

CLINICAL, FUNCTIONAL AND RADIOLOGICAL OUTCOME OF OSTEOPOROTIC VERTEBRAL COMPRESSION FRACTURES TREATED WITH PERCUTANEOUS VERTEBROPLASTY

G.Venkatesh¹, Sudhakar. R.²

¹Assistant Professor, Department of Orthopaedics, Government Tiruvannamalai Medical College and Hospital, Tamilnadu, India.

²Assistant Professor, Department of Orthopaedics, Government Tiruvannamalai Medical College and Hospital, Tamilnadu, India.

Received : 05/03/2026
Received in revised form : 23/04/2026
Accepted : 09/05/2026

Keywords:
Osteoporosis, Polymethyl Methacrylate, Spinal Fractures, Vertebroplasty, Visual analogue scale.

Corresponding Author:
Dr. G.Venkatesh,
Email: drvenkateshgandhi@gmail.com

DOI: 10.47009/jamp.2026.8.3.29

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2026; 8 (3); 163-167



ABSTRACT

Background: Osteoporotic vertebral compression fractures cause pain, disability, and reduced quality of life in the elderly. Percutaneous vertebroplasty stabilises fractures using polymethylmethacrylate cement. This study evaluated clinical and functional outcomes using the visual analogue scale (VAS) medication score, and overall clinical outcome assessment. **Materials and Methods:** This prospective observational study evaluated patients treated at the Tirunelveli Government Medical College from July 2015 to September 2017. All patients underwent clinical evaluation and radiological assessment using plain radiography and computed tomography. Percutaneous vertebroplasty was performed using a transpedicular approach under fluoroscopic guidance. Outcomes were assessed using the VAS, along with activity score and medication score to evaluate functional improvement and analgesic requirement. **Results:** Twenty patients were evaluated, including 15 women (75%) and five men (25%). Single-, double-, and triple-level vertebral involvement occurred in 14 (70%), four (20%), and two (10) patients, respectively. Excellent outcomes were achieved in 14 (70%) patients, good outcomes in three (15%), fair outcomes in one (5%), and poor outcomes in two (10%). Cement leakage occurred in two (10%) patients. Asymptomatic status improved from 14 (70%) patients' post-procedure to 18 (90%) at 12 months. Pain scores decreased from 6.26±1.75 to 1.59±1.99 immediately and to 0.24±0.99 at 3 months. Activity scores improved from 1.38±1.41 to 0.53±1.23 immediately and 0.26±0.79 at 3 months. Medication scores decreased from 1.15±0.99 to 0.41±0.56 immediately and 0.06±0.24 at 3 months. **Conclusion:** Percutaneous vertebroplasty is safe and effective, providing rapid pain relief, functional improvement, and reduced medication requirements in osteoporotic vertebral compression fractures with minimal complications.

INTRODUCTION

Osteoporosis is a public health issue characterised by decreased bone density and affects more than 200 million people worldwide. It results in fragile fractures. Owing to the increase in the aging population, 1 out of 3 females aged 50 years and above, and 1 out of 5 males aged 50 years and above will suffer from osteoporotic fractures. Fragility fractures lead to a significant number of deaths, disabilities, and morbidities.^[1] The annual cost of treating osteoporotic fractures in Canada, Europe, and the USA is between \$5,000-\$6,500 billion USD.^[2] Vertebral fractures have been identified as a public health issue because 5.37 million people were affected worldwide as of 2021. This number is

expected to increase to 8.01 million by 2050. Falls and road accidents have been identified as the causes of vertebral fractures, with a higher prevalence in Europe.^[3]

Osteoporotic vertebral compression fractures (OVCFs) are the most common type of fragility fracture in the elderly population. The 5-year incidence of OVCF in South Korea was 852.24 per 100,000 population, of which 45% were in patients in their seventies.^[4] These are caused by low-energy trauma or spontaneous collapse in osteoporotic bones.^[5] Pain, decreased mobility, spinal deformities, and decreased lung capacity are some of the manifestations of vertebral compression fractures.^[6] These fractures also lead to decreased mobility, pneumonia, and psychological problems for the

patients.^[5] Pain management, orthotics, vertebral augmentation, and treatment of osteoporosis are part of the treatment for these fractures.^[5,6]

