

**PROSPECTIVE COMPARATIVE INTERVENTIONAL STUDY OF  
PERCUTANEOUS VERSUS OPEN PEDICLE SCREW FIXATION FOR  
TREATMENT OF THORACOLUMBAR FRACTURES**

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**ABSTRACT**

**Background:** The main purpose of treatment of thoracolumbar injury is to stabilization of vertebrae to induce vertebrae healing, implementation of percutaneous surgery to minimize muscle damage, intra op and post-op morbidity. A prospective comparative interventional study of percutaneous versus open pedicle screw fixation for treatment of thoracolumbar fractures.

**Materials and Methods:** Hospital based prospective comparative interventional study, between November 2020 to December 2021. We reviewed 60 patients of thoracolumbar fracture, who were operated with pedicle screw by mis and open techniques. Hence, 60 patients were available for the study including 38 men and 22 women. Function and clinical evaluation were done using cobb's angle, vas score, perioperative blood loss, operation time, radiation exposure and follow up done at 2-week, 6 week, 3, and 6 months

**Results:** In our study 60 patients undergoing treatment of thoracolumbar fractures in which 30 patients of percutaneous surgery were compared with 30 patients of open surgery. percutaneous surgery had shorter hospital stay by  $3.57\pm 0.5$  days ( $p < 0.001$ ), less operative time  $73.17\pm 8.66$ , lower infection rate 0 out of 30, better vas score compares to open surgery but no significantly difference between post-op cobb's angle ( $p$  value  $< 0.001$ ) and postop vertebrae front body height ( $p$  value 0.0581).

**Conclusion:** We recommend treatment of thoracolumbar fracture by percutaneous techniques with less operative time and less hospital stay, less blood loss. Low infection rate compared to open surgery.

**Keywords:** thoracolumbar fractures, cobb's angle, open pedicle screw fixation

## INTRODUCTION

Thoracolumbar injury is the most common injury of the spinal column, 16000 cases found per year (1). Thoracolumbar fractures due to high energy trauma including road traffic accidents and fall from height and may cause pain, deformity and loss of daily activity (2,3,4). Some injuries are more painful and affect the quality of life of patients, absence from work for a prolonged period.

Socioeconomic effects on patients of thoracolumbar injury (5,6). Operative intervention for thoracolumbar injury has been associated with more complications like blood loss, infections. Prolonged hospital stays (7).

Spinal injuries of the spine are found in around 8-10 % of trauma patients. In which 3% of patients are associated with spinal cord injury and patients presents are associated with motor and sensory disturbance, bowel and bladder disturbance, paraplegia, hemiplegia, deformity like kyphosis, scoliosis. These patients have prolonged bed rest, which may lead to bed sores and lung infections, DVT (deep vein thrombosis) (8).

Thoracolumbar injuries are the second most common injury of the spine. It accounts for two third cases of injury occurring at the junction of T12 to l2. Only one third of cases associated with spinal cord injury (9).

Thoracolumbar fractures present as bimodal distribution, more in under 30 year of age [young population] and in the geriatric population (10). the managements of fractures vary from individual to individual that range from compression fractures and burst fractures to flexion distraction injuries with fractures dislocation. In which some fractures can be managed by non-operative intervention like bed rest, functional bracing, and close reduction of fractures. Some patients are required surgical intervention with open reduction internal

