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Outcome of posterior decompression and posterior stabilisation in dorsolumbar spinal fractures

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Abstract
Background and objectives: Vertebral Fractures with spinal cord injury represents a devastating injury with potentially drastic effects on the patient's life. The treatment options for unstable thoracolumbar spine fractures and fracture dislocations have long been controversial. Aim of the study was to access the commonest mode, level, type of fracture, efficacy of pedicle screw and rod system and the radiological, neurological and functional out come in order to recreate a stable pain free spinal column.
Methods: This study is a prospective clinical study of unstable thoracolumbar spinal injuries by posterior instrumentation (pedicular screw and rod fixation in thoracic, lumbar, and thoracolumbar spinal fractures). In all, a total of 20 cases were evaluated and assessed during the period from January 2016 to January 2018. At the end of 6 month of follow up the patients were evaluated clinically by using Denis work scale.
Results: In our study, we had 70% males and 30% female patients and average age was 37.55 years. Fall from height was the most common mode of injury with 65% followed by RTA with 30%. 70% of patients were T11-L2 level, 20% were between T1-T10, 10% were between L3-L5 levels. In our study we had of patients with 20% ASIA Grade-A, 25% with Grade Band 40% with Grade-C at admission and at latest follow up showed at least 1 ASIA Grade improvement. As per Denis work scale, 5 patients were in W1 category, 11 patients in W2 category, 2 patients in W3 category, and 2 patients in W4 category at the end of 6 months follow-up.
Conclusion: From our study, we conclude that posterior decompression and posterior stabilisation is a safe, relatively easier and effective approach to the management of traumatic dorsolumbar spinal fractures.

Keywords: Thoracic, lumbar, spine, fractures, pedicle screw, rod

Introduction
Vertebral Fractures with spinal cord injury represent a devastating injury with potentially drastic effects on the patient's life. The impact of spinal cord injury from physical, economical, psychological and social perspectives is enormous.
Motor Vehicle Accidents and fall from height constitute the major causes of SCI. With the annually increasing incidence of high velocity injuries, it is important that there is a deep understanding of the management of SCI.
Cervical spine injuries are the commonest type of spinal injuries followed by thoracolumbar injuries, usually occurring at the thoracolumbar junction. 60% of these occur between T12 and L2. 15 to 20% patients with fracture at thoracolumbar level have associated neurological injury [1].
The treatment options for unstable thoracolumbar spine fractures and fracture dislocations have long been controversial [2, 3]. Many authors, advised non-operative treatment, but later report emphasized the advantage of open reduction internal fixation with stabilization.
Operative management was seen to significantly improve neurological deficits. Lately consensus is evolving around the world for stabilization of spine, with fusion and instrumentation in unstable fracture [4].
Operative management of these fractures can be through anterior, posterior or combined approaches involving decompression and stabilization of segments [5, 6].
Historically, Harrington hook rod construct or its modifications have been extensively studied [7]. Their main disadvantage is that it spans 5-6 spinal segments [8].

Preferably, newer options, especially pedicle screw plate or rod constructs which provide short segment immobilization have gained popularity.

The goals of surgery are to achieve stability, to correct deformity, early mobilization, to expedite post-operative recovery and to decrease pseudarthrosis.

Materials and methods

The sample size of this prospective study was 20 and all cases were evaluated and assessed during the period from January 2016 to January 2018.All the patients were initially assessed in the outpatient department or casualty and then a detailed evaluation of their hemodynamic status, neurological status and other injuries was done. A thorough history was taken. After initial investigations and hemodynamic stabilization, patients were assessed neurologically in detail. A neurological chart was maintained for each patient. All the patients had routine X-rays of dorsolumbar and lumbar spine in both anteroposterior and lateral views. In all the patients CT was done, MRI was done for affordable patients.

Pre-operative neurological status was graded on the basis of ASIA grading. Patients with Traumatic Unstable Fractures-White and Panjabi Scoring >5, Incomplete neurological deficit, Progressive neurological deficit, Complete neurological deficit for the purpose of stabilization, Cases presenting within 3 weeks of injury were included in the study. Stable fractures of the spine-White and Panjabi Scoring <5, Pathological fractures of spine, Patients unfit for surgery, Patients not willing for surgery were excluded from the study.

Plain radiograph (static and dynamic wherever necessary) Anteroposterior and lateral views and CT scan were taken to assess extent of degeneration, instability, mechanism of injury, fracture pattern and its severity and canal compromise or deformity. Magnetic resonance imaging (MRI) was useful in determining the condition of the spinal cord following trauma and any soft tissue encroachment (intervertebral disc) of the spinal Cord.

All patients were administered preoperative prophylactic antibiotics. Patient was put in prone position. A posterior midline incision centering over the involved spinal unit and extending 2 levels above and below was made and dissected with electrocautery 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 center of transverse process and vertical line along center of superior facet. Using a rongeur cortical bone was removed around the pedicle entry point and pilot hole is made with use of sharp trocar with stopper. Centralizers or Blunt Kirshner wires were placed into the pedicle and their position was confirmed under C-Arm on both anteroposterior and lateral views.

Pedicle probe was passed and rotated 30 degrees clockwise and anticlockwise so it entered the pedicle at the region of least resistance which is the center 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. Pedicles were then 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 polyaxially inserter depending on the implant used.

During insertion the positions of the screws were checked with C-Arm 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 appropriately 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.

