ORIGINAL ARTICLE

Clinico-Radiological Profile of Thoraco-Lumbar Fractures - An Institutional Experience

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ABSTRACT

Introduction: The thoracolumbar fracture constitutes 90% of all traumatic spine fractures, out of which thoracolumbar junction (TLJ) accounts for 50-60% of all thoracolumbar fractures.

Patients and Methods: A retrospective, as well as prospective study, was conducted on 30 patients from March 2020 to February 2021 in Sher-I-Kashmir institute of Medical Sciences, Srinagar. All patients radiologically diagnosed with thoracolumbar spinal injury were clinically evaluated, classified and treated accordingly. In addition, pre-and post-operative clinical grading of the patients was noted, and outcomes were assessed as good or poor.

Results: In the study, 20 patients had a good outcome, out of which almost half had wedge angle <25o & canal compromise <50%, 16 had kyphotic angle <25o, and seven patients had cord contusion. Among ten patients who had a poor outcome, 6 had wedge angle >25o, 7 had kyphotic angle >25o & 7 had a canal compromise >50% and nine patients had cord contusion on assessment of MRI.

Conclusions: Imaging parameters like wedge angle, canal compromise & cord contusion can be correlated with initial neurological status for a better understanding of treatment and the prognosis of the injury. Wedge angle greater than 25o, canal compromise of more than 50% and an ASIA grade 'C' and below are best treated surgically and carry a poor prognosis. Non-operative treatment choices are reserved for patients with good clinical and radiological grading.

Keywords: Spinal fracture, thoracolumbar fracture, paraplegia, spinal injury

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INTRODUCTION

The thoracolumbar fracture constitutes 90% of all traumatic spine fractures[1], out of which thoracolumbar junction (TLJ) accounts for 50-60% of all thoracolumbar fractures[2]. Since the thoracic spine is kyphotic and stiffer, there is abrupt switching of forces into the distal mobile lordotic lumbar spine at the thoracolumbar junction, biomechanically leaving this transition zone prone to injuries. Mechanism of injury to the thoracolumbar junction is complex and usually is flexion-distraction, axial compression & rotation[3]. High energy trauma such as motor vehicle accidents are the leading cause of TLJ fractures and carry a mortality rate of 7% [4]. Most of the patients with TLJ fracture present with severe spinal cord injury and complete neurological injury. Almost 50% of the patients have cerebrospinal fluid leak & dural tear and are associated with thoracic and abdominal organ injury. The primary management of unstable TLJ fracture is optimal neural decompression, spinal stabilization, nursing care and rehabilitation. Either by anterior, posterior or combined approaches, stabilization and fusion can be achieved. However, the posterior approach is less extensive, so is the preferred by Neurosurgeons. Transpedicular fixation is a safe procedure that achieves reduction, stability and fusion along with early mobilization and pain relief.

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AIMS & OBJECTIVES

1. To determine the clinical profile of patients with D12-L1 junction injury.
2. Correlate radiological parameters with clinical outcome.

MATERIALS AND METHODS

1. This study was retrospective and prospective and conducted on 30 patients from March 2020 to February 2021 at Sher-i-Kashmir Institute of Medical Sciences, Srinagar, India. All patients who were radiologically diagnosed with thoracolumbar spinal injury were included. We excluded patients with pathological fractures and patients having a severe head injuries. We enrolled 30 patients. The motor power in the lower limbs was graded according to MRC (Medical Research Council's) grading[5]. The neurological classification of the patients was done using ASIA (American Spinal Injury Association) scale 6 in which

ASIA "A" are the patients with complete injury, no sensory or motor function preserved.

ASIA "B" is Sensory but not Motor Function is preserved below the neurological level and includes the Sacral Segments S4-S5.

ASIA "C" Motor Function is preserved below the Neurological Level, and more than half of key muscles have a muscle grade less than 3.

ASIA "D" Motor function is preserved below the neurological level, and at least half of key muscles have a muscle grade ≥ 3.

ASIA "E" are the patients with normal neurology.

