

# A Study of Fracture Patterns and Preventive Strategies of Thoracolumbar Spine Injuries

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## ABSTRACT

**Introduction:** Thoraco-lumbar spine fractures form majority of spine fractures and is an important cause of morbidity. However, comprehensive data regarding epidemiological pattern of trauma patients with spinal fractures are scarce. Many epidemiological reports about spinal fractures focus on osteoporosis as an etiologic factor. But in Indian population more important etiologic factors are road traffic accidents and falls from height. Studies concerning only operatively treated patients with spinal fractures show selective and biased data that might be useful for capacity planning in hospitals or evaluating results of operative treatment, but not for epidemiological purposes

**Material and Methods:** 86 consecutive patients with thoracic or lumbar fractures attending the out-patient department or Emergency department of Sree Gokulam Medical College Hospital, Trivandrum were enrolled in the study. All patients with fractures of the thoracic or lumbar spine were enrolled in this study.

**Result:** Distribution of fracture pattern in thoracolumbar spine injuries were studied. And the methods to prevent those fractures are listed in this study.

**Conclusion:** This study is a prospective cohort study of the epidemiological aspects and pattern of injury and treatment in thoraco-lumbar spine fractures at a tertiary care referral center. A total of 86 patients were enrolled in the study. The most common fracture pattern seen in this study was compression fractures (24.4%) which are stable. This was followed by stable burst fractures (23.2%, unstable burst fractures (18.6%), translational injuries (fracture-dislocations)(16.3%), flexion-distraction injuries(13.9%) and chance fractures(3.5%).

**Keywords:** Compression Fractures, Stable Burst Fractures Unstable Burst Fractures, Translational Injuries (Fracture-Dislocations), Flexion-Distraction Injuries and Chance Fractures, Tomography, ASIA Grading, McAfee Classification

## INTRODUCTION

Thoracolumbar spine fractures form majority of spine fractures and is an important cause of morbidity. Many epidemiological reports about spinal fractures focus on osteoporosis as an etiologic factor. But in Indian population more important etiologic factors are road traffic accidents and falls from height. The present study examines the etiology, patient characteristics, fracture patterns and treatment of thoracic and lumbar fractures at a tertiary care hospital. The most frequently diagnosed single spinal fracture is the thoraco-lumbar fracture without neurological deficit. The high prevalence rates in 20-29 years old men represent the young male peak in general in epidemiological

studies in traumatology.<sup>9</sup> In patients with spinal fractures of the thoraco-lumbar transition the observed male/female ratio is 2.5 at age 20-29 and shows inversion at the age of 60. The present study was done for demography, fracture patterns and preventive aspects of thoracolumbar fractures at a tertiary care hospital.

## MATERIAL AND METHODS

This study was conducted from January 2015 to February 2016 in the Department of Orthopedics, Sree Gokulam Medical College, Trivandrum. 86 consecutive patients with thoracic or lumbar fractures attending the out-patient department or Emergency department of Sree Gokulam Medical College, Trivandrum were enrolled in the study. After initial stabilisation of the general condition of the patient, necessary specialty teams were involved in the management of associated other system injuries.

All patients with fractures of the thoracic or lumbar spine were enrolled in this study. Data collection techniques and tools were as follows- Thorough history regarding the mechanism of trauma, associated injuries like head, abdomen, chest and extremity trauma were obtained and recorded in the proforma. Thorough neurological examination and classification according to ASIA impairment scale was done. Charting of motor power of muscle groups was done according to the Medical Research council grading system Plain Anteroposterior and Lateral radiographs were obtained for suspected areas of Spine fracture. When a fracture was identified, further imaging was done with Computed Tomographic scans of the fractured region to aid in classifying the fracture. In cases with neurologic deficits, MRI scan of the affected region was obtained to ascertain the status of the neural elements.

