

Functional and radiological outcomes of thoracolumbar traumatic spine fractures managed conservatively according to Thoracolumbar Injury Severity Score

ABSTRACT

Aim: To study the functional and radiological outcomes in cases managed conservatively for single-level traumatic thoracolumbar spine fractures without neurological deficit.

Materials and Methods: In this prospective study design, thirty patients who presented to tertiary care hospital and diagnosed with posttraumatic thoracolumbar vertebral fracture without any neurodeficit were recruited. All the patients were managed conservatively as per the protocol which included bed rest, spinal braces, and physiotherapy. Adequate analgesia was given wherever necessary. The patients were followed at regular intervals up to a maximum of 2 years. Clinically visual analog scale (VAS) score and Roland Morris Disability Questionnaire (RMDQ)-24 were assessed and radiologically local vertebral kyphosis, scoliosis, and loss of body height were noted at each follow-up.

Results: The data was statistically analyzed and the results were as follows. Thoracolumbar fractures were more in young adults (<26 years) and more so among the males (80% cases). The most common fracture type in our study was compression fracture. The most common site involved in our study was L1 vertebra (36.7%). There was a significant decrease of VAS score (pain score) in 79% cases with the maximum decrease in type A1 fracture. The mean RMDQ-4 score in our study was 5.53. The overall progression of kyphosis was 1.9. There was no relation found between the kyphotic deformity and the clinical outcomes (VAS and RMDQ-24 scores). Canal size changes were found to be insignificant at the end of 2 years compared to baseline.

Conclusion: Study showed favorable outcomes in terms of return to daily activities, making it a good option in managing Type A1 dorsolumbar fractures. Though there was a progression of kyphosis but no neurological deficit was seen.

Keywords: Kyphosis, nonoperative, Roland Morris Disability Questionnaire-24, thoracolumbar, visual analog scale score

INTRODUCTION

The dorsolumbar spine D10–L2 participates in the mobility of spine, hence any trauma to the spine is more likely to affect this segment. Fifty percent of the injuries are sustained in motor vehicle accidents whereas 25% are sustained in a fall from height (>6 feet). More than half of fractures occur between T11 and L1 vertebrae and another 30% occur between L2 and L5 vertebrae. Complete neurologic deficit occurred in 15% of patients.^[1,2] There have been similar studies

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How to cite this article: Bagga RS, Goregaonkar AB, Dahapute AA, Muni SR, Gokhale S, Manghwani J. Functional and radiological outcomes of thoracolumbar traumatic spine fractures managed conservatively according to Thoracolumbar Injury Severity Score. J Craniovert Jun Spine 2017;8:369-73.

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| Website: www.jcvjs.com | Quick Response Code  |
| DOI: 10.4103/jcvjs.JCVJS_93_17 | |

in the past but not enough literature is available evaluating outcomes of conservative management in Indian population.

MATERIALS AND METHODS

In a prospective observational study, thirty patients presenting to the outpatient and emergency departments of a tertiary care hospital with a diagnosis of traumatic thoracolumbar spinal fractures were recruited. This study was approved by the Institutional Ethics committee and a written informed consent was obtained from the recruited patients after proper explanation of the study and treatment protocol in the language they best understood.

The inclusion criteria were as follows:

1. All patients with dorsolumbar vertebral fractures on X-rays following trauma
2. Patients with single vertebral fracture
3. Thoracolumbar Injury Severity Score >4
4. Patients having no neurological deficits on presentation.

The exclusion criteria were as follows:

1. Patients with pathological fractures (such as osteoporosis, tumor, or infection)
2. History of any surgical interventions such as vertebroplasty/decompression/instrumentation
3. Neurological diseases causing impairment of function of lower limbs
4. Psychiatric illness
5. Hemodynamically or medically unstable patients.

For all the participating patients, the basic demographic information was documented at baseline and a detailed history was taken. A complete local and neurological examination and radiological assessment was done. The radiological assessment done included radiographs both anteroposterior and lateral in supine position. Magnetic resonance imaging (MRI) to screen the entire spine, especially the thoracolumbar spine, was done. All the recruited patients were then managed as per the standard protocol of conservative management for the vertebral fractures. Adequate bed rest for 3–4 days with a maximum of 10 days was given. Analgesics such as nonsteroidal anti-inflammatory drugs and opioid analgesics were given initially on a regular basis and later on as and when required. Patients were mobilized with thoracolumbar sacral orthosis (TLSO) following adequate analgesia. Physiotherapy regimen was individualized for each case as decided by an expert physiotherapist after complete evaluation, and the therapy was modified accordingly during follow-up. The regimen included low-velocity spinal mobilization, postural

taping, active stretches, progressive balance and strength training, and low-to-moderate intensity weightbearing aerobic activity.