The bladder and bowel functions were also recorded, and an appropriate urodynamic study was performed. Lateral x-ray of thoracolumbar junction followed by CT scan and MRI of the region were done. The imaging parameters like type of fracture, wedge angle, kyphotic angle, cord contusion etc., were tabulated. The wedge angle was measured by the Gardner method (Fig-1), which is the angle formed between a line drawn parallel to the lower endplate of the fractured vertebra and the superior endplate of the adjacent cephalad vertebra. Kyphotic angulation was measured as the angle between the superior endplate above and the inferior endplate of one level below the fractured segment. The thoracolumbar injury classification and severity score (TLICS)7 was calculated for each patient to classify the fracture and further manage the patients.

The TLICS scoring is based on three parameters: morphology, posterior ligamentous complex, and neurologic involvement. In morphology, the wedge compression fracture is given a score of 1, burst fracture as 2, translation/rotation as 3 and distraction as 4. The posterior ligament injury is confirmed; it is scored 3 and, if suspected, then scored as 2. The neurological injury of nerve root denotes score 2, incomplete cord/CONUS injury as 3, complete cord/CONUS injury as 2 and cauda equina injury as 3. The total score was calculated, and a score of 0-3 was treated conservatively, 4 was either operated or conserved, and a score of 5 & above was treated surgically.

Next, the patients were either operated on or conserved. Conservative treatment was given by analgesic, complete bed rest with log rolling and limb physiotherapy followed by assisted walking in Taylors brace after 6-weeks of bed rest. Operated patients were treated with transpedicular screw fixation and laminectomy. A post-op x-ray of the TLJ was performed, and all the patients were followed for at least 3-months. The ASIA score of immediate post-op and after 3-months were noted and compared.

Statistical analysis

Data was presented using descriptive statistics. P-value < 0.05 was considered statistically significant. Statistical Package for Social Sciences (SPSS) version 17.

RESULTS

63% (n=19) of the patients were males in the study, and the remaining 37% (n=11) were females. Most of the patients (37%) were below 25-yrs (Table-1). The average age in the study was 34.3-yrs. In our research, the most common trauma mode was fall from height. Twenty-two patients (73%) had an injury due to fall either from tree or rooftop of the house, five patients (17%) had high-velocity road traffic accidents and one patient each sustained injury from a log of wood falling on the back & trivial fall respectively.

Table 1: Age and gender distribution

Age Group			
	Males	Females	
< 25-yrs	4(13%)	7(23%)	11(37%)
26-44-yrs	8(27%)	2(7%)	10(33%)
45-65-yrs	6(20%)	1(3%)	7(23%)
> 65-yrs	1(3%)	1(3%)	2(7%)
Total	19(63%)	11(37%)	30(100%)

In our study, 37% of the patients presented with complete motor loss of both the lower limbs. The incomplete motor loss was seen in 23% of the patients, along with unilateral lower limb weakness were observed only in 2 patients. 33% of the patients had no neurological motor weakness in the lower limbs (Table-2). Also, 27% & 23% of patients had bladder involvement as urinary incontinence and retention. The bladder status of 5 patients was unknown at the time of presentation due to catheterization in the emergency department before assessment by the concerned specialist.

Table 2: Presenting complaints of the patients

Presenting complaints		No. of patients (%)
Weakness	Paraperesis	7(23%)
	paraplegia	11(37%)
	Monoplegia	2(7%)
	No weakness	10(33%)
Urinary symptoms	Incontinence	8(27%)
	Retention	7(23%)
	No symptoms	10(33%)
	unknown	5(17%)

Most of the fractures in our study were TLJ burst fractures followed by compression fractures (Fig-2). 10% of the fractures were associated with D12-L1 listhesis. Most of the fractures were at the L1 level. The maximum patients showed a wedge angle between 11o to 20o and a kyphotic angle between 21o to 30o. 50% of the patients showed canal compromise less than 50%, whereas six patients had no canal compression. The study had observed that 43% of the patients had cord contusion and 46% epidural hematoma. The TLICS score was calculated, and 14 patients were operated on with a score of more than 5. Out of 8 patients having a TLICS score of 4, two were operated surgically, and four were conserved (Table-3).

