle and vertebral height postoperatively without loss of more motion segments.

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