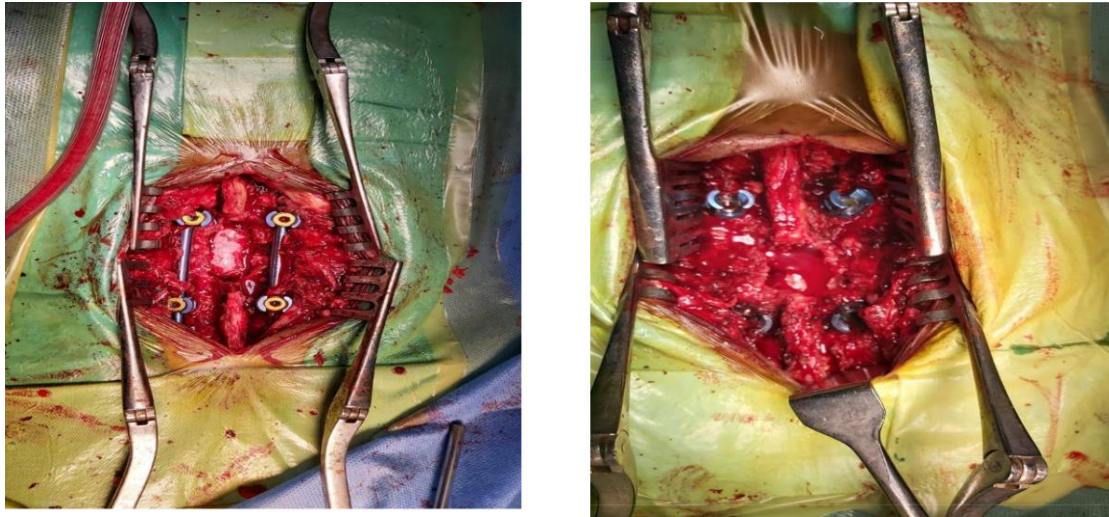
fixation. Recently, a minimally invasive technique for pedicle screw fixation has been implemented as a secondary approach for treatment of thoracolumbar injury, our aim to minimize soft tissue injury, blood loss, complications (11,12).

## **MATERIALS AND METHODS**

After obtaining clearance and approval from the institutional ethical committee and patients fulfilling the inclusion /exclusion criteria presenting in the department of orthopaedics, SMS Medical College, Jaipur (Raj.). Patients who met the inclusion criteria, age more than 18 years and less than 65 years, with thoracolumbar fracture (T11 to L5) (AO classification-type A2/A3/A4/B1/B2/B3) and neurological intact or neurological deficit patient not required decompression. Patients who don't included in study, patients aged less than 18 years and more than 65 years with fracture type a1/c (AO classification), patients have spinal deformity, osteoporotic bone, neurological deficit which requires canal decompression. And a pedicle fracture. Patients' unit for surgery.

### **Surgical Technique Surgical approach and technique for open pedicle screw fixation:**

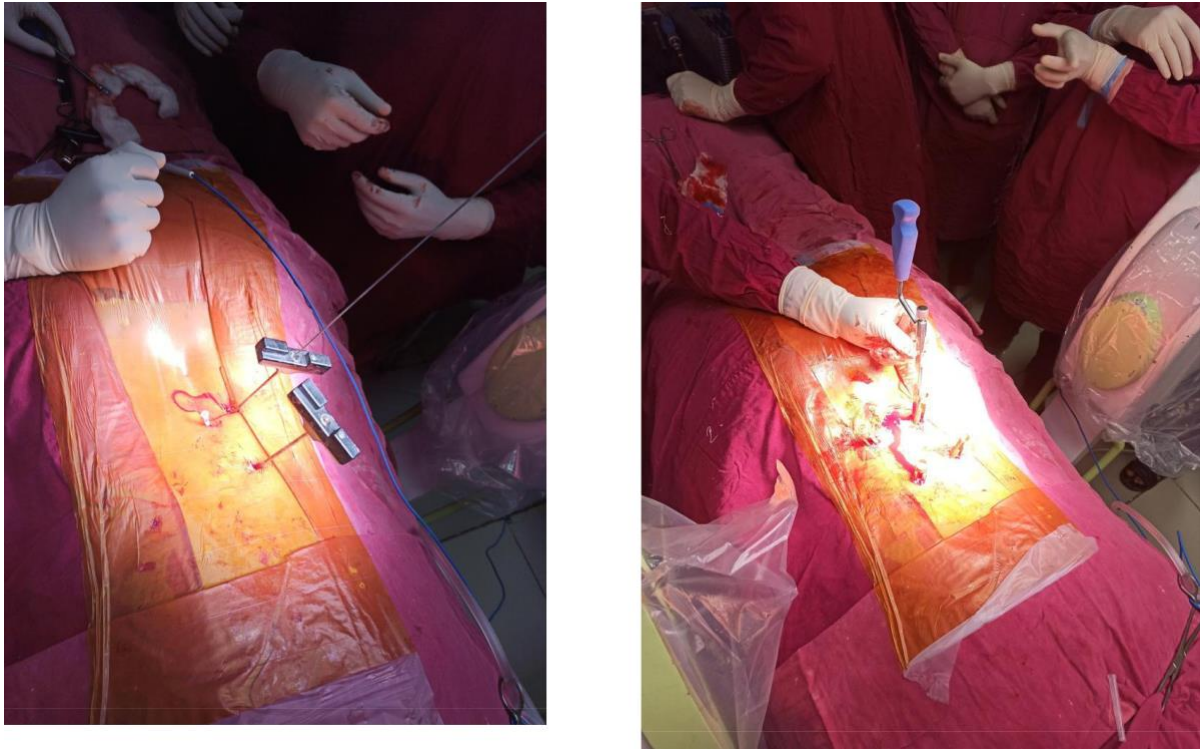
In the operative room under general anaesthesia and patient is prone. Positioned over the operating table part is prepared and draped. A posterior midline approach is used. Care is taken to see that the abdomen is free from pressure so as to prevent undue engorgement of epidural veins and hence to decrease the extent of intra operative blood loss. The subcutaneous tissues, erector spinae muscle infiltrated with adrenaline solution (1:5000000 dilution) subcutaneously to minimize bleeding. The incision is deepened by using electrocautery through the skin, subcutaneous tissue, and dorsolumbar fascia to the tips of spinous processes. The para spinal muscles are subperiosteally detached from tips of spinous process using a periosteal elevator. Image intensifier, the pedicles of vertebrae above and below the using an involved segment are identified. Entry points of pedicle screws made on the pedicle with the help of awl. Blunt kirschner's wires inserted into the vertebral bodies through the pedicles and their position is confirmed fluoroscopically pedicle is probed in all four quadrants to be sure that a solid tube of bone exists. Screw tap is introduced to cut the threads in the created tract. A rod of the appropriate size is selected and contoured to maintain normal number lordosis. A screw of appropriate length is selected so that penetration into the vertebral body approximates 80%. Reduction is achieved. Thorough irrigation of the wound done with antibiotic solution, closed suction drainage was inserted, and the wound is closed in layers.



