# Posterior Instrumentation with Transpedicular Screw and Connecting Rods in the Management of Unstable Thoracolumbar Fractures

Amit Kale

*Received: 7 December 2020 Accepted: 2 January 2021 Published: 15 January 2021*

## Abstract

To evaluate the use of posterior instrumentation with transpedicular screw and connecting rods in management of post-traumatic unstable thoracolumbar spine fractures.Methods: 20 patients with post-traumatic instability of thoracolumbar spine were included in our study. The spinal stability was assessed by the thoracolumbar injury severity scoring. All patients underwent an open reduction internal fixation by the posterior approach. The localisation of pedicles was done using intraoperative imaging. The assessment of neurological status of the patients was done using the ASIA grading scale and other complications were assessed and noted up to 6 months.Results: 20 patients with unstable thoracolumbar injuries were managed with pedicle screws and rods. Males were affected more than Females. The most common type was AO Type A and L1 was the level most affected. None of the patients deteriorated after surgery. 15 patients with incomplete cord injury showed at least one frankel grade improvement. 4 patients with complete cord injury showed no improvement.

***Index terms***— pedicle screws, thoracolumbar injuries.

## 1 Introduction

pinal trauma is one of the leading problems in orthopaedic practice, more so in the modern era where the individuals are more at risk due to high energy trauma [1]. Thoracolumbar spinal segment is the second most common involved segment after cervical segment in spinal injuries [2]. There is concentration of these injuries at the thoracolumbar junction, with its occurrence being such that 60 % is between T12 and L2 [3]. 15 to 20% patients with fracture at thoracolumbar level have associated neurological injury [4].

Author ?: e-mail: ceviod@gmail.com

The treatment options available for unstable thoracolumbar spine fractures and fracture dislocations of the spine have long been controversial. Many authors according to their understanding, advised non-operative treatment, but later their studies emphasized the advantage of Open reduction internal fixation with posterior instrumentation [2,5,6]. Historically, thoracolumbar fractures have been treated with immobilization for a period of 8-12 weeks [6].This mode of treatment is accompanied with complication due to recumbence. It is very labour intensive, cost of therapy in terms of hospital hours used, bed occupancy and care by trained personnel is very high. In a country like India, where there is acute shortage of hospital facilities and trained manpower, conservative management, more often than not, end up as benign neglect, so there is an urgent need for exploring possibilities of surgical stabilization, early mobilizations and rehabilitation of patients.

Internal fixation and stabilization of spinal lesion allows early mobilization of all patients, regardless of neurological deficit, while protecting the neurological structures from further injury and enhancing their recovery [7]. Surgical treatment can be anterior, posterior or combined approach. As most orthopaedic and spinal surgeons are more experienced in posterior approach and at the same time this approach requires less operative time with less blood loss, hence a safe alternative [8]. If an incomplete neurological deficit exists, significant residual neural compression is documented and when treatment is carried out 3 weeks later anterior approach can be considered

[9,10]. Historically, Harrington hook rod construct or its modifications have been extensively studied [11]. The main disadvantage of these instruments is that it spans 5-6 spinal segments [12]. Hence, newer options, especially pedicle screw plate or rod constructs which provide short segment immobilization have gained popularity [13].

The goal of surgery is to achieve stability, to correct deformity, early mobilization, to expedite postoperative recovery and to decrease pseudo-arthrosis [14]. The pedicle screw plate or rod construct helps to achieve all these [15]. In this study, we have stabilized cases of thoraco-lumbar unstable spinal lesions with pedicular screw and rod fixation. Pedicle screw system has gained much popularity in recent times.

# 2 II.

Objectives 1. To study the efficacy of pedicular screw and rod fixation system in achieving stabilization in thoracolumbar fractures of spine. 2. To determine the commonest mechanism, level, and type of fracture and to study radiological and clinical outcome. 3. To facilitate early mobilization of patients and thus help in easy nursing care of the patient, in order to recreate a stable, pain free spinal column.