Based on the findings on plain radiographs and CTomographic imaging, the fractures were classified according to McAfee's classification. MRI was not done as a routine imaging in all cases as there were limitations in view of availability and affordability for the patients during the study period (2015-2016). The fractures were classified into one of the five

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categories of McAfee's classification- compression, Burst, Chance, Flexion Distraction and translational injury. Since this is an observational cohort study, treatment decisions were not influenced by the study and data was collected regarding the treatment given to each patient on an "as-treated" basis.<sup>1</sup>

Patients were treated by both surgical and non surgical means and these were recorded. The study did not influence the modality of treatment chosen.

The data collected were tabulated according to the demographic characteristics of the patients, the etiology, McAfee classification, neurological injury status and the treatment given.

**Inclusion criteria:** All the patients with spine injury attending the emergency department of Sree Gokulam Medical College, Trivandrum are included in the study.

**Exclusion criteria:** Spine injuries associated with the severe head injury and patients with poly trauma and severe multi system involvement and patients of extremes of age are excluded in the study.

**Study Population:-** Data was collected from all (86) patients coming to the emergency department and OPD having thoracic and lumbar vertebral fractures of diagnosed by x-rays or CT-scan.

**Data collection technique:** 86 consecutive patients with thoracic or lumbar fractures attending the out-patient department or Emergency department of Medical college Hospital, Trivandrum were enrolled in the study. All patients with fractures of the thoracic or lumbar spine were enrolled in this study. Thorough history regarding the mechanism of trauma by history and clinical examination by a standard proforma.

## RESULTS

The study was conducted as an observational study to study the epidemiological characteristics of spine fractures presenting to a tertiary care center.

Out of a total of 86 patients enrolled in the study more than two-third (68.6%) was males (Table 1). This reflects the relatively greater extent of high risk work and greater amount of road travel undertaken by males in our society. Many of these men may not be able to return to their previous occupations requiring heavy manual work.

Age distribution of these fractures show more or less "bell shaped" distribution with the number of patients in the extremes of age progressively decreasing (Table 2). Two peaks are distinctly observed. First peak is in the 21- 40 years age groups representing the young and physically active subjects sustaining fractures primarily due to high velocity trauma like fall from height and road traffic accidents. The second peak in the age distribution is in the 60-80 years age group. These patients generally sustained the injury as a result of low velocity trauma like fall at home. In this age group the bone strength is predictably low. Majority of these low velocity trauma resulted in the stable type of injuries,

mostly compression fractures.

Road traffic accidents constituted the most common etiology of injury accounting for nearly 40 percent of cases (Table 3). Fall from height (fall from terrace, construction site accidents, fall into pits) constituted 19.7 percent. This point to the importance of the necessity for stricter safety requirements at construction sites. Safety net, catch platform or fall arrest harness system should be made mandatory for work sites involving manual work at heights. Ensuring proper coverage of unattended pits are also important in preventing falls.

Fall from trees constituted 17.4 percent. Climbing coconut trees for plucking coconuts is a common practice in Kerala and this sometimes results in accidents. These generally constitute high velocity injuries. Unfortunately most of these patients presented with neurological deficit, usually complete. Thus, fall from height and fall from trees put together constituted nearly 37.1% in our study.

Domestic falls constituted 23.2% of the thoraco lumbar fractures. Elderly subjects are at risk of falling in the domestic environment due to physical weakness, failing coordination and diminished vision. Notably there was no case of spine injury from sports or leisure activities.

The most common fracture pattern seen in this study was compression fractures which are stable (Table 4). This was followed by stable burst fractures, unstable burst fractures, translational injuries (fracture-dislocations), flexion distraction injuries and chance fractures.

Compression fracture involves only injury to the anterior column with the middle and posterior columns intact. 21 cases (24.4%) presented with this pattern of fractures. None of these patients had neurological deficits. Most of these fractures resulted from low velocity trauma especially in the elderly. These are considered stable.

Next common fracture type were stable burst fractures 20 cases (23.2%). Stable burst fractures involve fracture of anterior and middle column and the mechanism of injury is usually vertical compression as in a case of fall from height. Both these columns fail in compression. The posterior column is left intact. These are considered stable because of the intactness of the posterior tension band. None of these 20 patients had neurological deficit. When the posterior column also fails in compression they constitute the unstable burst fracture pattern.