**Figure 1**

**Surgical approach and technique for percutaneous pedicle screw fixation:**

Positioned over the operating table part is prepared and draped. A posterior midline approach is used. Care is taken to see that the abdomen is free from pressure so as to prevent undue engorgement of epidural veins and hence to decrease the extent of intra operative blood loss. The painting and draping are done. The stab incision done at 1 cm lateral to lateral margin of vertebrae under c-arm. Using an image intensifier, the pedicles of vertebrae above and below the involved segment and both pedicles of fractured vertebrae are identified. Then identification of pedicle by J-needle under c-arm. Then guidewire inserted vertebral body through pedicles and the position of guide wire confirmed by c-arm. Then multiple dilators are used to expose soft tissue then the entry point of the pedicle made by tap for screw fixation. Pedicle screws are inserted in all the pedicles to be sure that screw of appropriate length is selected so that penetration into the vertebral body approximates 80%. And a solid tube of bone exists. Screw position was checked and confirmed by c-arm. A rod of the appropriate size is selected and contoured to maintain normal lumbar lordosis or kyphosis correction. Rod placed in between the pedicle screws. Reduction is achieved. Final tightening done at all levels. Thorough irrigation of the wound done with antibiotic solution and the wound is closed.



**Figure 2**

**Post operative protocol and follow up and management:** - Post operative i.v. antibiotics for 5 days. First wound inspection done on 3rd postoperative day and looked for any discharges, blister, gaping followed by check x-ray. Proper positioning of patients on water bed done and 3 hourly regular turning done to prevent bed sores. Enemas, high fiber diet, proper fluids and digital evacuation used to prevent faecolith formation. Patients assessed neurological on a daily basis while in hospital. On 12th post- operative day stitches removed patient was enrolled in a rehabilitation program for obtaining functional recovery sitting with anterior hyperextension brace support permitted as soon as the pain subsided usually on the second or third day, after 4 weeks walking with support, after 6 weeks depending upon neurologic status of the patients.

### **Statistical analysis**

The collected data were revised, coded, tabulated and introduced to a pc as master sheet. The data was compiled using ms-excel worksheet and analysed using primer and SPSS software (trial version). The data were presented in tables and graphs wherever applicable. Quantitative variables were expressed as mean and SD. Qualitative variables were expressed as frequencies and percent. Appropriate statistical tests will be applied to obtain results. A significance level of  $p < 0.05$  was used in all tests,

## RESULTS

In our study the mean age in open surgery was  $38.73 \pm 11.64$  years and percutaneous surgery was  $38.73 \pm 10.93$  years. RTA (road traffic accident) injury was most common followed by fall from height. There were a total 60 patients in percutaneous surgery 22 male and 8 female, in open surgery 23 male and 7 female. With no sex and age difference in both surgeries, Surgical blood loss more in open surgery was  $398 \pm 109.76$  ml compared to percutaneous surgery  $32.2 \pm 3.49$  ml.