Conservative management involves bed rest, pain medication, bracing, physiotherapy, and medication. Some patients require surgery due to pain that persists in 15-35% of cases. Studies have reaffirmed the conservative management approach as the first-line of treatment, with pain management using acetaminophen, nonsteroidal anti-inflammatory drugs (NSAIDs), opioids, and calcitonin, and bisphosphonates and supplements.^[5] Jang et al. state that although the conservative approach is the first-line of treatment, 15-35% of patients with unstable fractures require surgical intervention.^[7] Ameis et al. found that orthoses can provide temporary pain relief with mobilisation.^[8] However, Nasto et al. found that bracing relieves acute pain but does not prevent the progression of kyphosis.^[9] These limitations led to the development of vertebroplasty and kyphoplasty as treatment options for resistant cases.

Percutaneous vertebroplasty (PVP) and balloon kyphoplasty (BKP), minimally invasive techniques using polymethylmethacrylate (PMMA) cement to stabilise fractured vertebrae, have been reported extensively.^[10] In PVP, PMMA cement is injected directly, whereas in BKP, a balloon creates a cavity before injection. Both procedures are more effective than nonsurgical management of vertebral compression fractures.^[11] Marcia et al. reviewed 33 studies and confirmed the safety and low complication rates of vertebral augmentation.^[12] These studies validate PVP as a treatment option for osteoporotic and traumatic vertebral compression fractures.

Even with advancements in the management of osteoporotic vertebral compression fractures, the optimal approach for treating the condition remains unclear. Vertebral compression fractures are associated with significant pain and a decreased quality of life in the elderly population. Although conservative management is the first-line treatment, pain relief is often incomplete, thereby reducing the quality of life in the affected population. Vertebroplasty helps stabilise the spine with PMMA cement injection for pain relief. Studies have shown that vertebroplasty is associated with significant outcomes compared to conservative management.

Aim

This study evaluated clinical and functional outcomes of percutaneous vertebroplasty in osteoporotic compression fracture during 2017-2018 using Visual Analogue Scale (VAS) scores, activity score, medication score, and overall clinical outcome assessment.

MATERIALS AND METHODS

This prospective observational study analysed the patients treated at the Tirunelveli Government Medical College and Hospital for vertebral

osteoporotic compression fractures using percutaneous vertebroplasty from July 2015 to September 2017. Ethical approval was obtained from the Institutional Ethical Committee, and informed consent was obtained from the patients before study initiation.

Inclusion and exclusion criteria

This study included patients aged > 60 years with pain from an unresolved osteoporotic vertebral compression fracture after three weeks of medical management. Patients with active infection, atypical fracture patterns, and unstable fractures involving posterior elements were excluded.

Materials

The materials included Jamshidi needles of 11 and 13 gauge in 10 cm and 15 cm sizes, PMMA bone cement with high viscosity and contrast agent, 5-mL syringes for cement injection, a C-arm fluoroscopic imaging system, standard surgical instruments, and emergency drugs.

Methods

Patients were evaluated with history and physical examination. Pain from vertebral body collapse was typically aggravated by spine flexion and affected the ability to stand or sit for prolonged periods. Physical examination documented the site of pain and tenderness, baseline peripheral neurological examination, and detected any neurological impairment. Radiological evaluation using X-ray and CT scan assessed vertebral body collapse, structural alteration, posterior element integrity, and pedicle anatomy before the procedure. Patients were kept nil per oral after midnight. Prophylactic broad-spectrum antibiotics were administered before the procedure. The patient was positioned prone on the operating table under strict aseptic precautions using fluoroscopic guidance.

