

## Radiological and Functional Outcomes of Conservatively Managed Osteoporotic Vertebral Fractures at the Thoracolumbar Junction: A Cross Sectional Study

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### ABSTRACT

**OBJECTIVE** This study examined how osteoporotic vertebral fracture (OVF) patients treated conservatively at a multi-specialty hospital were progressing clinically and radiologically.

**METHODS** This cross sectional, observational study was conducted at Sir Ganga Ram Hospital, New Delhi, India during the period of July 2021 to October 2021. Cases with at least a 6-month follow-up were evaluated. VAS pain score, Oswestry Disability Index (ODI), and local kyphotic angle (COBB's angle) at the time of fracture and at the latest follow-up were recorded and analyzed.

**RESULTS** There were 30 patients (female: male = 2.75:1) with a mean age of 67.37 years (45–85). The average VAS score at the time of fracture was 8 (6 to 10) and at the time of final follow-up was 2 (1 to 6) ( $p = 0.001$ ). The average ODI score at the time of fracture was 44 (35 to 62) and at the time of final follow up was 5 (4 to 40) ( $p = 0.001$ ). The average Cobb's angle at the time of fracture was 14.31° and at the final follow up was 15.66° ( $p = 0.011$ ).

**CONCLUSIONS** Conservative management of OVF can lead to an increase in the local kyphotic angle. The fact that the patients experienced significant decreases in VAS pain scores and ODI scores by the final follow-up leads to the conclusion that patients can have a good quality of life even with conservative management of osteoporotic vertebral fractures.

**KEYWORDS** conservative management, osteoporotic, thoracolumbar, vertebral fracture

### INTRODUCTION

The incidence of osteoporotic vertebral fracture (OVF) is increasing every year as the average life expectancy increases. This type of fracture results in a huge burden to the health system as approximately 200 million people are affected worldwide each year (1). Among

the various approaches used to manage OVF, conservative treatment has long been a traditional line of management (2). Sir Ganga Ram Hospital has been providing conservative management for all osteoporotic fractures of the spine with the exception of cases with neurological involvement, excruciating pain or a local

kyphotic angle of more than 35 degrees. Although it has been used since long time, little is known regarding the natural course following this management practice. Of the available studies, one reported that 20% of the conservatively managed group eventually develop chronic back pain (3). In addition to back pain, spinal deformity (kyphosis, kyphoscoliosis and loss of vertebral height), and impaired function leading to diminished quality of life are known sequelae of conservatively managed OVF.

These types of fractures occur because of compression failure of the anterior and middle vertebral columns which have decreased bone mineral density. The fracture can occur even under physiological axial load or minimal stress following trivial injury. The thoracolumbar (TL) junction is the mechanical transition zone between the rigid, kyphotic thoracic spine and the flexible, lordotic lumbar spine (4). The absence of stabilizing articulations with the ribs at the thoracolumbar junction, a straighter spine and more sagittal oriented facet joints increase the chances of fracture at this level (5).

Numerous classification systems have been proposed to guide the management of OVF. The Spine Section of the German Society for Orthopedics and Trauma (DGOU) classification (6) suggested type I and II for conservative management, whereas the Sugita classification (7) suggested that concave types and dented types have a good prognosis with conservative management. Type III, IV and V fractures in the DGOU classification, including the swollen front type, bow-shaped type and projecting type, need to be managed operatively or with minimally invasive techniques such as vertebroplasty or kyphoplasty (7,8). The choice of management is based on three principles: restoring biomechanical stability to promote healing with an acceptable alignment, neurological optimization, and long-term preservation of maximum painless mobility (8). These measures have been used extensively. What has yet to be examined, however, is the natural course following the conservative management of OVF.

This study aimed to assess the natural course of conservatively managed osteoporotic TL junctional fractures. We assessed the change

in the local kyphotic angle of the fractured vertebrae between the time of the fracture and the last follow-up, and the functional status of the patient in terms of Visual Analogue Scale (VAS) pain score (9) and Oswestry Disability Index (ODI) score (10).

