

## Clinico-Radiological Outcome of Percutaneous Vertebroplasty in Dorso-Lumbar Osteoporotic Vertebral Compression Fractures (OVCFs)

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### Abstract

**Introduction:** Vertebral compression fractures (VCFs) are the most common complication of osteoporosis where Percutaneous vertebroplasty is thought to immediately improve the pain and disability status via stabilization and reinforcement of the fractured body with polymethylmethacrylate (PMMA) injection. **Purpose:** To evaluate the clinical and radiological outcome of Percutaneous vertebroplasty in osteoporotic VCFs in Dorso-Lumbar (DL) Spine. **Materials and methods:** It is a prospective study carried out in Bangabandhu Sheikh Mujib Medical University (BSMMU) and different private hospitals in Dhaka, from January 2010 to March 2023. Total number of patients was 121 i.e., 92 female 29 male patients (167 treated vertebrae), age ranged from 65-85 years with mean age 73.40 years. 10 cases at D<sub>10</sub> and D<sub>11</sub> each, 26 cases at D<sub>12</sub>, 21 cases at L<sub>1</sub>, 15 cases at L<sub>2</sub>, 16 cases at D<sub>12</sub>-L<sub>1</sub>, 03 case at D<sub>9,12</sub>, 05 cases at D<sub>10,11</sub>, 07 cases at L<sub>1,2</sub> and 03 case at D<sub>9,12</sub>L<sub>1</sub> and 05 cases at D<sub>12</sub>L<sub>1,2</sub>. Follow up ranged from 24 to 36 months and outcome assessed regarding neurological status (Radiculopathy and Myelopathy), pain [Visual Analogue Score (VAS)] and disability [Oswestry Disability Index (ODI) questionnaire]. Radiological assessment of the treated spine was done to identify any vertebral height gain (McKiernan method), kyphosis correction (Cobb's method). **Results:** The mean age was 73.40 ± 03.75 years. 74(60.97%) patients were in 65-74 years age group. 105(63.41%) cases had single vertebral level, 49(29.26%) with 02 levels and 12(07.32%) with 03 levels involvement. D<sub>12</sub> (n=53, 31.17%) and L<sub>1</sub> (n=52, 31.13%) were most frequent. The age, sex, occupation, and the level of involvement had no significant difference (p>0.05, chi-squared test). VAS for pain had significantly improvement (p<0.05, paired t test) from preoperative 08.50±0.50 to 03.50±0.30 postoperatively and 02.80± 0.50 at 1 year. The preoperative ODI 71.11±09.69 improved significantly (p<0.05, paired t test) to 17.34±04.11 postoperatively and 09.76± 04.83% at 1 year. The kyphotic angle was corrected to 05°±02.50° at the 12 months follow up radiograph. One level (02.30%) had cement leakage which was evident on postoperative X-ray but was asymptomatic even on the last follow up. **Conclusion:** Percutaneous Vertebroplasty is a significantly effective technique for immediate and short-term pain relief, disability status improvement in Vertebral Compression Fractures (VCFs) with satisfactory radiological outcome in DL spine.

**Keywords:** Percutaneous Vertebroplasty, Vertebral Compression Fractures.

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### INTRODUCTION

Vertebral Compression fracture (VCF) is the most common complication of osteoporosis [1] and is

associated with significant declines in health and functional activity [2]. Its prevalence steadily increases with age, reaching 40% in 80-year-old women, [3] having a 15% higher mortality rate [4]. All the vertebrae

could be affected but the Dorso lumbar region is the commonest and it typically occurs at the anterior third of the body resulting in altered biomechanics of the spine, making adjacent levels more vulnerable to further fracture and if left untreated, progressive spinal deformity may also be ensued [5]. Moreover, one third of these fractures results in persistent pain, [6] progressive loss of functional capability and ultimate loss of mobility [7]. Primary modalities for the treatment of VCFs include: conventional medical management, reconstructive surgical intervention, and Percutaneous Vertebroplasty (PV) [8].

after being introduced for the treatment of Vertebral Angiomas in 1984 by Galibert and Deramond, [9] PV is being a useful intervention for osteolytic neoplasms [10] and osteoporotic fractures [11]. Reported pain relief is achieved in 70%–100% [12] cases of osteoporotic fractures which are thought to be achieved via stabilization and reinforcement of the fractured body [1] by Injection of polymethylmethacrylate (PMMA) [13]. This procedure leads to partial or complete pain reduction within 72 hours of injection [14] and is particularly advantageous because of their brief surgical time, limited sedation, minimal recovery period, and short or no hospital stay<sup>15</sup> as well as avoiding and minimizing the need for antero-posterior stabilization and their associated morbidities in elderly group of population [16].