Under C-arm guidance, the vertebral level was identified, and the entry point was marked. A Jamshidi needle was introduced through the pedicle using a transpedicular approach and advanced into the vertebral body under continuous fluoroscopic monitoring in anteroposterior and lateral projections. After confirming needle placement, normal saline was injected to check free flow, indicating an intact intravertebral cavity. PMMA bone cement with a toothpaste-like consistency was prepared and injected under fluoroscopic monitoring. Cement injection was discontinued if leakage was suspected or if the cement approached the posterior vertebral body margin. The cement volume was approximately 1 cc per side for high thoracic vertebrae, 2 cc for lower thoracic vertebrae, and up to 3 cc for lumbar vertebrae.

After vertebral body filling, the needle was withdrawn and sterile dressing applied. The patients remained supine for two hours with monitored neurological status post-procedure. Ambulation was allowed after 6-8 hours. Pain relief and neurological complications were assessed after the procedure and at 24 hours. The patients were discharged on the third postoperative day with osteoporosis management

advice. All patients were evaluated at 8 hours, on the third postoperative day, at one month, three months, and one year after the procedure. Pain assessment was performed using the VAS. Functional outcome was evaluated using activity score and medication score to assess functional improvement and analgesic requirement.

Clinical outcome was graded as excellent, good, fair, or failure based on improvement in pain, functional status, and return to daily activities. Procedure-related complications, particularly cement leakage, were recorded during and after the procedure.

Statistical Analysis

Data are presented as mean, standard deviation, frequency, and percentage. Continuous variables

were compared using a paired t-test. Statistical significance was set at $P < 0.05$ using a two-tailed test. Data analysis was performed using IBM-SPSS version 25.0 (IBM-SPSS Science Inc., Chicago, IL).

RESULTS

In this study of 20 patients, 15 (75%) were women and 5 (25%) were men. Single-, double-, and three-level vertebral involvement were found in 14 (70%), four (20%), and two (10%) patients, respectively. [Table 1]

Table 1: Distribution of Patients According to Sex and Number of Vertebral Levels Involved

		N (%)
Sex	Female	15(75%)
	Male	5(25%)
Number of levels	Single	14(70%)
	Double	4(20%)
	Three	2(10%)

Clinical outcomes following percutaneous vertebroplasty were excellent in 14 patients (70%), good in three patients (15%), fair in one patient (5%), and failure in two patients (10%). Cement leakage

was reported in two patients (10%), while 18 patients (90%) had no complications after the procedure. [Table 2]

Table 2: Distribution of Patients According to Clinical Outcome and Complications

		N (%)
Outcome	Excellent	14(70%)
	Good	3(15%)
	Fair	1(5%)
	Failure	2(10%)
Complication	Cement Leakage	2(10%)
	No complications	18(90%)

After the procedure, 14 patients (70%) were asymptomatic, two (10%) improved, two (10%) remained static, and two (10%) deteriorated. At the 3-month follow-up, the number of asymptomatic patients increased to 16 (80%), with one (5%) improving, one (5%) remaining static, and

deterioration was reported in two (10%). At the 12-month follow-up, 18 patients (90%) were asymptomatic, with improved and static conditions in one (5%) patient, and no deterioration (0%). [Table 3]

Table 3: Distribution of Patients According to Clinical Status at Immediate Post-Procedure, 3-Month Follow-up, and 12-Month Follow-up

		N (%)		
		Immediate post-procedure result	Follow up result at 3 months	Follow up result at 12 months
Clinical Status	Asymptomatic	14(70%)	16(80%)	18(90%)
	Improved	2(10%)	1(5%)	1(5%)
	Static	2(10%)	1(5%)	1(5%)
	Deteriorated	2(10%)	2(10%)	0(0%)

The pain score decreased significantly following vertebroplasty, and the mean pain score decreased from 6.26 ± 1.75 to 1.59 ± 1.99 after vertebroplasty ($P = 0.0001$). Activity score improved from $1.38 \pm$