## METHODS

This single-center cross-sectional observational study was conducted at the Department of Ortho-Spine Surgery in Sir Ganga Ram Hospital, New Delhi, India. All patients with OVF at the thoracolumbar junction who were managed conservatively since 2015 and who were willing to participate in the research were invited to be included in the study. All patients included in the study had been managed by the same senior consultant of the department and had followed the same conservative management protocol. However, depending upon improvement in pain and compliance with medications, there were some individual variations in the duration of anti-osteoporotic medications, bed rest, physiotherapy and application of braces. Patients who had previously undergone vertebroplasty or kyphoplasty for an osteoporotic vertebral fracture, those with concomitant fractures of other regions of the spine or fractures around the hip, those with follow-up of less than 6 months or who had lost follow-up, and those with a pathological fracture secondary to malignancy or infection were excluded from the study.

As outlined in the flowchart below, a total of 49 patients who had been managed conservatively for OVF between 2015 and 2021 were identified through the hospital electronic record system and OPD records. Of those patients, two had a multiple level fracture, one had an L4 fracture, one had an L5 fracture, two had a follow-up of less than six months, one had undergone vertebroplasty one month after conservative treatment, and 12 had no subsequent follow up records. Hence, only 30 cases were finally included in the study.

The data of most of the participants were collected at the time of the OPD visit. A questionnaire was administered to assess general information and associated comorbid conditions, and the risk of osteoporotic fracture. The

patient's functional status was evaluated by VAS pain score and ODI score at the time of the fracture and at the latest follow-up. Records of dual energy X-ray absorptiometry (DEXA) scans, if done at the time of the fracture were obtained and the latest DEXA scans were advised to evaluate improvement following the treatment. The lists of all anti-osteoporotic medications prescribed for each patient were recorded. X-ray and/or MRI images at the time of diagnosis and the final X-ray or MRI images at the latest follow-up were used to assess the progression of segmental kyphosis. Fractures were classified using the DGOU classification and Sujita's morphological classification (7). In cases where a patient failed to visit OPD, a telephonic interview was conducted to acquire the required information for the study.

Statistical analysis was done using SPSS version 25.0. Mean and standard deviation were calculated for continuous and numeric variables. The average VAS and ODI scores at the time of the fracture and at the latest follow up were compared using the Wilcoxon Signed Rank Test. P values less than 0.05 were considered to be statistically significant.

## RESULTS

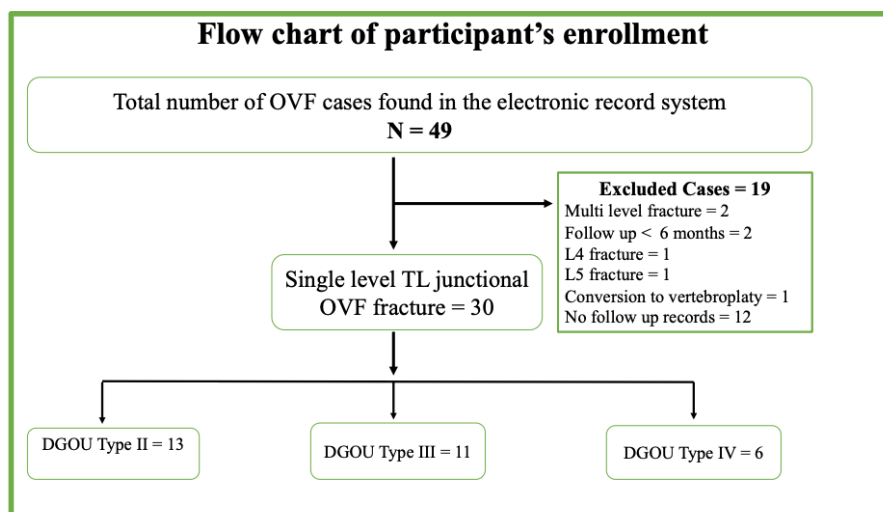
Among the 30 patients, 22 (73.3%) were female and eight (26.7%) were male (F:M = 2.75:1). The average age of the patients was  $67.37 \pm 10.95$  years (45–85). Three males were public service holders, four males were retired officers, one male was a businessman, and all 22 females

were housewives. Seventeen patients (56.7%) had the fracture because of a slip injury, eight (26.7%) fell on level ground, three (10%) fell from a bed, and two (6.7%) had the fracture while changing posture. Thirteen patients (43.3%) had a DGOU type II fracture, 11 (36.7%) had a type III fracture and six (20%) had a type IV fracture. The average follow-up time was 20 months, with a range of 6 to 72 months.

