Functional Outcome of Various Surgical Modalities for Thoracolumbar Vertebral Fractures

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ABSTRACT: Introduction: Thoracolumbar fractures with neurological injury complicates 15-20% of the fractures occurring at thoraco-lumbar level.65% of thoracolumbar fractures occurs as a result of motor vehicle accidents, fall from height and injuries related to occupation and sports. It has major functional, medical, psychological and financial effects on the injured person family and society. Recent trends in management of thoracolumbar fractures with or without spinal cord injury is one of the controversial areas in modern spinal surgery and continues to evolve.
Aim and Objectives: To analyse the functional outcome and neurological recovery following surgical management of thoracolumbar fractures with spinal cord injury.
Materials and Methods: A prospective study was done on 25 patients with post traumatic thoracolumbar fractures with spinal cord injury in the Department of Orthopaedics, Vinayaka Mission Kirupanandavariyar Medical College Hospital, Salem. Patients with traumatic fractures of thoracolumbar region with spinal cord injury, presentation<3 weeks after the time of injury, age between 18-60 years were included in the study.
Results: Males have four fold increased risk than females in most of the studies. We too observed a male preponderance (80%) with a mean age of 34.7 years. Of the 25 patients in our series 10(40%) were operated within the first week of injury,9 patients (36%) in the second week and six (24%) in the 3rd week in the seven patients who were operated within one week, all of them had good neurological recovery with Frankel's grade improved to grade E in 5 patients and grade D in 2 patients.4 patients stabilized within 72 hours of injury had good neurological recovery, with Frankel's grade improved to grade E in three patients and grade D in 1 patient.
Conclusion: Hence, early surgical decompression and adequate spinal stabilization gives good results in spinal cord injury patient.

Keywords: *Spinal cord injury, thoracolumbar region, vertebral fracture, Frankel's score*.

INTRODUCTION

Thoracolumbar fractures with neurological injury complicates 15-20% of the fractures occurring at thoraco-lumbar level.65% of thoracolumbar fractures occurs as a result of motor vehicle accidents, fall from height and injuries related to occupation and sports. It has major functional, medical, psychological and financial effects on the injured person family and society. Recent trends in management of thoracolumbar fractures with or without spinal cord injury is one of the controversial areas in modern spinal surgery and continues to evolve. An unstable fracture of vertebrae produces spinal instability and narrowing of the spinal canal producing neurological deficit. The surgical spinal stabilization is indicated in these conditions to maintain the anatomical

position, to promote the early bony fusion, early mobilization and neurological recovery. Recent trend towards open reduction arthrodesis and stable internal fixation of spinal fractures are to allow rapid mobilization of patients reduced reliance on orthotic containment and protection against spinal malalignment or neurological injury when the patient is ambulant and to decease the complications of prolonged bed rest. In the past non-operative care in the form of either a body cast or a brace in stable thoracolumbar fractures without neurological deficit, avoids a major surgical intervention with its attendant morbidity.

The optimal treatment of patients with mild to moderate deformity and incomplete neurological deficit and residual spinal canal compromise after conservative or surgical management remains a grey area. During the past 25 years, the field of spine surgery has seen a dramatic increase in the operative management of thoracolumbar fractures with anterior or posterior spinal instrumentation to provide stable internal fixation has rapidly changed the concepts of patient management.