Unstable burst fracture are, as the name suggests, are mechanically unstable. Here, the anterior, middle and posterior columns fail in compression. In our study, 16 cases (18.6%) presented with unstable burst fracture pattern of which 9 cases had neurological deficits. 3 cases had complete neurological deficit (ASIA A) while six had partial neurological deficit.

Next common injuries were translational injuries (fracture-dislocations) which were present in 14 (16.3%) patients.

Male	59 (68.6%)
Female	27 (31.4%)
Total	86

**Table-1:** Gender Distribution

	<20 yrs	21-40 yrs	41-60 yrs	61-80 yrs	>80 yrs
Male	2	17	15	15	10
Female	2	4	5	10	6
Total	4 (4.6%)	21 (24.4%)	20 (23.2)	25 (29.0%)	16 (18.6%)

**Table-2:** Age Distribution

	Total	Male	Female
Road Traffic Accident	34	24	10
Domestic Fall	20	8	12
Fall from Tree	15	15	0
Fall from Height	17	12	5
	86	59	27

**Table-3:** Etiology of injury

	Male	Female	Total
Compression	11	10	21
Stable Burst	16	4	20
Unstable Burst	10	6	16
Chance	3	0	3
Flexion Distraction	7	5	12
Translational injury 12 (Fracture Dislocation)		2	14

**Table-4:** Fracture pattern distribution

	Total	ASIA A	ASIA B	ASIA C	ASIA D	ASIA E
Compression	21	0	0	0	0	21
Stable Burst	20	0	0	0	0	20
Unstable Burst	16	3	0	3	3	7
Chance	3	0	0	0	1	2
Flexion Distraction	12	4	0	0	2	6
Translational injury (Fracture Dislocation)	14	13	1	0	0	0

**Table-5:** Distribution of Neurological deficits

	Non-Operative	Surgical Stabilisation	Total
Compression	21	0	21
Stable Burst	20	0	20
Unstable Burst	6	10	16
Chance	1	2	3
Flexion Distraction	1	11	12
Translational injury (Fracture Dislocation)	2	12	14

**Table-6:** Treatment given for different fracture patterns

<b>Non Operative group (n= 51)</b>	
Pressure sores	4
Urinary infection	11
Pneumonia	2
Deep Vein Thrombosis	1
Deaths	1
<b>Operative group (n=35)</b>	
Surgical site infection	1
Wound dehiscence	2
Urinary infection	13
Pneumonia	4
Pressure sores	2
Deep Vein Thrombosis	0
Deaths	1

**Table-7:** Complications

These are devastating injuries in which all three columns fail in shear. In our study all patients had paraplegia (13 ASIA A and 1 ASIA B). Most of them sustained injury due to fall from height (building) or fall from tree.

Flexion distraction injuries accounted for 13.9% of cases with 12 patients presenting with these injuries. 50% had neurological deficit of which 4 presented with complete paraplegia and 2 presented with ASIA D neurology. Flexion Distraction injuries are highly unstable injuries as evidenced by the high incidence of neurological deficits. In this type of injury, anterior column fails in compression and middle and posterior columns fail in distraction. Most of these injuries resulted from road traffic accidents. In our study, three patients presented with chance fractures making it the least common type of fracture in our study.

In all, 30 patients (34.8%) presented with neurological deficit (Table 5). 20 patients had complete neurological deficits categorized as ASIA A evidenced by absence of any neurological function (sensory or motor) below the level of injury even after the cessation of spinal shock (Table 5). This carries a very poor prognosis for recovery of any neurological function. Most of these cases were of fracture-dislocation, flexion distraction and unstable burst type of fractures denoting high velocity injury.