1.41 to 0.53 ± 1.23 post-vertebroplasty ($P = 0.0187$). The medication score decreased from 1.15 ± 0.99 to 0.41 ± 0.56 after vertebroplasty ($P = 0.0003$). [Table 4]

Table 4: Comparison of Pain, Activity Score, and Medication Score Before and After Vertebroplasty in the Immediate Post-Procedure Period

		Mean \pm S.D.		P value
		Pre-vertebroplasty	Post vertebroplasty	
Immediate post-procedure	Pain	6.26 ± 1.75	1.59 ± 1.99	0.0001

	Activity score	1.38±1.41	0.53±1.23	0.0187
	Medication Score	1.15±0.99	0.41±0.56	0.0003

Pain scores decreased at the 3-month follow-up after vertebroplasty, with the mean pain score reduced from 6.26 ± 1.75 to 0.24 ± 0.99 ($P = 0.0001$). Activity scores improved significantly from 1.38 ± 1.41 to

0.26 ± 0.79 after vertebroplasty ($P = 0.0002$). Medication scores decreased from 1.15 ± 0.99 to 0.06 ± 0.24 at the 3-month follow-up ($P = 0.0001$). [Table 5]

Table 5: Comparison of Pain, Activity Score, and Medication Score Before and After Vertebroplasty at 3-Month Follow-up

		Mean ± S.D.		P value
		Pre-vertebroplasty	Post vertebroplasty	
Follow up result at 3 months	Pain	6.26±1.75	0.24±0.99	0.0001
	Activity score	1.38±1.41	0.26±0.79	0.0002
	Medication Score	1.15±0.99	0.06±0.24	0.0001

DISCUSSION

In our study, female patients represented more than half the sample, indicating a higher prevalence of osteoporotic VCFs in women. The involvement of single vertebral levels was greater than that of multiple vertebral levels. The demographics of this population were similar to those of another study by Sureshkumar et al., which had 15 females out of 75% and 14 patients with single vertebral levels out of 70%.^[13] These demographics are also similar to those of another study by Ahsan et al., which had 84.6% females out of 26 patients with 30 VCFs.^[14] This shows that there is more involvement of females and single vertebral levels, which is according to the already known concept of osteoporosis and vertebral compression fractures.

Most of the patients included in our study showed favourable clinical outcomes after percutaneous VBP. Excellent results were more common than good or fair results. There were few complications with minimal cement leakage. Sakthivel et al. showed similar results, with 15 out of 20 patients showing excellent results (75%), with only one case of cement leakage.^[15] Another study by Zuluaga García et al. is a systematic review of 15 studies of 8,500 patients from 2009 to 2024. There were 20-70% cases of cement leakage, although symptomatic complications were < 1%. Clinical results were consistently good, with 85% showing excellent or good outcomes.^[16] These results were consistent with other studies, showing that VBP is a safe and effective treatment for patients with symptomatic osteoporotic vertebral compression fractures.

In our study, there was progressive improvement in the clinical status after vertebroplasty. Most patients became asymptomatic immediately after treatment, and this increased over time. Only a small percentage showed improved or static status, and initial deteriorations in a few patients were resolved at the final follow-up. Percutaneous vertebroplasty presents progressive clinical improvement; 90% of patients became asymptomatic at 12 months, consistent with sustained pain relief. Ahsan et al. showed that 88.46% of 26 patients experienced a dramatic decrease in pain on postoperative day 1.^[14]

Yang et al. studied 544 patients, of whom 280 underwent vertebroplasty and observed significant pain reduction for 6 months compared to conservative treatment.^[17] A meta-analysis conducted by Lou et al., comprising 13 random studies and 1,624 patients, also proved that vertebroplasty is effective in reducing pain for acute cases.¹⁸ The increasing number of asymptomatic patients indicates that stabilisation of the spine by cement injection helps patients recover from the condition. This was also proven by studies on vertebroplasty for patients with osteoporotic compression fractures, which is effective.