AIM AND OBJECTIVES

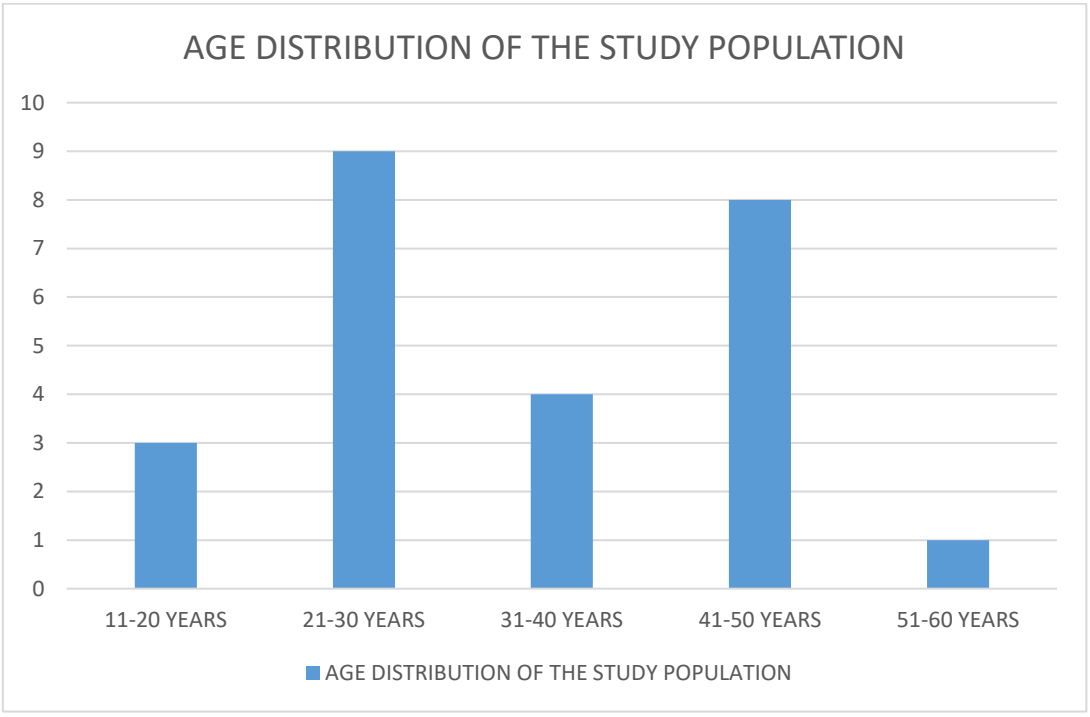
To analyse the functional outcome and neurological recovery following surgical management of thoracolumbar fractures with spinal cord injury.

MATERIALS AND METHODS

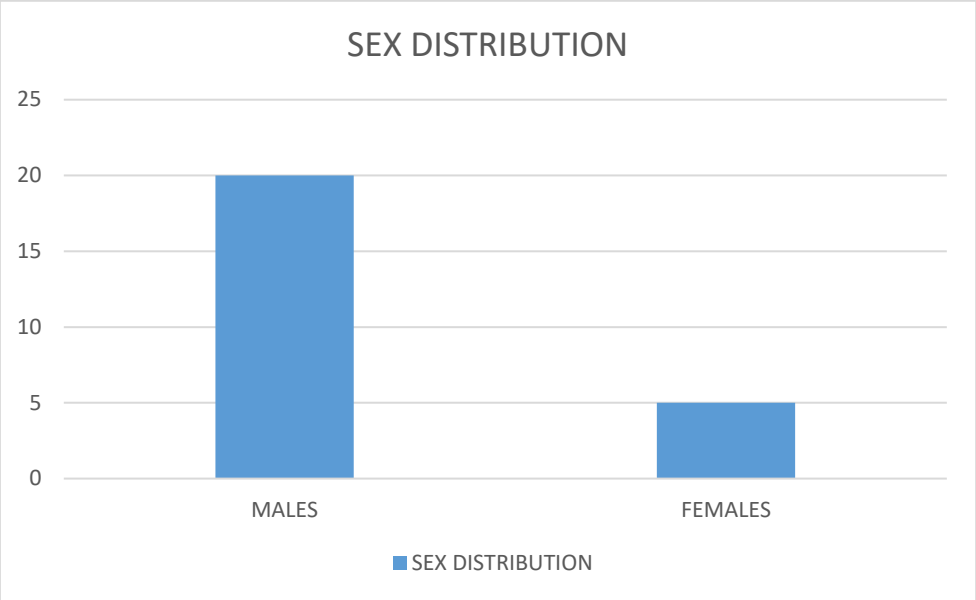
A prospective study was done on 25 patients with post traumatic thoracolumbar fractures with spinal cord injury in the Department of Orthopaedics, Vinayaka Mission Kirupanandavariyar Medical College Hospital, Salem. Patients with traumatic fractures of thoracolumbar region with spinal cord injury, presentation<3 weeks after the time of injury, age between 18-60 years were included in the study. Patients with head injury, open fractures, fractures due to osteoporosis pathological fractures, patients with cancer, systemic infection, bleeding disorders, extensive skin disease were excluded from the study.