Ten patients had partial neurological deficits (one ASIA B, three ASIA C and six ASIA D). These carry a better prognosis for neurological recovery as significant structural damage to spinal cord is unlikely in these cases

Treatment: 51 patients (59.3%) were managed non operatively (Table 6). Non operative treatment is indicated in stable patterns like compression fractures and stable burst fractures. These fracture patterns presented with neurologically intact patients. In 10 patients non surgical treatment was chosen even though the fracture pattern was unstable. This was due to unacceptable risk for anaesthesia due to co morbidities, such as severe associated other system injuries requiring abdominal surgery and open stoma, extensive de-glowing or infected skin abrasions over back and patient refusal for surgery.

Non operative treatment in stable fracture patterns involve bed rest for a period of about one week followed by mobilization with the help of a Thoraco-Lumbo-Sacral Orthosis (TLSO of Taylor's Brace type).

Surgical stabilization is indicated in all cases with neurological deficits and also in cases with unstable pattern of injury. Fracture dislocations, flexion-distraction, chance fractures and unstable burst fractures are considered unstable and warrant surgical stabilization. Surgical stabilization aims at restoring the biomechanical integrity by realigning the spine, allowing load bearing without risk of further neurological damage and maintaining such position until healing occurs. In our study, pedicle screw stabilization was used for fixation.

In our series, 35 out of 86 cases were surgically stabilized with pedicle screws. After surgery patient were mobilized on bed three to four days after surgery with the help of a Thoraco-Lumbo-Sacral Orthosis (TLSO of Taylor's Brace type). Neurologically intact patients were allowed to ambulate as soon as possible as per comfort. Those with neurological deficit were mobilized on wheel chair within the first week after surgery. Complications were mainly pressure sores, urinary infections, pneumonia in both groups (Table 7). There was a death in the non operative group in which a 56 yr old man died following myocardial infarction. One death was also observed in the operative group. A 65 year old lady died following septicemia arising from urinary tract infection.

## DISCUSSION

This study is a prospective cohort study of the epidemiological aspects and pattern of injury and prevention in thoracolumbar spine fractures at a tertiary care referral centre.

A total of 86 patients were enrolled in the study. More than two-third (68.6%) were males reflecting the relatively greater extent of high risk work and greater amount of road travel undertaken by males in our society and also the economic importance when the breadwinner of the family is injured (Table 1).

Age distribution of the patients showed two distinct peaks.<sup>2</sup> First peak is in the 21-40 years age group representing the young and physically active subjects sustaining fractures primarily due to high velocity trauma like fall from height and road traffic accidents. The second peak in the age distribution is in the 60-80- years age group sustaining injury due to domestic fall (Table 2).

The most common fracture pattern seen in this study was compression fractures (24.4%) which are stable. This was followed by stable burst fractures (23.3%, unstable burst fractures 918.6%), translational injuries (fracture dislocations) (16.3%), flexion distraction injuries (13.9%) and chance fractures (3.5%) (Table 4).<sup>3,4</sup>

In our series 34/8% had neurological deficits of which two thirds (23.2%) constituted ASIA A injuries (complete spinal cord injury).<sup>5</sup> In the Wang H series, 479 (15.3%) patients were classified as having ASIA A injuries, 913 (29.1%), ASIA B, ASIA C or ASIA D; and 1750 (55.7%), ASIA E, Knutsdotir et al series included only patients with spinal cord injuries of which 39% had complete injuries (Table 5).<sup>6,7</sup>

Treatment methods were analysed on 'as-treated' basis. 51 patients (59.3%) were managed nonoperatively. Non operative treatment is indicated in stable patterns like compression fractures (Table 6).