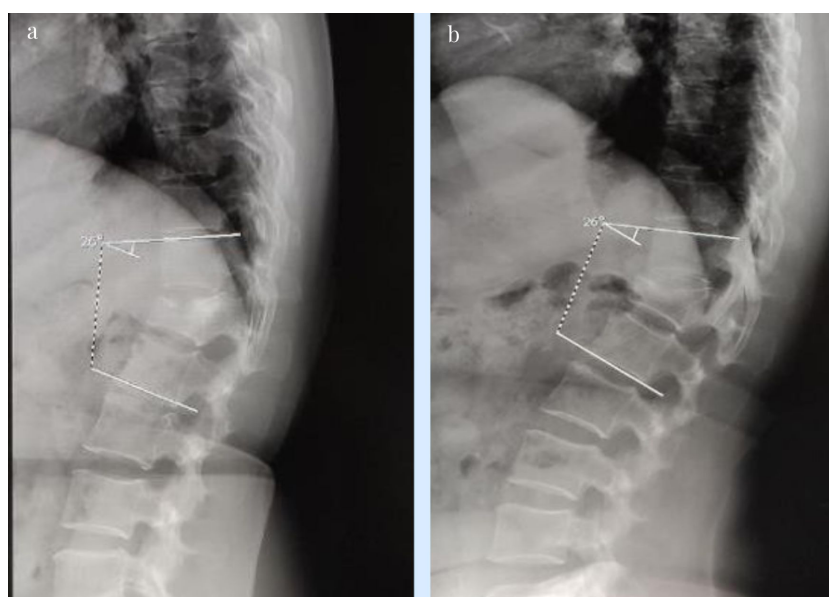
Classifying fractures according to Sujita's morphological classification was not feasible for three patients (10%). According to this classification system, 17 (56.7%) had concave type, seven (23.3%) had dented type, and three (10%) had bow type. Among the bow type patients, one had a two degree increment in the segmental kyphotic angle at the 11 month follow-up. Another had a five degree increment in the segmental kyphotic angle at the 57 month follow-up and the third case had no change in segmental kyphotic angle at the 34 month follow-up.

One patient was a long-term steroid user as she had undergone renal transplant surgery thrice in her life. One patient had recovered from a breast carcinoma and one patient had undergone open heart surgery. The most common co-morbid condition was hypertension (n = 18, 60%), followed by type II diabetes (n = 10, 33.3%).

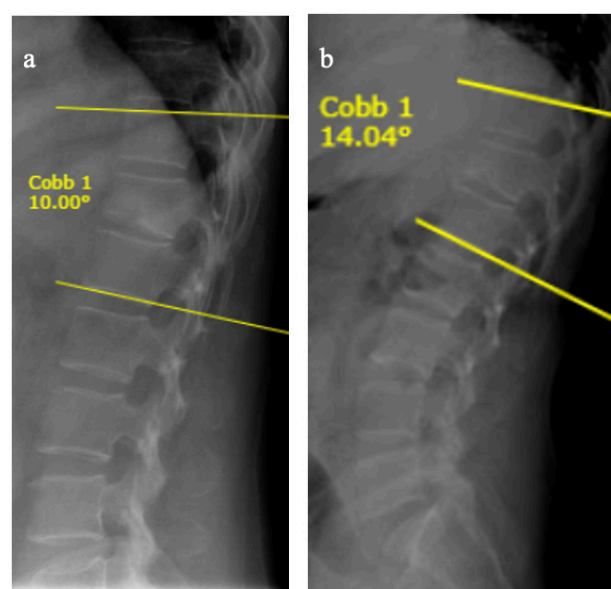
The average VAS score at the time of fracture was 8 (6 to 10) and at the time of final follow-up was 2 (1 to 6) ( $p = 0.001$ ). The average ODI score at the time of fracture was 44 (35 to