Physiotherapy was started from first day post operatively. 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 thoracolumbar belt on third or fourth post-operative day. A close watch was kept for any improvement or deterioration in the neurological status.

Patients wore spinal jacket for about 6 weeks. Those with incomplete neurological deficits were given physiotherapy and gradually ambulated. Patients with complete neurological deficits were given physiotherapy and ambulated on wheel chair. Routine postoperative X-rays were taken prior to discharge. The neurological grading and radiological parameters were recorded on 3rd day of the operation.

All the patients were followed up in OPD every 4th week after surgery for 6 months and at each follow up clinical, radiological & neurological examination was done to assess spinal stability. At the end of 6 month of follow up the patients were evaluated clinically by using Denis work scale. Functional outcomes of patients were evaluated using and the Denis Work Scale [9].

Denis Work Scale is a five-level scale ranging from W1 to W5, as detailed below-

W1: Return to previous employment (heavy labour) or physically demanding activities.

W2: Able to return to previous employment (sedentary) or return to heavy labour with restrictions.

W3: Unable to return to previous employment, but works full time at a new job.

W4: Unable to return to full time work.

W5: No work, completely disabled.

Results and discussion

In our study we had 70% males and 30% female patients. The average age was 37.55 years and more common in the third and fourth decade. In our study we noted fall from a height in 65% patients as the most common mode of injury and was mainly the result of work injury. Road traffic accident was the second commonest cause 30% of patients. In our series we had 70% of patients with fractures between T11-L2 levels. 20% with fractures between T1-T10, 10% with fractures between L3-L5 levels. In our study we had of patients with 20% ASIA Grade-A, 25% with Grade Band 40% with Grade-C at admission and at latest follow up showed at least 1 ASIA Grade improvement.

Nasser M.G. *et al*., noted that patients who had neurological deficits showed at least 1 grade improvement at latest follow up. Gregory F Alvina *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. Rick C. Sasso *et al*., in their study noted that all patients with incomplete neurological deterioration improved at least by 1 grade. Razak M *et al*, noted that 64.4% of those with incomplete lesions showed an improvement of at least 1 grade. Khan I *et al*., noted that 20 grade improvement in 18 patients (1.1 Grade improvement).

In our series the duration from injury to surgery was 3.4 days and average hospital stay was 40.5 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. Razak M *et al*, noted that average time duration to surgery was 5.6 days and average hospital stay was 24 days.

In our study we had 3 patients with bed sores and 1 patient with superficial wound infection. No case of hardware loosening and no misplacement of pedicle screws were noted.

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

This Study was undertaken to assess the functional and neurological outcome following posterior decompression and posterior stabilization in dorsolumbar spinal fractures. Dorsolumbar spinal fractures were seen to be more common in the age group of 30-40 years with a male preponderance. Young males are more commonly affected as they are involved in outdoor activities, work injuries and high velocity injuries. Fall from height is the commonest mode of injury, usually at place of work.

Lumbar spine was seen to be most commonly affected with most of the injuries being in the thoracolumbar junction. This may be due to hyperflexion or axial loading.

Management of dorsolumbar spine fractures requires careful pre-operative planning, patient selection, neurological evaluation and meticulous intra-operative care and post-operative rehabilitation, which includes counselling, for good functional outcome.

In our study, we have not assessed the results of high dose methyl prednisolone in the treatment of Spinal cord injury, as the evidence presented in NASCIS 2 and NASCIS 3 trials do not unequivocally demonstrate the efficacy of steroids. Further, the risk of sepsis and pneumonia is high with use of steroids.

Due to the short postoperative follow-up period, we have excluded the evaluation of kyphotic angle in our study.

The optimal timing for decompression remains controversial. Better neurological outcome and shorter hospital stay has been reported in some studies, but there are no published clinical trials which definitely prove the effectiveness of early decompression. Early fixation results in improvement of clinical outcome, but the effect on neurological outcome is debatable. Neurological outcome is dependent on multiple variables. We could not draw definitive conclusions on the optimal timing of surgery as estimation of these variables were not exact in our study. Therefore, we conclude that early decompression is still recommended as a practice option as it ensures shorter hospital stay, and lower complications.

Posterior approach to the spine was relatively easy, safe and extensile. It allows for effective decompression and stabilization of the spine.

In our study, it was observed that there was an improvement of at least one ASIA grade in the follow-up period after posterior decompression and stabilization. This indicates that posterior decompression and stabilization has a direct relation to neurological improvement. The functional and neurological recovery was seen to be affected by the severity of the primary damage to the spinal cord.

As per Denis work scale, 5 patients were in W1 category, 11 patients in W2 category, 2 patients in W3 category, and 2 patients in W4 category at the end of 6 months follow-up.

Most of the patients in our study showed good functional outcome and pain relief following surgery. The rates of complications were low. Surgical decompression and stabilization allowed early mobilization and fewer days of hospital stay and contributed to the low incidence of complications such as wound infection and bed sores. Furthermore, good nursing care also was a factor in reducing complications.

Conclusion

From our study, we conclude that posterior decompression and posterior stabilization is a safe, relatively easier and effective approach to the management of traumatic dorsolumbar spinal fractures. It effectively decompresses the vertebral canal and achieves significant correction of deformity, with good functional outcome and significant pain relief. Furthermore, early and significant pain relief ensures early mobilization and rapid recovery with minimal complications.

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