Non operative treatment in stable fracture patterns involve bed rest for a period of about one week followed by mobilisation with the help of a thoraco lumbosacral orthosis (TLSO of Taylor's Brace type).<sup>8</sup>

In our series, 35 out of 86 cases were surgically stabilised with pedicle screws.<sup>9</sup> After surgery patient were mobilised on bed three to four days after surgery with the help of a thoraco lumbosacral orthosis (TLSO of Taylor's Brace type). Neurologically intact patients were allowed to ambulate as soon as possible as per comfort. Those with neurological deficit were mobilised on wheel chair within the first week after surgery. One of the largest series touching on the epidemiology of thoraco lumbar spine fractures were published by Wang H et al.<sup>10</sup> They retrospectively analyzed 3142 patients with traumatic spinal fractures. 65.5% of the patients were male. The peak frequency of these injuries occurred in the 31- to 40-year-old age group. Accidental falls and traffic accidents were the most common causes of spinal fractures (58.9% and 20.9%, respectively). Traffic accidents tended to occur in younger patients, whereas accidental falls tended to occur in older patients. The most common area of fracture was the thoraco-lumbar spine (54.9%). Cervical spinal fractures were significantly more common in patients injured in traffic accidents, while lumbar spinal fractures were more common in accidental fall patients.

In the Wang H series,<sup>10</sup> 479 (15.3%) patients were classified as having ASIA A injuries; 913 (29.1%), ASIA B, ASIA C,



or ASIA D; and 1750 (55.7%), ASIA E. ASIA A injuries were more common in patients who suffered thoracic spinal fractures (15.09%) than in those with fractures in other areas of the spine. A total of 954 (30.4%) patients had associated nonspinal injuries. Of these patients, 389 (40.78%) suffered a thoracic injury, and 191 (20.02%) sustained a head and neck injury. The length of hospitalization differed significantly between the accidental falls from high heights and falls from low heights, as did the mean cost of hospitalization ( $p < 0.05$ ), but no significant difference was found between accidental falls from high heights and traffic accidents ( $p > 0.05$ ). The length of hospitalization differed significantly among the 3 groups according to the ASIA classification, as did the mean cost of hospitalization ( $p < 0.05$ ). Of patients with incomplete lesions, 39.3% improved 1 or more grades in ASIA classification during hospitalization. Accidental falls emerged as the leading cause of traumatic spinal fracture in this study, and the numbers of fall-induced and sports-related injuries increased steadily with age. They suggested that there should be increased concern for the consequences of fall- and sports-related injuries among the elderly.

Knutsdotir et al published data on spinal cord injuries in 207 patients in Iceland over a 34 year period between 1975 and 2009. This was a population based retrospective analysis. A total of 207 patients with traumatic spinal cord injury (TSCI) were admitted: males 72%, females 28%. The percentage of females with TSCI increased to 37% in 2000-2004. Mean age at injury was 38 years. Causes of injury were road traffic accidents (RTA) in 42.5% of the cases. Falls amounted to 30.9%, with an increase of low falls among the elderly causing incomplete cervical lesions. Sport/leisure activities were the cause in 18.8%, of which 54% occurred after 2000. The main single cause of TSCI in sport/leisure was horse-riding accidents, followed by winter sport accidents, especially among women. Other causes constituted 7.7%. The injury was complete in 39%; cervical lesions were 57% and thoracic/lumbar lesions were 43%. In December 2009, the crude prevalence rate was 526 per million populations. The findings showed a significant increase of TSCI in 2005-2009, especially in sport/leisure accidents and incomplete cervical lesions due to falls among elderly.<sup>7</sup>

## CONCLUSION

The males constitute more than two-thirds of cases of thoracolumbar spine fractures. The age groups 21-40 years and 61-80 constitute two distinct peaks for this injury. Most common fracture type was compression fractures without neurological deficits. However more than a third presented with neurological deficits while more than one fifth had complete neurological deficits. Prevention strategies need to focus on these risk groups and on seatbelt use.

- 1). Adherence to traffic rules especially avoiding to drunken driving, wearing seatbelts and avoiding rash driving.
- 2). The importance of the necessity for stricter safety requirements at construction sites, safety net, catch platform or arrest harness system should be made mandatory for worksites involving manual work at

heights.

- 3). Ensuring proper coverage of un attended pits are also important in preventing falls.
- 4). Proactive action from the government and increased awareness among the public about the importance of observing traffic rules.
- 5). Safer technique for harvesting coconut by using machines or using monkeys.

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