**Figure 1.** Flow chart of the participants' enrollment



**Figure 2.** 65 years female with D12 fracture OF type III, with Cobb angle of 26 degree at the time of fracture (a) and similar Cobb angle of 26 degree (b) at 10 months follow up period



**Figure 3.** 58 years female with D12 fracture OF type III, with Cobb angle of 10 degree at the time of fracture (a) and Cobb angle of 14 degree at 34 months follow up period

62) and at the time of final follow-up was 5 (4 to 40) ( $p = 0.001$ ). The average Cobb's angle at the time of the fracture was 14.310 and at the final follow up was 15.660 ( $p = 0.011$ ). Representative cases are shown in [figure 2](#) and [figure 3](#). We could only trace the bone density scores of six patients during the final follow up visit, so an appropriate analysis with regard to the DEXA scan was not feasible.

All patients received calcium and vitamin D as a part of their medical treatment. As a part of their anti-osteoporotic medications, 10 (33.3%) received oral alendronate whereas 20 (66.7%)

received injectable alendronate, i.e., zoledronic acid, 21 (70%) received calcitonin nasal spray, 28 (93.3%) received teriparatide injections, and only two patients (6.7%) received denosumab injections.

Complete bed rest was advised for 21 patients (70%). Bed rest ranged from two weeks to three months, the most common being two weeks (40%). Twenty-four patients (80%) used a Knight Taylor brace. The duration of the brace application ranged from two weeks to three months. Sixteen patients (53.33%) received physiotherapy for periods ranging from four to six weeks.

## DISCUSSION

This study found a significant increase in the local kyphotic angle after conservative management of the OVF. Similarly, there was a significant improvement in VAS pain scores and ODI scores following conservative management of OVF.

This study found a higher incidence of OVF among female patients than males with a ratio of 2.75:1. This result is similar to several other studies which have also reported a preponderance of female osteoporotic vertebral fracture patients (11–13). This difference is due to an acceleration of bone loss in the first decade after the onset of menopause in females and is referred to as type I osteoporosis (11). Within the first decade after the onset of menopause, the rate of bone loss affecting the lumbar spine nearly triples (12, 13).



The most common mode of injury was trivial slip injury at home (56.67%) followed by falls on level ground (26.67%). This distribution could be explained by the fact that most of the patients in this study (63.33%) were above 65 years old. Additionally, all 22 females were housewives which suggests a high risk of trivial injuries around the home.

Most of the patients in our study were advised to take two weeks of bed rest. However, they were allowed to be mobile for basic daily activities and for brief ambulation around the bed with a support brace which is comparable to previous studies. For example, Shah, et al. mentioned a short period of bed rest, analgesic medications, antiosteoporosis pharmacotherapy, and bracing support for the fracture along with guided physical therapy and postural correction aid for lasting alleviation of pain (11). Similarly, Park, et al. recommended confinement to bed for two to three days, accompanied by the use of analgesics, hot packs, massage, and lumbar orthosis (14).

Francis, et al. stated that management of patients with acute vertebral fractures should include measures to reduce pain and improve mobility as well as treatment for osteoporosis (2). Similar recommendations were found in the prescriptions given to the participants we studied. The main goals of the treatment were to allow pain-free mobilization as early as possible, and to prevent further collapse of the vertebrae through the use of anti-osteoporotic medications, and to stimulate bone formation using injections of teriparatide.