Radiological assessment of our patients revealed that out of 16 patients who were operated on, three patients were unstable due to translation and distraction at fracture level, nine patients were unstable burst fracture with retropulsion fragment with more than 50% canal compromise, and 3 were compression fracture with severe neuro deficit requiring decompression with stabilization. Only one patient with burst fracture having <50% canal compromise required neurological decompression surgery due to severe deficiency. Out of 14 patients treated conservatively, nine patients had stable compression fracture, and 5 had stable burst fracture with intact posterior ligamentous complex with ASIA grade 'D' or 'E'.

Table 3: Radiological findings at presentation.

Parameters		No of patients	percentage
Type of fracture	Burst	15	50%
	Compression	12	40%
	With Listhesis/distraction	3	10%
Level of Fracture	D12	7	23%
	L1	18	60%
	D12-L1(Both)	5	17%
Wedge Angle	0-10^o	6	20%
	11-20^o	10	33%
	21-30^o	6	20%
	>31^o	4	13%
	No wedging	4	13%
Kyphotic Angle	0-10^o	5	17%
	11-20^o	6	20%
	21-30^o	12	40%
	>31^o	4	13%
Canal Compromise	0-50%	15	50%
	>50%	9	30%
	Canal maintained	6	20%
Cord contusion		13	43%
epidural Hematoma		14	46%
TLICS score	0-3	8	27%
	4	8	27%
	>5	14	47%

In our study, there were 14(47%) patients who were treated conservatively out of which nine patients were already ASIA 'E', four patients were ASIA' D' who improved at 3-months follow up, and only one patient was ASIA 'C' who deteriorated to ASIA' B' at 3-months and later operated with decompression laminectomy and transpedicular screw fixation (Fig-3). In addition, 16(53%) patients were treated surgically, out of which six patients were ASIA A/B remained complete paraplegic, one patient deteriorated from ASIA' C' to 'B', rest other nine patients improved significantly at three months follow up (Table-4). The radiological parameters which correlated with poor outcomes in our study were a greater kyphotic angle, canal compromise and presence of cord contusion (Table-5).

Table 4- ASIA Grading of patients with their outcome

		No. of patients pre-treatment	No. of patients (post-treatment)	No. of patients (at 3 - months FU)
ASIA GRADING	Grade A	6	4	3
	Grade B	6	7	5
	Grade C	4	3	2
	Grade D	6	7	5
	Grade E	8	9	15

Table 5- Radiological features of the patients based on their management

Management	No. of patients	Male	Female	Wedge angle	Kyphotic angle	Canal compromise	TLICS
Conservative	14	8	6	<25°	<25°	<50%	.
Surgical	16	11	5	>25°	>25°	>50%	≥5

Table 5- Radiological parameters and clinical outcome

Outcome	No. of patients	Wedge angle <25°	Wedge angle >25°	Kyphotic angle <25°	Kyphotic angle >25°	Canal compromise<50 %	Canal compromise>50	Cord contusion present	Cord contusion absent
Good	20	16	4	16	4	17	3	7	13
Poor	10	4	6	3	7	3	7	9	1
P value		**0.09**		**P value**	**0.02***	**P value**	**0.01***	**P value**	**0.01***

* = statistically significant

DISCUSSION

As much as 50% of the thoracolumbar junction fractures are unstable and can lead to a significant neurological deficit, deformity and lifelong disability[8]. So, it is of utmost importance to clinically assess the TLJ fractures and correlate them radiologically to classify and provide the appropriate early intervention, which may lead to a catastrophic outcome for the patient.

Males were affected more than females in this study. Again, a significant part of the working population in society constitutes males, so they encounter trauma more than females. Similar findings were published in previous studies also[9].

Most authors agree that motor vehicle collisions are the most common mode of injury to thoracolumbar junction[10,11]. However, contrary to it, we observed that the most common cause of injury to TLJ in our study was fall from a height instead of motor vehicle accidents. This observation was based on the fact that, from October to January every year (also called walnut season locally), the locals in the state of Kashmir fetch walnuts by climbing tall walnut trees unaided sustain injury due to fall. This concluded that all the patients with falls from height need to be evaluated for spinal fractures even if neurologically intact.

A thorough history and clinical assessment are compulsory in the case of TLJ injury patients. Missed junctional fractures are related to high morbidity and mortality. The rate of secondary neurologic injury is just 1.5% in those injuries recognized early. In fractures with delayed analysis, this rate increases to 10%. A detailed history gives significant knowledge of the pathomechanics of the injury. Figuring out which force vectors was the cause of injury helps identify the unstable segment and determines the most efficient fixation to aid stability[12].