# 3 III.

Material and Methods 20 cases were assessed during the study period of 12 months between June 2019 to June 2020. All the patients underwent treatment according to protocol. The patients were assessed in the emergency department and after initial investigations, and haemodynamic stabilization patients were assessed neurologically in detail. All the patients had their routine radiographs done along with MRI and CT scans. The pre-operative neurological status was graded on the basis of ASIA scale grading. It was also used to assess post-operative recovery and follow-up. The indication for the surgery was instability for which instrumentation was needed to restore spinal stability or to protect neurological elements. To assess extent of degeneration, instability, mechanism of injury, fracture pattern and its severity and canal compromise or deformity. e) Procedure Prophylactic intravenous antibiotics were given preoperatively. In supineposition general anaesthesia with endotracheal intubation was administered. The patient was put in prone position on a 4 poster frame encouraging morelordosis. Care being taken to keep the nipples in females and the scrotum in males from free from pressure. This position avoids venous stasis and decreases intra-abdominal pressure, thus reducing venous bleeding. All bony prominences were padded. The skin, subcutaneous tissues, and paraspinal muscles down to the level of lamina were infiltrated with 1:50000 epinephrine solution to minimize bleeding. A posterior midline incision was made centering over the involved spinal unit and extending 2 levels above and below. The incision was deepened to expose posterior elements of the vertebrae one level above and one below the injury. The dissection was carried laterally to the tips of the transverse processes, maintaining meticulous homeostasis. The pedicles were identified, by identifying the point of convergence of a horizontal line along centre of transverse process and vertical line along centre of superior facet. Using a rongeur cortical bone was removed around the pedicle entry point. Pilot hole is made with use of sharp Trocar with stopper. Centralizers or Blunt Kirschner wires were placed into the pedicle and their position was confirmed under image intensifier on both anteroposterior and lateral views. Pedicle probe was passed with rotating it over 30 degrees clockwise and anticlockwise so it entered the pedicle at the region of least resistance which is the centre of the pedicle. The depth of the pedicle was confirmed with probe by the markings on it and confirming its position by passing it to 80% of its depth. Now the pedicles were tapped with 5.5mm or 6.25mm taps depending on appropriate size. The pedicle was probed in all four quadrants with a pedicle sound to make sure that solid tube of bone exists and violation of pedicular cortex has not occurred and the screws of appropriate lengths were selected and inserted into the pedicles with help of monoaxial or polyaxial inserter depending on the implant used. During insertion the positions of the screws were checked with image intensifier in both anteroposterior and lateral views. A rod contouring template is placed into the slots of the implants. The template is shaped to reflect the natural curve of spine. A under contoured rod was used to create distraction-extension assembly. The appropriate sized rods (10mm) were selected and contoured using cam action bending instrument to match the template. The rods were held with self-locking, long rod holder and aligned and placed over the slots on the implant placed. A rod pusher straight or curved can be used to push the rod into implant slots. The rod is fixed by inserting the inner screw and outer nut with help of combined insertion device for inner screw and outer nut by gently aligning the inner screw with inner threads of the screw. Use 1-2 counter clockwise turns to engage inner threads. A slight click will confirm proper alignment of screws. The inner screw is rotated clockwise to engage 2-3 threads and is not tightened at this stage. Holding the inserter for inner screw in position the inserter for the outer nut is disengaged from the ball catch holding it and outer nut is lowered and aligned and inserted by rotating clockwise to engage 2-3 threads only and is not tightened, the combi inserter is disengaged by lifting it clean and the assembly is inspected to ensure the threads are properly engaged. All outer and inner screws are similarly inserted over the implant and the assembly is constructed. Using angled spreader, distraction is applied by placing the prongs of spreader straddling the rod and in contact with the head of the implant. Adequate distraction is applied for correction of deformity and the inner screw is tightened with long hex screw driver. A thorough homeostasis was achieved and the wound was closed in layers over drain. Clean dressing was applied.

# 4 a) Inclusion criteria

# 5 f) Post-operative treatment

All the patients were given post-operative intravenous antibiotics for 5 days. They were switched over to oral antibiotics till suture removal. Physiotherapy was started from first day post operatively. Sutures were removed on fourteenth day. On the second day patients were allowed to roll from side to side. They were allowed to sit up and were mobilized on a wheel chair after application of KT brace on fifth post-operative day. A close watch was kept for any improvement or deterioration in the neurological status.

# 6 g) Follow up

All the patients were followed up at interval of 6th week, 12th week and at 6months on each follow up clinical, radiological & neurological examination was done to assess spinal stability.

IV. In our series the mean kyphotic angle was 20.8° at admission, 4.6° at 3 months follow up and 6.1° at 6 MONTHS follow up. A significant correction in kyphotic deformity after posterior spinal stabilization with pedicle screws and rod system was observed.

# 7 Results

# 8 ?

# 9 ? Anterior Vertebral Body Height

In our study, average anterior vertebral body height was 52%, post op was 85% and at 6 months follow up was 80%.

# 10 ? Complications

In our series 3 (15%) patients had pressure sores and were treated accordingly. No patient had superficial wound infection. 1(5%) patient had malpositioning of the screw but developed no neurological complications due to it.

V.

# 11 Discussion

# 12 ? Age and Sex Distribution

In our study we had 90% males and 10% female patients. The average age was 36.6 years and more common in the third and fourth decade. Gregory F. Alvine et al in their study found that average age was 31 years, with a male predominance [16]. Nasser M.G et al in their study found that average age was 28.8 years with a male predominance [17]. Rick C. Sasso et al, in their study had 77% males and 23% females with a mean age of 34 years [18]. Razak M et al in their study found that average was 30 years with a male predominance [19].