All cases were followed up at 45 days, 3 months, 6 months, 9 months, and at the final follow-up at 2 years. At baseline and at each follow-up, clinical and radiological parameters were assessed. The clinical parameters were tenderness at the site of fracture, paraspinal muscle spasm, Straight Leg Raise test, neurological signs, visual analog scale (VAS) score for back pain severity assessment, and Roland Morris Disability Questionnaire (RMDQ-24) for disability rating. The radiological assessment included locating the site (dorsal or lumbar), number of vertebra involved, pattern of fracture (wedge/split/burst), type of wedge, percentage decrease in vertebral height, type of fracture (as per AO classification), stability of fracture, and kyphotic and scoliotic angles using Cobb's method [Figure 1]. Posterior ligamentous complex injury assessed using Short tau inversion recovery images, cord changes, and canal size was evaluated on MRI at the end of 2 years.

All the data collected were statistically evaluated. The statistical analysis was done using SPSS 20th version. *P*-value <0.05 was considered statistically significant.

RESULTS

The mean age of the patients recruited in our study was 31 ± 8.9 years, range being 18.0–48.0 years. Thirty-seven percent of the total patients were <26 years of age, indicating higher incidence of posttraumatic spinal fractures in the younger age groups. Eighty percent of the patients were males, suggesting an increased predisposition of males to develop traumatic spine fractures. On comparing the site of involvement, 36.7% of cases were of L1 fracture, 16.7% of D12 and L3 fractures, 13.3% of D11 fracture, 6.7% of L2 fracture, and 3.3% of L4, D7, and D8 fractures each [Figure 2]. Thus, L1 vertebra was most commonly involved and among the dorsal vertebrae D12 was the most common. Evaluating the type of fracture in accordance with the AO classification system for vertebral fractures, 53% cases were of A1 type, 27% were of A2 type, and 20% of A3 type. Out of the total, 53.3% of vertebral fractures had both anterior and middle columns involved while 46.7% of vertebral fractures had only anterior column involvement. There were no patients with all the three columns involved as these tend to be unstable and require surgical intervention. Radiological assessment was done to quantify percentage height loss. It was noted to be $15.5\% \pm 5.5\%$ in type A1 fractures, $21.5\% \pm 1.9\%$ in Type A2 fractures, and 29.3% in Type A3 fractures. Mean height loss was $19.8\% \pm 7.41\%$ in the fractured vertebrae [Table 1].

In our study, 70% of cases had <25% fractured vertebrae height loss and only 30% had ≥25% of fractured vertebral body height loss. The mean VAS score in Type A1 fracture on presentation was 9.63 ± 0.50 , in Type A2 fractures was 9.88 ± 0.366 , and Type A3 fractures with 10.0. Overall mean VAS score in the study was 9.77 ± 0.43 which decreased to 2.03 ± 0.90 at the end of 2 years. The mean VAS score was high at presentation due to severe acute pain following trauma. However, there was statistically significant decrease in mean VAS score in all types of fractures at all follow-ups and at the end of 2 years ($P < 0.05$). The mean RMDQ-24 score was 14.97 ± 2.72 at 3 months compared to 5.53 ± 2.16 at the end of 2 years. The maximum RMDQ-24 score was seen in A3 fractures (score = 20) and minimum was seen with A1 fracture (score = 8). The mean RMDQ-24 score in A1 fracture was 4.31 compared to A2 fracture which was 6.13 and A3 fracture score of 8.00 at the end of 2 years. There was a significant decrease in mean RMDQ-24 score at both 6 and 9 months as compared to baseline ($P < 0.05$). In addition, there was a significant decrease in mean RMDQ-24 score from 6 to 9 months also after which there was no significant decrease at the final follow-up.

Tenderness was the universal symptom on presentation for all traumatic spine fractures. Tenderness got resolved with bed rest and analgesics. On day 45, only eight cases, i.e., 26.67% had tenderness which got resolved at further follow-up of 3 months. At the end of 9 months and final follow-up, none of the patients had tenderness. The patients having tenderness at day 45 are of Type A3 fractures mainly. Of those eight cases, 80% were males and 20% were females.