RESULTS

Graph 1: Age Distribution of the Study Population



Graph 2: Sex Distribution of the Study Population



Graph 3: Frankel's Grade at Admission:

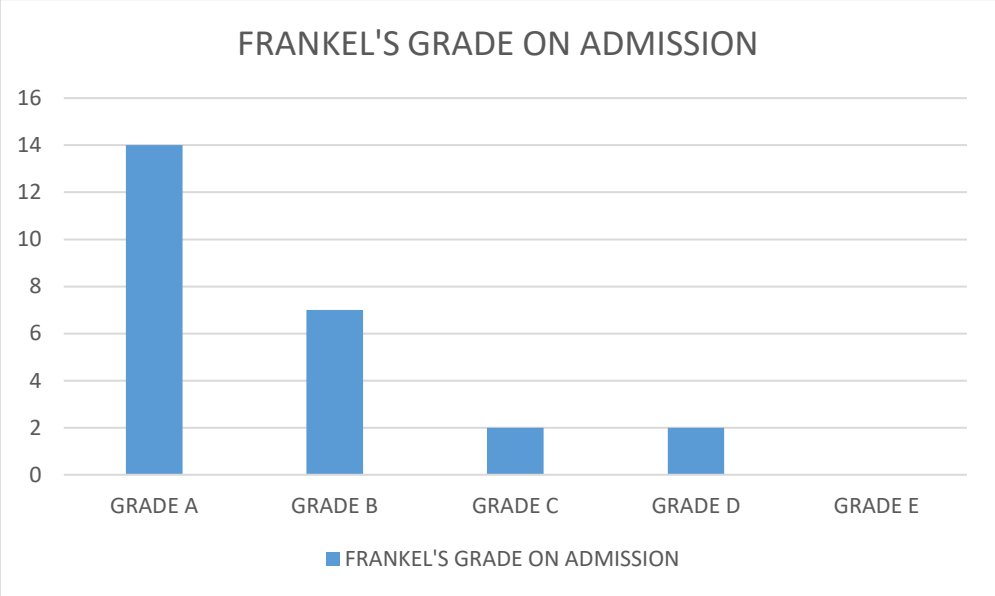
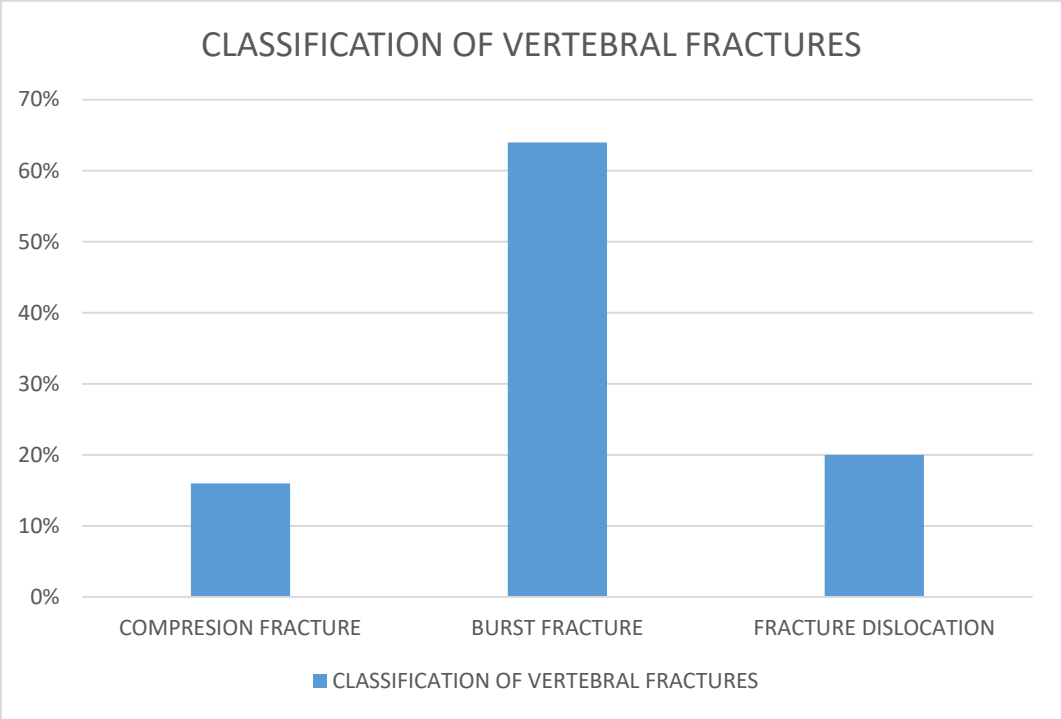