# 13 ? Mode of Injury

In our study we noted fall from a height in 80% patients as the most common mode of injury and was mainly the result of work injury. Road traffic accident was the second commonest cause 15% of patients and fall of heavy object in 5%. Nasser M.G et al in his study noted that the main cause of injury was fall from a height and road traffic accident was the second commonest [17]. Gregory F. Alvine et al noted that in 52% of patients injuries resulted from fall from a height, in 39% patients due to road traffic accidents and 9% due to fall of heavy objective [16]. Razak M, et al in his study noted that 69% of injuries were caused from fall from height, 31% due to road traffic accident [19].

# 14 ? Classification Type

In our series we found 80% of patients with AO Type-A fractures, 15% with AO Type-B fractures and 5% with AO Type-C fractures. Nasser M.G et al in their study noted 76% of patients with Type-A, 8% with Type-B and 16% with Type-C [17]. Rick C.Sasso et al noted that 62.5% had AO Type-B and 37.5% had AO Type-A fractures [19]. Gregory F.Alvine et al noted that Type-B fractures were seen in 57.5% of patients Type-A in 22.5% and 20% Type-C [16].

# 15 ? Neurological Status

In this study 4(20%)patients were of grade A, 4 (20%) were grade C,and12(60%) were grade D at admission and at latest follow up 15 cases showed at least 1 ASIA Grade improvement.

Nasser M.G et al. noted that patients who had neurological deficits showed atleast 1 grade improvement at latest follow up [17]. Gregory F Alvine et al noted that neurological improvement was seen in 50% of cases with 40% improving with 1 grade and 20% with 2 grades and none had decrease in neurological level [16]. Rick C.Sasso et al., in their study noted that all patients with incomplete neurological deterioration improved at least

by 1 grade [19]. Razak M et al noted that 64.4% of those with incomplete lesions showed an improvement of at least 1 grade [18].

# 16 ? Radiological Parameters

In our series the mean kyphotic angle by Cobb's method was 20.8° on admission, 4.6° post operatively and 6.1° at latest follow-up. Nasser M.G et al noted the kyphotic angle was 23.6° on admission, 7° post -operatively and 11.5° at latest follow-up [17]. Gregory F. Alvine et al noted that sagittal plane angulation was 12° pre operatively, 1° post operatively and 6° at follow-up [16]. Rick C.Sasso et al noted that the kyphotic angle was 17.6° pre operatively, 3.5° post operatively and 11.6° at latest follow up [19]. Razak M. et al. noted that the average kyphotic angle was 20° pre operatively, 7° post operatively and 9° at latest follow up [18].

# 17 ? Time Duration

In our series the duration from injury to admission was a mean of 1.90 days, from injury to surgery was 3.85 days and average hospital stay was 17.2 days. Rick C.Sasso et al noted in their study that average time interval between time of injury to time of surgery was 4 days and mean hospital stay was 16 days [19]. Razak M et al noted that average time duration to surgery was 5.6 days and average hospital stay was 24 days [18].

# 18 ? Complications

In our study we had 3 patients with pressure sores and no patient with superficial wound infection. 1 case of misplacement of pedicle screws was noted. No neurologic complications were noted in the patient with misplacement of screws. As the literature suggests only 0-1%complication rate in patients with misplacement of screws, no revision surgery was undertaken.

Khan. I et al in their study noted that there was 1 patient with superficial wound infection, and 1 patient with deep vein thrombosis [20]. Razak M et al noted 2 instances of hardware loosening and 3 misplaced pedicle screws [19].

# 19 VI.

# 20 Conclusion

This study was conducted to assess the Radiological, Neurological and Clinical outcome of surgical management of thoracolumbar fracture spine with pedicle screws and rod system.

We conclude:

1. Thoracolumbar spine fractures are more common in the 3rd and 4th decade of life with male predominance due to outdoor activities. 2. The commonest mode of injury was fall from a height. 3. Management of thoracolumbar spine fractures requires careful pre-operative planning, patient selection, neurological evaluation and meticulous intra-operative care and post-operative rehabilitation including detailed counselling for good functional outcome. 4. The posterior midline approach provides adequate exposure and direct visualization. 5. Pedicle screw fixation should be done as early as possible in order to facilitate neurological recovery, help in good nursing care and early mobilization of the patient and to prevent deterioration of the neurological status. 6. Pedicle screw instrumentation provides less surgical exposure, correction of deformity and better stabilization, of one motion segment above and below the fracture. It provides fixation and stabilization of all the three columns. So stabilization, reduction and decompression using pedicle screws and rods helps in stabilization of unstable fractures and helps in further neurologic recovery of the patient. 7. Early surgical intervention helped in good neurological recovery.

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