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Case Series

The study of functional outcome in traumatic thoracolumbar spine fractures treated with Moss-Miami instrumentation

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ABSTRACT

Thoraco lumbar fractures are grave injuries of utmost concern. If left untreated may result in marked morbidity and disability to the patient. Most of the polytrauma patients suffer from spine fractures which in turn can be associated with neurological deficits which makes the treatment of the spine fractures an important entity. Hence the present study was undertaken to study efficacy, evaluate the clinical and radiographic results, to study the advantages, complications and to facilitate early mobilization of patients and thus helping easy nursing care of the patients in order to recreate a stable, pain free spinal column by using Moss-Miami (pedicular screw). This prospective study was undertaken in the department of orthopaedics KIMS hospital and research centre, Bangalore, conducted on 20 patients fulfilling the inclusion and exclusion criteria. This study was undertaken from December 2020 to June 2022. Patients were followed up at 6, 12 and 24 weeks for data collection. The mean age of the study group was 45.7 years. The most common vertebrae involved in this series were between T11-L2 to the extent up to 65%. Among all the subjects 75% were able to return to previous employment with some restriction 75% had occasional minimal pain with no need for medication. The results of this study demonstrate the superiority of pedicle screw-rod instrumentation as a treatment for vertebral fracture with very high statistical significance in restoration of vertebral body height, mean regional angle, mean anterior wedge angle and considerable amount of neurological healing.

Keywords: Moss-Miami, Thoraco lumbar fractures, Spine fractures

INTRODUCTION

Trauma to spine is one of the grave injuries. Thoraco lumbar fractures are serious injuries of concern. If left untreated may result in marked morbidity and disability to the patient. The spinal traumas are common and leading problem in orthopaedic practice.

Between 5% and 10% of polytrauma patients suffer spinal fractures or dislocations with 65% to 80% of these injuries occurring within the thoracic or lumbar regions.[1] The vast majority of these injuries affect the motion segments between T11 and L2 at the thoracolumbar junction.[2]

These motion segments connect the relatively rigid, kyphotic thoracic spine, which is stabilized by the rib cage, to the more mobile, lordotic lumbar vertebrae; the differences in mobility between the thoracic and lumbar spine regions cause this transitional zone to experience substantial biomechanical stresses during traumatic incidents, making it more susceptible to fracture.[1-4]

Spinal fractures are commonly associated with motor and sensory disturbance, bladder and bowel disturbances, erectile dysfunction, deformities like kyphosis, scoliosis as result of neurological injury. The patients are also prone for bed sores and pulmonary infections.[5]

Only 15-20% of fractures at thoracolumbar level are associated with neurological injury.[6]

Thoracolumbar injuries are usually thought to exhibit a bimodal age distribution, with peaks among males under 40 years of age and again in the 50 to 70 age group which is made up of a higher percentage of females compared to the younger age groups.[1-3] With the advent of increased incidence of road traffic accidents and industrial trauma, there has been a significant increase in the number of thoraco- lumbar spinal injuries.[7] The elderly are at particular risk of thoracolumbar spinal fractures principally because of poor bone density and declining mental status. Elderly patients typically present after a low energy mechanism, such as a fall from a standing position, which is the most common mechanism of injury.[8]

Management of these spinal fractures is one of the most controversial areas in modern spinal surgery.

Historically, the thoracolumbar fractures were treated by conservative methods like bed rest for a period of 8-12 weeks.[9,10] This method of treatment often accompanied by multiple complications and very labour intensive. This method of treatment is very costly since it requires care by highly skilled personnel with prolonged stay in the hospital and occupancy of hospital bed for prolonged time.[11]

Decompression and early fusion with instrumentation is a generally accepted treatment method for patients with unstable injuries and with a neurological deficit; it helps in early mobilization, and avoids complications associated with prolonged recumbency, of conservative regimen.

Goals of surgical treatment are to get effective decompression of spinal canal with adequate reduction, healing of spine without deformity, limitation of movement, instability and pain, with early mobilization and rehabilitation.[12]

The surgical approaches for thoracolumbar fractures are anterior, posterior, lateral or antero-posterior approaches. The posterior approach often a safe alternative for the surgery because most of specialists are more experienced with posterior approach. Also, the spine can be stabilized by posterior approach with many available instruments.[13]

In Moss-Miami (pedicular screw) instrumentation, fixation achieved is more rigid as the screw is passed through force nucleus of the vertebra. This is the point through which five anatomical structures-the superior facet, the inferior facet, the lamina, the pedicle and the transverse process; channel all the posterior forces and further transmit to the body.[14]

In this study, we stabilize the cases of the unstable thoracolumbar spine fractures with decompression and Moss-Miami (pedicular screw) instrumentation according to TLICS scoring and further have evaluated all patients for maintenance of spinal correction and neurological improvement and clinical outcome in terms of spinal scoring system as ASIA charting.