For the management of pain, all patients in this study were given oral analgesics. Anti-osteoporotic medication was found to have been started from the very beginning of treatment. All patients received alendronate, calcium and vitamin D supplementation. Twenty-eight patients (93.3%) in our study received injectable teriparatide, while only two patients for whom teriparatide was contra-indicated received injections of denosumab. This resembles the reports of meta-analyses which described the use of teriparatide for pain management in patients with acute fractures (15, 16). Seventy percent of the patients received calcitonin nasal spray. Calcitonin, administered either by subcutaneous or intranasal routes, can be beneficial in reduc-

ing pain from acute vertebral fractures (17). A recent systematic review and meta-analysis of the use of calcitonin for patients with a painful osteoporotic fracture (n = 246) concluded that calcitonin is an effective analgesic for acute pain in recent osteoporotic fractures (18). Alendronate, popularly used in the management of osteoporosis, has also been used for management of pain. In a randomized, double-blinded, controlled trial on the efficacy of intravenous pamidronate, it was observed that pamidronate provided rapid and sustained pain relief in patients with an acute osteoporotic fracture compared with a placebo (19).

For the management of chronic pain, the back muscles should be strengthened through manual therapies and exercise intervention. Physical rehabilitation has a beneficial effect on bone metabolism, bone turnover, and bone mineral content (11). All the patients with OVF in this study were advised to engage in physical rehabilitation and active ambulation as soon as they were pain free; however, only sixteen (53.3%) were found to have actively participated in a physiotherapy rehabilitation program. A number of systematic reviews and meta-analyses, similar to our study, have reported positive effects of exercise on bone mineral density, muscle strength, and quality of life in both men and women with osteoporosis or low BMD (20).

Spinal orthoses can lessen pain by reducing mobility, decreasing postural flexion and providing axial support in patients with muscle fatigue and spasms (11). All the patients in our study were advised to use a Knight Taylor brace for a short period of time so that it would be much easier for the patients to facilitate ambulation. However, only 80% (24 patients) were found to have actually used the brace as recommended. The remaining 20% (7 patients) had suffered more discomfort during the application of the brace. The degree of vertebral body compression in patients who used the brace as advised was quite low, mainly in DGOU type II fracture and they had a rapid reduction in pain after initiation of anti-osteoporotic medications.

There was a significant decrease in the height of the anterior column in the patients leading to a significant increase in the local kyphotic angle after conservative management

of OVF at the thoracolumbar junction. The change in the height of anterior column could be explained by the fact that 80% of the body weight is transferred to the anterior column, creating a constant compression force through the anterior column, leading to decreased anterior column height and a significant increase in the local kyphotic angle ( $p = 0.011$ ). However, the change in local kyphotic angle was not found to have hampered activities of daily living, as our patients had significantly decreased VAS pain scores and ODI scores by the end of their treatment ( $p = 0.001$ ).

This study has some limitations. There could have been some recall bias as the patients had to report their VAS score and ODI score at the time of the fracture based on memory. A few patients had only six months of follow-up, which may be too short period to arrive at conclusions regarding the final vertebral height of the fractured vertebrae as the height and local kyphotic angle could continue to change with time. Our inability to get access to 12 patients who were treated conservatively for OVF might also have affected the outcome of our analysis. However, as this was a cross-sectional study, we analyzed only the available cases in the specified time frame. Additionally, there are various potentially confounding factors that could have affected the VAS pain scores and ODI scores of the patients both at the time of the fracture and at the latest follow up. In this study, however, we considered only the pain and disability induced by the vertebral fracture as the final functional outcome. We would recommend a prospective cohort study which includes records of all essential parameters as well as potential confounding factors in order to obtain more robust results.

## CONCLUSION

Conservative management of osteoporotic vertebral fractures, based on the perceptions and experience of patients, can be concluded to have importance even in recent times. Conservative management can lead to an increase in the local kyphotic angle. That the patients experienced a significant decrease in VAS pain scores and ODI scores by the end of the treatment leads to the conclusion that the patients

can have a good quality of life with conservative management of osteoporotic vertebral fractures.

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## CONFLICTS OF INTEREST

None

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## ADDITIONAL INFORMATION

### Data availability statement

The data in this study are available from the corresponding author upon reasonable request.

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