In our study, vertebroplasty showed significant improvement in pain, functional activity, and medication needs. Patients received immediate pain relief along with improvement in functional activity and reduction in analgesic dependence. The study also revealed sustained improvement over time with reduction in pain, improvement in activity scores, and minimal analgesic needs. Arivoli et al. reported significant pain relief among 20 patients over 12 months of follow-up.^[19] Buchbinder et al. analysed 12 studies involving 775 participants and reported moderate evidence that vertebroplasty had no significant advantages over placebo for pain, disability, or quality of life, with only a 0.7-point greater pain reduction on a 0-10-point scale at one month.^[20] The study proved the effectiveness of vertebroplasty for pain reduction and functional improvement. Although there are some concerns regarding the effectiveness of vertebroplasty over placebo, vertebroplasty is effective for patients with osteoporotic vertebral compression fractures.

Limitations

The sample size was relatively small, which may limit the generalisability of the findings. The absence of a control or comparison group restricts the ability to directly compare vertebroplasty with conservative or alternative treatment modalities. The study was conducted at a single centre, which may introduce selection bias. Although patients were followed up to one year, longer-term outcomes, including the risk of adjacent vertebral fractures, were not assessed. Functional outcomes such as activity and medication scores were not based on standardised validated

scales, which may affect the objectivity of these measures.

CONCLUSION

Percutaneous vertebroplasty is used to treat osteoporotic compression fractures that do not respond to conservative treatment. It is used as a splint for the treatment of pain using methyl methacrylate cement. Pain relief, deformity, mobility, function, and stature are immediate. The success of the procedure depends on proper selection, planning, and careful performance. Percutaneous vertebroplasty is used to treat complications of vertebral compression fractures and increases patient stature. Modified vertebroplasty is used to reduce cement leakage.