CASE SERIES

This prospective study was undertaken for 18 months (December 2020 to June 2022) in department of orthopedics at Kempegowda institute of medical sciences and research centre, Bangalore. Twenty patients fulfilling inclusion and exclusion criteria were studied. Patients with unstable fracture-dislocation of thoracolumbar and lumbar spine were operated.

The patients presented generally with either a fall from height or a high velocity trauma with majority of patients with the former mechanism of injury.

Upon arrival to the emergency thorough demographic details of the patient were taken. A thorough history of the patient including the mode of injury, duration of injury, any known comorbidities were registered.

A thorough general physical examination was done with detailed neurological examination. Complete head to toe examination was done to see any associated head injury, exaggerated lumbar lordosis, paraspinal muscle spasm, central furrowing, deviation of spinal curvature, paraspinal bulge or swelling, local rise of temperature and tenderness, any palpable step, knuckle or gibbus of spine is noted.

The neurological examination is done according to ASIA chart and scoring system.

Higher mental function of patient, speech, orientation to time/place/person is evaluated. Further the motor and sensory system is evaluated and both deep and sensory reflexes response was checked. The bladder and bowel control of the patient is evaluated.

The patient is subjected to radiological examination. Plain x-ray is done for the patient and evaluated. Later CT scan and MRI of the spine is done with whole spine screening.

Regular blood investigations sent including complete hemogram, coagulation profile, serology and blood grouping and patient prepped accordingly for operative management.

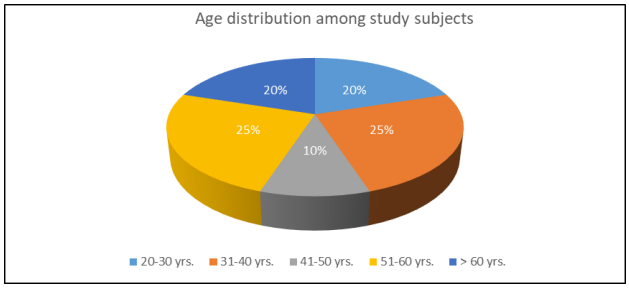

Figure 1: Distribution of study group according age group.

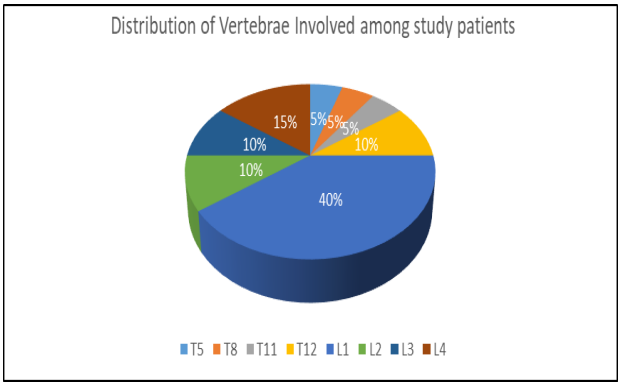

Figure 2: Vertebra affected in the study group.

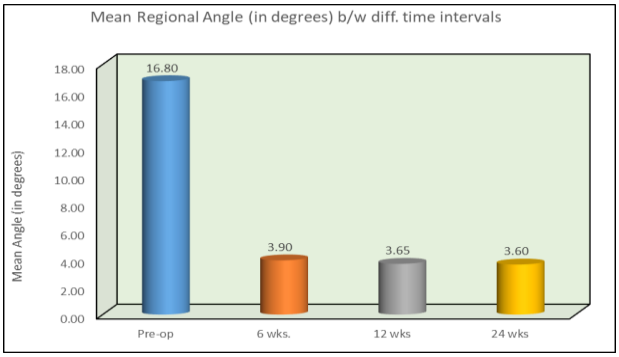

Figure 3: Regional angle in the study group.

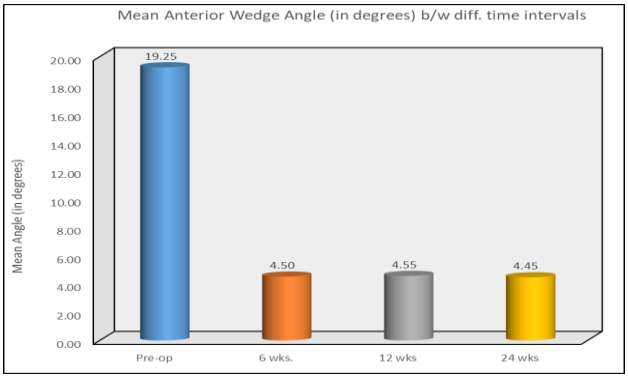

Figure 4: Anterior wedge angle in study group.