Table 1: Vertebral Fracture Level

LEVEL	NUMBER OF PATIENTS
D7	1
D8	0
D9	1
D10	2
D11	4
D12	5
L1	10
L2	2

Graph 4: Classification of Vertebral Fracture



Graph 5: Frankel's Grading Post-Operative

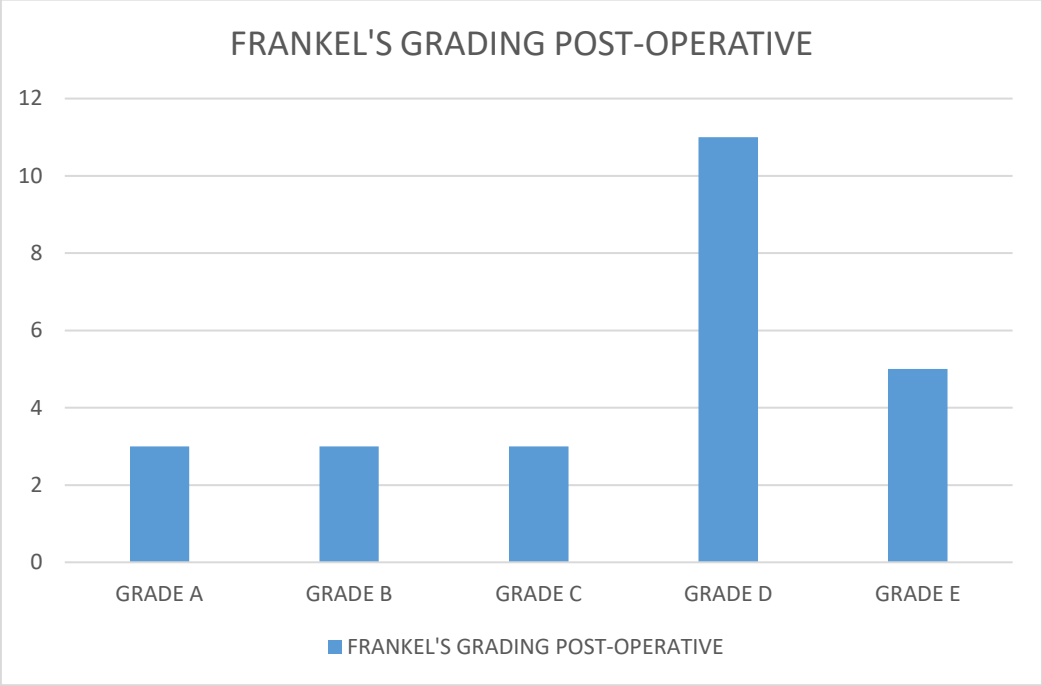


Table 2: Time of Surgery

TIME OF SURGERY	NUMBER OF PATIENTS
<1 WEEK	7
1-2 WEEKS	11
2-3 WEEKS	7

Graph 6: Functional Outcome

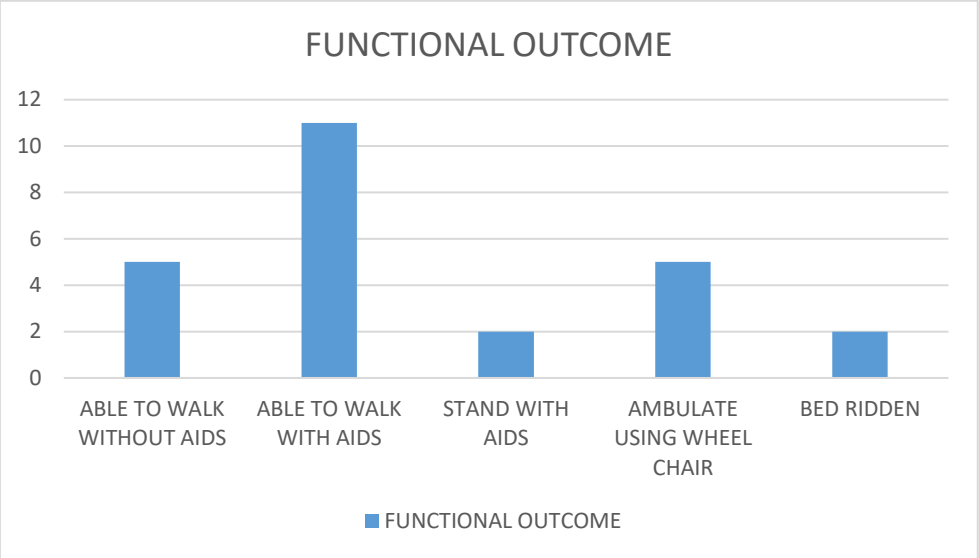


Table 3: Post-Op Complications

COMPLICATION	NUMBER	PERCENTAGE
SACRAL BED SORES	6	24%
RESPIRATORY INFECTION	4	16%
SURGICAL SITE WOUND INFECTION	3	12%

DISCUSSION

The unique transitional anatomy of the thoracolumbar spine renders it vulnerable to the high –energy deceleration trauma associated with fall from height and motor-vehicle collisions (3). The goal of the treatment of thoracolumbar fractures, regardless of the selected method are the restoration of the stability of the vertebral column and decompression of the spinal canal, leading to earlier mobilization of the patient and enhances the chances of neurological recovery. In 1975 Krauss et al noted that the most commonly injured region of the spine is dorsolumbar junction. About 16% of dorsolumbar injuries occur between T_1 to T_{10},52% between $T_{11}$to $L_1$and 32% between L_1 and L_5. In our study regarding the level of vertebral fracture D_{11} (4 patients-16%), D_{12} (5 patients-20%) and L1(10 patients-36%).The commonest type of fractures was burst fracture (64%).In 1991 Carpenter et al described that the injuries are sustained commonly by middle aged by younger individuals. They are almost always due to high energy trauma such as fall from height and motor vehicle accidents. The commonest mode of injury in our study was fall from height (60%).The other mechanisms being road traffic accident and fall of heavy object.