REFERENCES

1. Sözen T, Özişik L, Başaran NÇ. An overview and management of osteoporosis. *Eur J Rheumatol* 2017; 4:46–56. <https://doi.org/10.5152/eurjrheum.2016.048>.
2. Rashki Kemmak A, Rezapour A, Jahangiri R, Nikjoo S, Farabi H, Soleimanpour S. Economic burden of osteoporosis in the world: A systematic review. *Med J Islam Repub Iran* 2020; 34:154. <https://doi.org/10.34171/mjiri.34.154>.
3. Bae Y, Kim M, Jeong W, Jang S, Lee SW. Epidemiology and future burden of vertebral fractures: Insights from the Global Burden of Disease 1990–2021. *Healthcare (Basel)* 2025; 13:1774. <https://doi.org/10.3390/healthcare13151774>.
4. Choi SH, Kim DY, Koo JW, Lee SG, Jeong SY, Kang CN. Incidence and management trends of osteoporotic vertebral compression fractures in South Korea: A nationwide population-based study. *Asian Spine J* 2020; 14:220–8. <https://doi.org/10.31616/asj.2019.0051>.
5. Patel D, Liu J, Ebraheim NA. Managements of osteoporotic vertebral compression fractures: A narrative review. *World J Orthop* 2022; 13:564–73. <https://doi.org/10.5312/wjo.v13.i6.564>.
6. Marchenkova LA. Osteoporotic vertebral compression fractures: Medical, social aspects, clinical picture, treatment and medical rehabilitation. A review. *Bulletin of Rehabilitation Medicine* 2023; 22:91–9. <https://doi.org/10.38025/2078-1962-2023-22-6-91-99>.
7. Jang HD, Kim EH, Lee JC, Choi SW, Kim HS, Cha JS, et al. Management of osteoporotic vertebral fracture: Review update 2022. *Asian Spine J* 2022; 16:934–46. <https://doi.org/10.31616/asj.2022.0441>.
8. Ameis A, Randhawa K, Yu H, Côté P, Haldeman S, Chou R, et al. The Global Spine Care Initiative: a review of reviews and recommendations for the non-invasive management of acute osteoporotic vertebral compression fracture pain in low- and middle-income communities. *Eur Spine J* 2018; 27:861–9. <https://doi.org/10.1007/s00586-017-5273-6>.
9. Nasto LA, Jannelli E, Cipolloni V, Piccone L, Cattolico A, Santagada A, et al. Three generations of treatments for osteoporotic vertebral fractures: what is the evidence? *Orthop Rev (Pavia)* 2022; 14:38609. <https://doi.org/10.52965/001c.38609>.
10. Chandra RV, Meyers PM, Hirsch JA, Abruzzo T, Eskey CJ, Hussain MS, et al. Vertebral augmentation: report of the Standards and Guidelines Committee of the Society of NeuroInterventional Surgery. *J Neurointerv Surg* 2014; 6:7–15. <https://doi.org/10.1136/neurintsurg-2013-011012>.
11. Beall DP, Phillips TR. Vertebral augmentation: an overview. *Skeletal Radiol* 2023; 52:1911–20. <https://doi.org/10.1007/s00256-022-04092-8>.
12. Marcia S, Muto M, Hirsch JA, Chandra RV, Carter N, Crivelli P, et al. What is the role of vertebral augmentation for osteoporotic fractures? A review of the recent literature. *Neuroradiology* 2018; 60:777–83. <https://doi.org/10.1007/s00234-018-2042-0>.
13. Sureshkumar DA, Dinesh DS, Venkatesh DG. Role of percutaneous vertebroplasty in osteoporotic compression fractures: A prospective study. *Int J Orthop Sci* 2020; 6:165–70. <https://doi.org/10.22271/ortho.2020.v6.i2c.2032>.
14. Ahsan MK, Pandit OP, Khan MSI. Percutaneous vertebroplasty for symptomatic osteoporotic compression fractures: A single-center prospective study. *Surg Neurol Int* 2021; 12:176. https://doi.org/10.25259/SNI_212_2021.
15. Sakthivel DR, Khader DFA. Outcome of vertebroplasty in osteoporotic vertebral compression fracture. *Int J Orthop Sci* 2023; 9:127–30. <https://doi.org/10.22271/ortho.2023.v9.i2b.3360>.
16. Zuluaga-Garcia JP, Sierra MA, Call-Orellana FA, Herrera D, Andrade-Almeida RA, Ravindran PK, et al. Complications of vertebroplasty in adults: Incidence, etiology, and therapeutic strategies—A comprehensive, systematic literature review. *Complications* 2025; 2:22. <https://doi.org/10.3390/complications2030022>.
17. Yang W, Song J, Liang M, Cui H, Chen H, Yang J. Functional outcomes and new vertebral fractures in percutaneous vertebroplasty and conservative treatment of acute symptomatic osteoporotic vertebral compression fractures. *World Neurosurg* 2019; 131: e346–52. <https://doi.org/10.1016/j.wneu.2019.07.153>.
18. Lou S, Shi X, Zhang X, Lyu H, Li Z, Wang Y. Percutaneous vertebroplasty versus non-operative treatment for osteoporotic vertebral compression fractures: a meta-analysis of randomized controlled trials. *Osteoporos Int* 2019; 30:2369–80. <https://doi.org/10.1007/s00198-019-05101-8>.
19. Arivoli. Dr, Rushikesh Hari U Dr, Babu M.B S Prof Dr. Functional outcome of vertebroplasty in osteoporotic vertebral fractures – a prospective study. *Ijsr* 2023;50–2. <https://doi.org/10.36106/ijsr/6308081>.
20. Buchbinder R, Golmohammadi K, Johnston RV, Owen RJ, Homik J, Jones A, et al. Percutaneous vertebroplasty for osteoporotic vertebral compression fracture. *Cochrane Database Syst Rev* 2015:CD006349. <https://doi.org/10.1002/14651858.CD006349.pub2>.