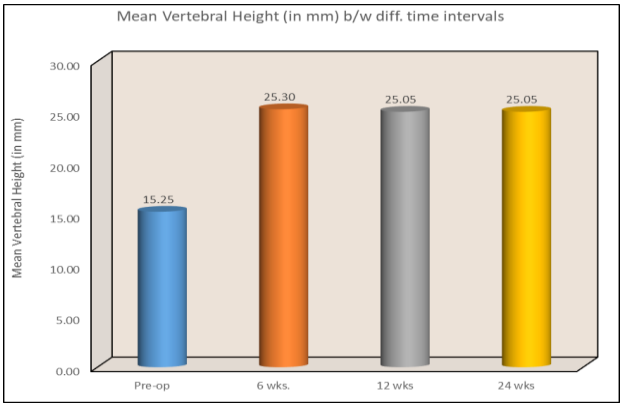

Figure 5: Vertebral height in study group.

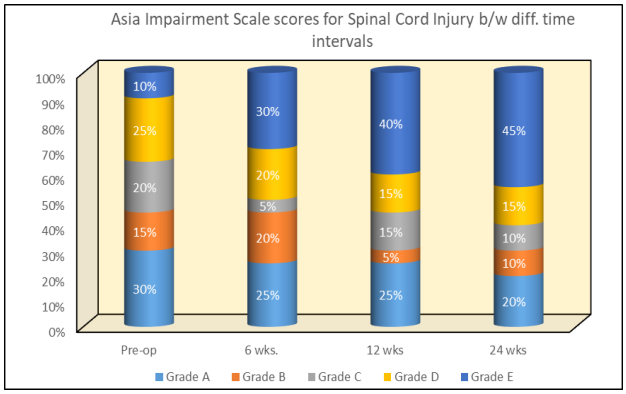

Figure 6: ASIA grading for neurological status in study group.

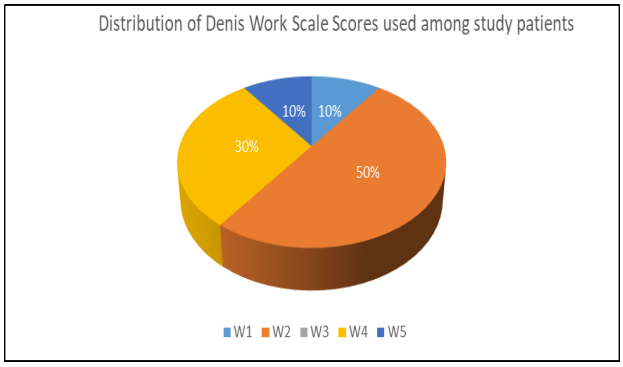

Figure 7: Functional outcome-Denis work scale.

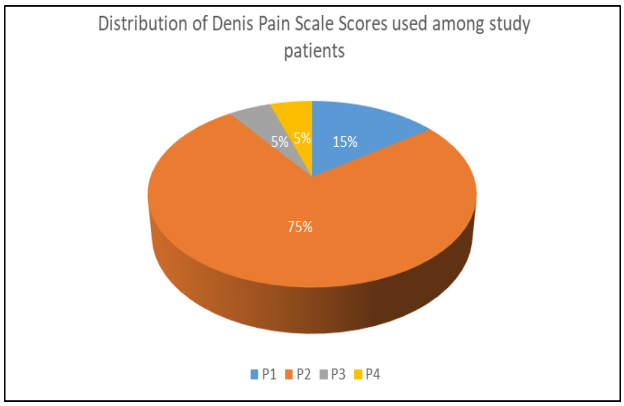

Figure 8: Functional outcome-Denis pain scale.

Table 1: Type of fracture.

Variables	Category	N	Percentages (%)
Types of Fracture	Type A: Compression fracture	15	75
	Type B: Distraction	4	20
	Type C: Rotational	1	5

DISCUSSION

Spinal trauma is one of the serious injuries. Thoraco-lumbar fractures are grave accidents that should be prevented. If untreated, the patient may experience significant morbidity and disability. The most frequent and serious issue in orthopaedic practise is spinal trauma.

Between 5% and 10% of polytrauma patients experience spine fractures or dislocations, with the thoracic or lumbar areas accounting for 65% to 80% of these injuries.[1] The motion segments at the thoracolumbar junction between T11 and L2 are affected by majority of these lesions.[2]

This transitional zone experiences significant biomechanical stresses during traumatic incidents due to the mobility differences between the thoracic and lumbar spine regions, making it more prone to fracture. These motion segments connect the relatively rigid, kyphotic thoracic spine, which is stabilised by the rib cage, to the more mobile, lordotic lumbar vertebrae.[1-4]

As a result of neurological injury, spinal fractures are frequently accompanied with motor and sensory disturbance, bladder and bowel abnormalities, erectile dysfunction, and deformities such kyphosis and scoliosis. Additionally, bed sores and lung infections are common among the patients.[5]

Care for the victims is sometimes overlooked in a country with little resources like India. Therefore, it is urgent to investigate the possibilities of surgical stabilisation, early mobilisation, and patient rehabilitation. Every spinal injury treatment aims to return the patient to the full function and a life free from disabilities. The goal of surgical intervention is to provide the spine with immediate stability, enable deformity repair, as well as the maximise neurologic recovery by directly or the indirectly removing any lingering impingement of the neural components.