Males have four fold increased risk than females in most of the studies. We too observed a male preponderance (80%) with a mean age of 34.7 years. In 1983 Post and Green reported that 5-20% of patients with spinal injuries, contiguous and non-contiguous spinal injuries are also present. Calen off et al emphasised that failure to detect non-contagious concomitant injuries can lead to delayed instability and neurological deterioration. In our study too associated vertebral fractures encountered. In the study by Colter et al in 1986and Court Brown et al in 1988 described that depending on the type of dorsolumbar spine injury associated spinal and non-spinal injuries occur in upto 50% patients. Intra thoracic injuries occurred in about 20% of the patients while intra-abdominal injuries occurin 10% and associated skeletal injuries occurs in upto 20% of the patients. The most common of these are calcaneal (24%) and pubic rami (20%) fracture were the commonest associated injuries in

the study. The treatment of thoracolumbar fractures with cord injury remains a controversial issue. Early reports of decompression and stabilization in patients with neurological deficit and thoracolumbar fracture demonstrated improvement that was equal to that of non-operative results with the advent of newer instrumentation techniques and aggressive direct anterior decompression, the degree of neurological recovery appears more favourable than earlier reports. Mchain studied patients with severe spinal fractures treated with segmental fixation and described its advantages viz. immediate mobilization of patients with less dependence on bracing, the distribution of corrective forces over multiple levels and the reduction of the likelihood of implant failure.

Indication for spinal intervention is the presence of progressive neurological deterioration in the presence of spinal cord compression (1). When direct spinal cord compression is promptly performed in such an injury neurological recovery has been observed. Of the 25 patients in our series 10(40%) were operated within the first week of injury,9 patients (36%) in the second week and six (24%) in the 3rd week in the seven patients who were operated within one week, all of them had good neurological recovery with Frankel's grade improved to grade E in 5 patients and grade D in 2 patients.4 patients stabilized within 72 hours of injury had good neurological recovery, with Frankel's grade improved to grade E in three patients and grade D in 1 patient. Excellent spinal canal decompression can be achieved by either a posterolateral transpedicular or an anterior approach (2,3). In our study, spine was exposed through posterior approach in the majority of cases (68%) .8 patients (32%) were approached anteriorly. In the presence of a non-progressive neurological deficit the evidence supporting surgical decompression is conflicting. Most of the surgeons feel that canal compromise in the absence of a neurological deficit is not an indication for surgery. Since canal remodelling can occur with time, in patients whose fractures are surgically reduced and stabilized. Dai et al (4) found that the degree of spinal canal stenosis was similar in those treated non-operatively as compared to operatively in a comprehensive review of the literature, Boegar et al (5) failed to find support for canal clearance. Boeger et al (5) go as far as to state that in the absence of instability any canal clearance by surgical intervention would be causing a patient a disservice. There is no role of isolated laminectomy for decompression of thoracolumbar fractures, since laminectomy disrupts the posterior elements contributing to further instability.

Regarding the level of fusion many authors agree the long segment fusion (instrument two or more levels above and below a fractured vertebra) is stronger and stiffer (higher ultimate failure that short segment fixation (instrumentation one level above and below a fracture vertebra) however it sacrifices spinal motion. In our study, of the 10(40%) patients who sustained L1 fracture, eight (32%) of them neurologically recovered to Frankel's grade E and D and were walking independently. Similarly, the two patients who patients who sustained L2fracture were improved to Frankel's grade E and D. It revealed that the functional outcome of neurological recovery in patients who sustained lumbar fractures were good which were correlated with other studies (6). The location of fracture can influence the surgeon's choice of fusion. A long fusion in the upper and middle thoracic spine does not reduce patient's mobility and function much. However, the thoraco lumbar and lumbar spines are functionally very important. Preservation of mobility in these segments of the spinal column is fundamental particularly in manual workers whose jobs require increased demands of spine with regard to stabilization after decompression when a single vertebral body is highly comminuted, anterior reconstruction of the spinal column and anterior instrumentation is superior to posterior fixation(7).The pedicle screw rod systems, by virtue of direct fixation through middle and anterior columns, are able to reduce fractures of these columns by ligamentotaxis.Transpedicular screw rod construct is currently the standard in segmental fixation of thoracolumbar spine(6). Posterior surgery with pedicle screw constructs over a short segment stabilizes the fracture and allows early mobilization, much as nonoperative regimens do. Recent prospective randomized studies comparing these two treatment options suggest there is no clinical advantage of surgery over non-operative care (7). Surgery corrects deformity but modest recurrence is common, even with attempts to perform