None of the patients in our study developed any neurodeficit over the follow-up of 2 years. One case out of the 30 patients had Straight Leg Raising test positive at 3-month follow-up which had type A3 fracture of L4 vertebrae which resolved at the last follow-up. In the study, mean kyphosis angle was $15.30^\circ \pm 5.58^\circ$ at presentation and $17.23^\circ \pm 6.02^\circ$ at the end of 2 years. In Type A1 fractures, there was mean change in kyphosis angle of 0.75° compared to A2 fractures which was 2.12° and Type A3 fractures with 4.83° of mean change in kyphosis angle. Overall, there was mean change in kyphosis angle of 1.93° . In the study, there was significant ($P < 0.05$) change in mean kyphotic angle, comparing baseline to 3, 6, and 9 months, but there was no significant change at the final follow-up. There was no significant change found in mean kyphotic angle comparing 3–6 and 6–9 months [Figure 3]. In the study, there was a mean change of scoliotic angle of 3.43 ± 2.36 at presentation to 4.53 ± 2.94 at the end of 2 years. Hence, there was an overall change of 1.10° . Mean change in scoliotic angle in type A1 fracture was 0.62°



Figure 1: Measuring deformity in coronal and sagittal planes using Cobb's method

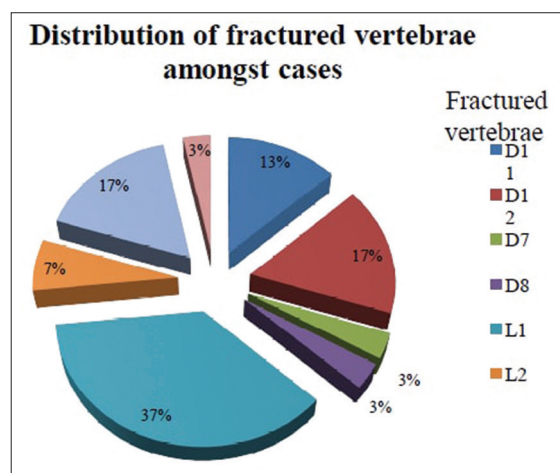


Figure 2: Distribution of fractured vertebra in the study

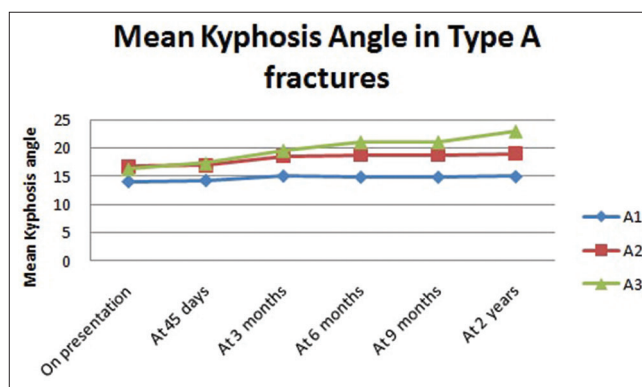


Figure 3: Mean kyphotic angle in AO Type A thoracolumbar fractures at regular follow-up

compared to type A2 fractures which had a mean difference of 1.25° and type A3 fractures with 1.10° of change. In the study, there was no significant change in mean scoliotic angle in the first 45 days of the study, but with further follow-ups, there was significant ($P < 0.05$) change in the mean scoliotic

Table 1: Decrease in vertebral body height in AO Type A spine fractures

| AO classification | Mean height loss (%) | Standard deviation | Number of cases |
|-------------------|----------------------|--------------------|-----------------|
| A1 | 15.437 | 5.5011 | 16 |
| A2 | 21.500 | 1.9272 | 8 |
| A3 | 29.333 | 6.9474 | 6 |
| Total | 19.833 | 7.4143 | 30 |

angle compared to baseline. Applying paired *t*-test and comparing mean scoliotic angle at 45 days and 3 months showed significant change in mean scoliotic angle. There was no significant change after 3 months. Cord changes were found only in 1 out of 30 cases at presentation without any neurodeficit. Changes in cord were absent at the end of the final follow-up.

In our study, there was no correlation found between the VAS score and kyphosis angle. Increase in deformity was not related to worsening or increase in functional outcomes. Similarly, no correlation was found between RMDQ-24 score and change in kyphosis and scoliotic angle, i.e., increase in kyphosis angle and scoliotic angle was not related to change in RMDQ-24 score. There was a significant correlation between height loss and kyphosis angle in our study. No correlation was found between age and sex with any of the discussed parameters. Canal size changes were found to be insignificant at the end of 2 years compared to baseline.