On correlating the clinical profile of the study group with radiology, we found that all the patients who were paraplegic and had bladder dysfunction in the initial assessment sustained severe D12 or L1 fracture and a high TLICS score which ultimately required surgical intervention and had a poor outcome on comparison of ASIA grades after 3-months follow up. Our study's severity, improvement, and outcome were assessed by ASIA score. ASIA' D' & 'E' were considered a good outcome and ASIA 'C' & below as poor. The patients with ASIA grades of 'C' and 'D' did reasonably well at 3-months of follow up. Similar results were observed in a study conducted by Yüceli et al. [13] on 32 patients with TLJ injury in which he concluded that patients with a higher neurological deficit at the initial assessment carried a poor outcome of the treatment, and non-surgical treatment will not be suitable for patients with a highly unstable fracture with severe neuro deficit.

In a study by Daffner et al. [14], he concluded that most bust fractures occur from T4 to L5, and 50% occur at L1. Our study similarly concluded that 50% of the fractures at the thoracolumbar junction were burst fractures, and the most common fracture level was at the level of L1. 50% of the burst fractures have the potential for severe neurological injury; it is of utmost importance to diagnose them early and

considered unstable at emergency department assessment. In this study, 12 out of 15 patients diagnosed with burst fracture were treated surgically, considering the burst fracture as highly unstable.

Wang et al. [15], in a study on 27 patients with thoracolumbar fractures, operated patients with kyphosis angle >15o, wedge angle >15o and canal compromise of >50% and found surgical treatment in such patients with long-segment fixation was required to avoid long term complications. In the current study, we correlated wedge angle, Kyphosis angle and percentage canal compromise with TLICS score and ASIA grading. We found higher TLICS & ASIA grades had kyphotic/wedge angle more than 25o along with >50% canal compromise and were treated surgically in almost all the cases.

Out of 30 patients in our study, 14 patients had an epidural hematoma on their MRI. None of the patients treated conservatively had epidural compression due to hematoma, whereas 16 patients were treated surgically, 13 had an epidural hematoma. Of the 13 patients having an epidural hematoma and treated surgically, only six patients showed improvement postoperatively, and 7 had no improvement. This observation indicates that out of all the patients who had epidural hematoma, there are chances that more than 50% of the patients might not improve even after appropriate surgical intervention. However, factors like time since injury, severity, cord contusion, and other factors might also influence the result.

Non-operative treatment choices incorporate bed rest, postural reduction, bracing, and observation. While considering today's cost-cognizant hospital environment alongside the medical problems of delayed bed rest, an early objective of non-operative treatment is an ambulatory patient with or without a brace. The decision of a brace relies on creating a power vector inverse of the injury forces. For instance, extension support would give the most strength to a flexion injury. Non-operative treatment is reserved for stable injuries without the potential for future deformity or neurologic injury.

Our study has several limitations:

1. The study had a small sample size which would be not enough to reflect the results of a wider community of patients. A more extensive multicentric survey with a large sample size might address the limitation.
2. The study's short follow-up duration might not be enough to consolidate the prognosis of a particular fracture type at the thoracolumbar junction; its associated clinical and radiological picture and concomitant treatment are given. It would require a longer follow up to precise comment on the outcome of the particular treatment for a specific injury type.
3. Different surgeons have performed the operations.

Randomized clinical trials are needed to provide evidence-based findings. Lastly, none of the pathological fractures like osteoporosis was considered in the study, comprising many cases in thoracolumbar junction fractures that might have led to the overestimation of the results.

CONCLUSIONS

Despite tremendous advances in imaging and management techniques of thoracolumbar junction injuries, early clinical & radiological evaluation and their correlation are of utmost importance to aid in better outcome of TLJ fractures. Imaging parameters like wedge angle, canal compromise & cord contusion can be correlated with initial neurological status for a better understanding of treatment and the prognosis of the injury. Wedge angle greater than 15o, canal compromise of more than 50% and an ASIA grade 'C' and below are best treated surgically and carry a poor prognosis. Non-operative treatment choices are reserved for patients with good clinical and radiological grading.

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