The fixation provided by the variable screw placement system (VSP) is stiffer because the screw is inserted through the vertebral "force nucleus." All posterior forces that are communicated to the body pass through this location and are routed by five anatomical structures: the superior facet, the inferior facet, the lamina, the pedicle, and the transverse process.

Age and sex distribution

Mean age of the study group was 45.7 years with a standard deviation of 12.3 years. There were 75% of male patients and 25% of female patients from sample size of study.

These results were almost comparable to a study by Uzumcugil et al.[15] Alvine et al in their study found that average age was 31 years, with a male predominance.[16] Sasso et al in their study had 77% males and 23% females with a mean age of 34 years.[17] Razak et al in their study found that average was 30 years with a male predominance.[18] However the mean age in this study group was higher compare to these studies.

Level of injury

The most common vertebrae involved in this series were between T11-L2 to the extent up to 65%. While Alvine noted to the extent of 70%, Sasso et al noted to the extent up to 80% and Razak et al noted up to 92% of the fractures were at the level of T11-L2.[16-18]

Classification of fractures

About 75% of patients had type A fractures, 20% had type B and 5% had type C fractures in this study. Alvine et al, Sasso et al have also noted similar findings.[16,17]

Radiological parameters

Mean regional angle during the pre-op stage $16.8^0 \pm 4.79^0$, 6^{th} post-op week $3.90^0 \pm 3.64^0$, during 12^{th} post op week was $3.65^0 \pm 3.68^0$ and 24^{th} week post-op period was $3.60^0 \pm 3.65^0$

Nasser et al noted kyphotic angle was 23.6° on admission, 7° post-op and 11.5° at latest follow-up.[19] Alvine et al noted that sagittal plane angulation was 12° pre-op 1° post operatively and 6° at followup.[16] Sasso et al noted that the kyphotic angle was 17.6° pre-op 3.5° post op and 11.6° at latest follow up.[17] Razak et al noted that average kyphotic angle 20° pre-op 7° post-op and 9° at latest follow up.[18] Study showed similar results to Sasso et al.[17]

Neurological status

The ASIA grading for neurological state during pre-operative period-30% were graded as grade A, 15% as grade B, 20% as C, 25% as D and 10% as grade E. During 6^{th} post operative week, the grade A was 25%, B was 20%, C was 5%, D was 20% and E was 30%. During 12^{th} post operative week grade A was 25%, B was 5%, C was 15%, D was 15% and E was 40%. During 24^{th} week-post operative period, grade A was 20%, grade B was 10%, C was 10%, D was 15% and E was 45%.

Nasser et al noted that patients who had neurological deficits showed at least 1 grade improvement at latest follow up.[19] 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] Sasso et al in their study noted that all patients with incomplete neurological deterioration improved at least by 1 grade.[17] Razak et al noted that 64.4% of those with incomplete lesions showed an improvement of at least 1 grade.[18]

Complications

Study group showed 95% of patients with no complications and 5% with pressure sores as complication. Razak et al noted 2 instances of hardware loosening and 3 misplaced pedicle screws.[18]

Outcome

Among all the subjects 15% of the patients returned to their previous work or physically demanding job, 75% were able to return to previous employment with some restriction, 5% of the patients were unable to return to their previous employment but worked for full time in their new employment and 5% of the patients were unable to return to their fulltime work.

In this study 15% of the patients had no pain, 75% had occasional minimal pain with no need for medication, 5% had moderate pain with occasional need for medication and 5% had moderate to severe pain with occasional absence from work and change in activities of daily living.

CONCLUSION

The results of this study demonstrate the superiority of pedicle screw-rod instrumentation as a treatment for vertebral fracture. With this technique, thoracolumbar fractures have a very high statistical significance in restoration of vertebral body height, mean regional angle, and mean anterior wedge angle. When all instances with neurological abnormalities were combined, a considerable amount of neurological healing was observed.

There was a significant improvement in the overall well-being of the patient with decrease in the pain and improvement of daily living activities of the patient post-surgery. The surgery helped to stabilize the spine and helped in early mobilization of patient.

In our study the complications were minimal and patient benefitted with the surgery. We have concluded that prognosis is improved when interventions are made early. However, there are also certain restrictions in this study. In a prospective interventional study like this one, the value of pedicle screws isn't being validated by using a comparison group.

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Ethical approval: Not required

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