transpedicular bone grafting, as the anterior column remains deficient (8). Anterior decompression will be more efficient for decompressing the spinal cord in burst fractures. Anterior decompression has been shown to increase axoplasmicflow, decrease ischaemia and lead to improvement of neurological function. The disadvantage of posterior approaches to achieve anterior decompression include the need to resent major portions of neural arch (often uninjured) to obtain access to the middle column. Finally, it is difficult to reconstruct the anterior and middle columns after a posterior approach has been used to decompress a burst fracture, and there is significant incidence of construct failure (9).

Our experience with short segment pedicle screw based fixation has been excellent, we utilized short segment fixation for young healthy people with isolated spinal injuries. While out of bed patient must wear a brace, for 6-8 weeks until the fusion consolidated. Stabilization was done with Hartshill rectangle with sub laminar wires in patients (16%), pedicle screw instrumentation in patients (52%) and anterior stabilization with vertebral screws and rods with bone graft (cage/strut graft) (32%) in our series. We used a full-thickness autologous iliac struct graft to reconstruct the spinal column with excellent results. We performed a modular and stackable cage spacer filler with auto graft from the vertebrectomy and excised rib, with same type of dual rod/screw implants. Use of the cage avoided the large iliac crest site pain.

Follow up:

Post-operative intravenous antibiotics were given for 72 hours, sutures removed on 15th day and patients discharged after through education regarding back care, bladder care and rehabilitation protocol. Patients were followed in the 1st, 3rd and 6th month with complete neurological evaluation (Frankel's grading) and radiographs obtained. The longest follow up was 24 months and shortest 6 months with a mean of 13 months. Regardless of the fixation system used, we were careful not to over distract the fracture site. The normal sagittal and coronal spinal alignments were restored, with or without fully correcting the vertebral height. Overzealus distraction using a principle of ligamentotaxis creates a gap (empty space) at the fracture site which further decreases the load sharing of the axial forces between the implants and fractured body and hence avoided. Post-surgical kyphosis is a clinical and radiological condition, which results following a failure after operative stabilization. It can develop due to failure to recognize or under-estimation of translational injuries, poor bone quality, inadequate spinal bracing or follow up or errors in surgical bracing or follow up or errors in surgical technique or spinal healing. It can be mild, moderate or very severe. Patients can present with mechanical or neurological symptoms. Back pain is the most common presenting feature an indication for intervention. In our study, we were fortunate for not encountering post-surgical kyphosis. Six patients who did not improve clinically, whose neurological status remained same were followed up with post-operative MRI, which revealed severe cord degenerative changes. Post-operative Frankel's grade improved to Grade E in five patients (20%) and grade D in 12 patients (44%).Six months after surgery were consistent with most of the major studies.

In the 7 patients who were operated within one week, all of them had good neurological recovery with Franknel's grade improved to grade E in 5 patients and grade D in 2 patients.4 patients stabilized within 72 hours of injury had good neurological recovery with Franknel's grade improved to grade E in 3 patients and grade D in 1 patient.

CONCLUSION

Severity of primary cord damage at the time of accident constitute major factor in the neurological recovery of the patients. Earlier the intervention and less number of transfers of patients from place to place gives good prognosis. The most commonly injured region of the spine is dorsolumbar junction. L1 constitutes majority (40%) of the fracture. In most patients we stabilized spine through posterior approach and we achieved good neurological recovery. Majority of the patients (64%) is walking independently and resumed to their normal

activities with good neurological recovery. Hence, early surgical decompression and adequate spinal stabilization gives good results in spinal cord injury patient.

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