DISCUSSION

The most common fracture type in our patients was compression fracture. Compression fractures are stable fractures produced by hyperflexion forces. The injury is only localized in the anterior portion of the vertebral body. In our study, 37% of cases were <26 years of age and 80% of cases were males which go with the fact that traumatic thoracolumbar spine fractures are common in young males. The most common level involved in our study was L1 with 36.7% followed by D12. A study by Siebenga *et al.*^[3] showed 47% L1 fracture with 40% D12 fractures. Another study by Wood *et al.*^[4] showed 65% L1 fracture and 17% D12 fracture. Shen and Shen^[5] found 49% L1 fracture followed by 23% D12 fracture in their study. In our study, there was 79% decrease in VAS score from mean of 9.67–2.03. Type A3 fractures of AO classification had decrease of 71.3% VAS score compared to A2 fractures with 75% decrease and A1 fractures with 85% decrease. A study by Post *et al.*^[6] showed a decrease of VAS score of 79% which has similar results to our study. A study by Post and Leferink^[7] in 2004 had 72.6% of decrease in VAS score. There was a significant decrease in mean VAS score throughout the duration of study, favoring conservative

management a good option for traumatic thoracolumbar spinal fractures, especially type A fractures. In our study, mean RMDQ-24 score came out to be 5.53 and A3 fractures had RMDQ score of 8.00. In a study by Post *et al.*^[6] RMDQ score was found to be 5.2 which is similar to our study but longer duration of study makes it less comparable. Weinstein *et al.*^[8] reported a RMDQ-score of 13.2 measured 20 years after nonoperative treatment for a thoracolumbar burst fracture. Comparison makes our results seem favorable. However, 22% of the patients had some neurological deficit in the aforementioned study. In a recent study by Wood, RMDQ score in nonoperatively treated patients was found to be 4.4.^[7] These findings are comparable to our results. A RMDQ-24 score of 3.9 was reported recently in patients 3.7 years after nonoperative treatment of a spinal fracture by Siebenga *et al.*^[3] Comparing various studies, our results seem favorable, but longer duration of some studies makes it less valid. In the study, there was an overall progression of 1.9° in kyphosis. Cantor *et al.*^[9] had 1° of progression in a study following 18 patients for 19 months. Chow *et al.*^[10] showed 2.3° of progression in 26 patients over 34 months. Similar studies by Chan,^[11] Shen and Shen,^[5] and Tropiano *et al.*^[12] showed a progression of 1.6°, 4°, and 1.2°, respectively. Though we had similar results compared to the aforementioned studies, duration of some studies was longer making our study less comparable. In our study, there was no relation found between the kyphotic deformity and the clinical outcomes (VAS and RMDQ-24 scores). It is generally accepted that radiological and functional results of conservative treatment do not correlate with each other.^[13,14] Hazel *et al.*^[15] could not find any relation between severity of the initial injury and radiological development of degenerative changes with clinical complaints. In addition, Young^[14] did not report any relation between symptoms and severity of fracture, deformity produced, or any other radiological changes found in 116 patients with compression fractures treated conservatively. Mumford *et al.*^[13] reported 2-year follow-up results of 41 patients with burst fractures treated initially by 30-day bed rest and later mobilization with TLSO. They detected 66% good to very good clinical results and 90% of the patients could return to their previous jobs. They could not find any relation between initial injury severity and post-treatment deformity. Cantor *et al.*^[9] studied 18 patients with stable burst fractures in the thoracolumbar junction. They were treated by orthosis and early ambulation. Fifteen of 18 patients were able to return to their previous daily activities without or with only minimal pain. Weinstein *et al.*^[8] in their study of 52 thoracolumbar burst fractures treated conservatively reported that there were no increases in neurological status of the patients, 88% of whom were able to return to their previous jobs. They found kyphosis

angle of 26.4° at the end of treatment and could not find any relation between kyphosis degree and pain or functional scores. A study by Ağuş *et al.* in 2003 found no relation between local kyphosis angle and clinical outcomes.^[16] In our study, there was no significant remodeling of canal. However, there was no increase in canal compromise during the follow-up cases. The fear that the canal compromise will progress and result in spinal canal stenosis or neurological deficit^[17] in later life is also unfounded.^[18] In fact, the opposite is true as the retropulsed fragments gradually resorb with remodeling of the canal. Over a period of 2 years, many studies like by Shen and Shen, Boerger *et al.*, Celebi *et al.*, and McNamara have reported an improvement in canal dimension on subsequent scanning.^[5,19,20] Shen and Shen^[5] noted a resorption of approximately 50% of the retropulsed fragment within 12 months. Interestingly, Celebi *et al.*^[19] found that, the higher the amount of initial spinal canal compromise, the better the remodeling. Yazici *et al.* and Dai *et al.*^[20] found no statistical difference in the degree of spinal canal remodeling between patients treated conservatively and operatively. Longer duration of study showed improvement in spinal canal dimensions which was not seen in our study. However, there were no neurological deficits due to canal compromise in our study, and hence favoring canal compromise is not an indication for surgical management. Several complications, such as thromboembolic events, decubitus, cast syndrome, and urinary infection, have been reported to occur during the course of conservative treatment of spinal fractures.^[13,21] We found no such complications in our patients and regard regular and careful follow-up as essential to reduce such complications.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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