Vas scored in percutaneous  $2.43 \pm 0.63$  and open surgery  $5.67 \pm 0.8$ .

Hospital stay in percutaneous surgery was  $3.57 \pm 0.5$  days and open surgery was  $8.37 \pm 1.1$  days

Surgical time in percutaneous surgery was  $73.17 \pm 8.66$  minutes and open surgery was  $108.67 \pm 7.66$  minutes. Surgical time more in open surgery

Radiation time (sec): - mean radiation time in percutaneous surgery  $28.07 \pm 11.46$  sec (range 13-50) and open surgery  $22.33 \pm 7.21$  sec (range 13-38).

Men radiation dose in percutaneous surgery  $349.33 \pm 77.63$  Cgycm<sup>2</sup> and open surgery  $212 \pm 34.61$  Cgymcm<sup>2</sup>

**Radiological outcome:** - Cobb's angle in percutaneous pre op  $11.27 \pm 2.61$ , post op  $4.7 \pm 1.29$  and open surgery pre-op  $16. \pm 2.08$  and post op  $7.23 \pm 4.05$ .

Vertebrae front height percentage (VFHP) in open pre op  $55.1 \pm 6.38$  and post op  $84.73 \pm 5.90$ , in percutaneous surgery in pre-op  $56.07 \pm 2.18$  and post-op  $84.17 \pm 6.86$ .

Infection rate was more in open surgery 3 out of 30 than percutaneous surgery 0 out of 30 patients. Pedicle screw malposition in open surgery was 2 out of 30 and open surgery was 4 out of 30.

## DISCUSSION

In our study, treatment of thoracolumbar fractures for pedicle screw fixation. Percutaneous pedicle screw fixation had provided better outcome in perioperative blood loss, shorter Hospital stay, low infection rate, decrease postoperative pain as compared to open pedicle screw fixation (13,14) but there is no statistically difference between radiological outcome in both percutaneous and open pedicle screw fixation.

Percutaneous pedicle screw fixation is a close procedure which requires an image intensifier (fluoroscopy), so that the patient can be selected accordingly (15).

Patients with severe neurological deficit required canal decompression, BMI >35, osteoporotic bone, these patients are not suitable for pedicle screw fixation (16).

Patients have unstable or burst fractures with no neurological deficit then percutaneous surgery favour for these patients (17).

There is no significant difference between age, sex, mode of injury, Cobb's angle, vertebrae front height percentage (VFHP) in both open and percutaneous study groups(18).

In percutaneous surgery radiation exposure (time and dose) is required more compared to open surgery. Because percutaneous surgery is minimally invasive whole vertebra is not exposed which required intra-op imaging to identify pedicle location (19)

Surgery done for treatment of thoracolumbar fracture, first reported in 2004 (20), minimally invasive percutaneous surgery is suitable in patients where the pedicle is intact.

Open surgery has more muscle damage due to cut and electro cauterization of muscle which may lead to muscle atrophy in future. loss of muscle strength and function (21). Compare to percutaneous surgery which has minimized the complication.

In percutaneous surgery, reduced intra-op and post-op bleeding so that these patients don't require blood transfusion compared to open surgery (22).

In percutaneous surgery, there is less hospital stay and return to work earlier than compared to open surgery which requires more hospital stay, more healing time which impacts on socioeconomic and quality of life of patients (23).

In our study, no infection found in percutaneous surgery but some patient has postoperative infection in open surgery (24). Pedicle screw malposition more in percutaneous surgery than open surgery (25)

## **CONCLUSION**

Percutaneous pedicle screw fixation for thoracolumbar fracture gives the same radiological results as open pedicle screw fixation.

Perioperative blood loss, infection rate, hospital stay. Muscle damage, post operative pain, incision size less in percutaneous surgery than open surgery.

Radiation time and radiation dose exposure more in percutaneous surgery than open surgery

We suggest the percutaneous surgery in cases which provide satisfactory results could be replaced in many cases with extensive open surgery.

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