Since being introduced into surgical practice in the late 1990s, vertebroplasty has become one of the preferred methods for treating Osteoporotic Vertebral Compression fractures (OVCF) for many spine surgeons [17]. As the dorso-Lumbar (DL) Spine had been most affected in different series of literatures due to its unique biomechanical characteristics we have evaluated the clinical and radiological outcome of the procedure in OVCFs of the region.

## METHODS

It is a prospective study carried out in Bangabandhu Sheikh Mujib Medical University (BSMMU) and different private hospitals in Dhaka, from January 2010 to March 2023. Total number of patients was 121 i.e., 92 female 29 male patients (167 treated vertebrae), age ranged from 65-85 years with mean age 73.40 years. All the patients were evaluated preoperatively by coagulation screening, X-ray DL spine A/P, standing and supine lateral views, Magnetic Resonance Imaging (MRI) of the DL spine and Computerized Tomography (CT) scan to delineate the vertebral anatomy and intra spinal neurological condition. The patients with painful OVCFs involving the DL spine refractory to medical treatment or associated with osteonecrosis, unstable and multiple OVCFs were treated. Patients with i) back pain attributed to myelopathy or radiculopathy resulting from stenosis of the vertebral canal or narrowing of the intervertebral foramen, ii) Associated OVCF severe vertebral body

collapse to more than one-third of its original height iii) CT documented interrupted posterior cortical outline, iv) OVCF involving spinal regions other than DL Spine and v) patients with coagulopathies were excluded.

Follow up ranged from 24 to 36 months and outcome assessed regarding neurological status (Radiculopathy and Myelopathy), pain [Visual Analogue Score (VAS) [18] and disability [Oswestry Disability Index (ODI) questionnaire [19] at day 10, 1 month, 3 months, 6 months and every 6 monthly thereafter. Radiological assessment of the treated spine was done to identify any vertebral height gain (by McKiernan [20] method), kyphosis correction (by Cobb's [21] method). Statistical analysis was done using SPSS software and chi-squared test and t-test done where applicable. Statistical significance were considered when the results were <0.05.

**Operative Procedure:** In the procedure room, after giving a prophylactic dose of injectable antibiotic the patients were carefully positioned prone to avoid new fractures over a Wilson frame with extra padding to avoid pressure points. Sedation was accomplished using fentanyl and propofol infusion at the discretion of the anesthesiologist to maintain adequate sedation. Following site preparation and sterile draping, the C-arm was rotated until the pedicles of the VBFs were in a proper view. Skin and subcutaneous tissues were anesthetized and a 0.5-cm stab skin incision was made. Under the C-arm guidance, an awl-tipped probe was inserted and gradually advanced through the pedicle (biportal) using continuous anterior-posterior (AP) and lateral C-arm views to ensure correct needle advancement. Once the probe was at the junction of the posterior third and the middle third of the vertebral body a 0.5 mm (OD) stainless steel threaded-tipped cannula was railroaded over the probe and rotated clockwise to advance the catheter into the cancellous bone, just past the cortical wall. The probe was then removed, leaving the cannula in place. The same procedure was performed on the opposite pedicle.

The cement mixture consisted of 40 ml powder methyl-methacrylate polymer mixed with 10 mL liquid methyl-methacrylate monomer and 12 g barium sulfate. The cement was allowed to reach the thin paste consistency and taken into a syringe. The cement was slowly injected into the cannula until the cavity was filled which was confirmed by C-arm. The same procedure was repeated in the opposite side (biportal). Injection was immediately discontinued if fluoroscopic evidence of cement extrusion was observed. In patients with extravasation of cement beyond the boundaries of the vertebral body, CT imaging was used to detect leakage into the epidural space or neural foramen. One to three levels were treated during a single procedure, with a total amount injected per level of 2.5 to 5 mL of cement. The cannulas were then removed and the

incision sites were closed. Total fluoroscopy time was 3 to 4 minutes per level treated.

The patients were discharged after 6 hours of recovery, and close contact was maintained with them over the next 72 hours. Patients returned to the office 10 days later for suture removal and postoperative evaluation by comprehensive neurologic examination, repeat VAS scoring of pain and disability assessment. Postoperatively all the cases were routinely treated with Bisphosphonates.

## RESULTS

Total 121 cases, age ranging from 65 to 85 years, mean age  $73.40 \pm 03.75$  years were included. Maximum 74(60.97%) patients were in 65-74 years age group. Out of these patients 92(76%) were female, male: female ratio 1:4 with a female predominance. All female patients were Housewives, and 18(14.63%) male patients were sedentary workers. Total 167 vertebra were involved in which 105(63.41%) cases had single vertebral level, 49(29.26%) with 02 levels and 12(07.32%) with 03 levels involvement. Maximum cases involved at D12 (n=53, 31.17%) and L1 (n=52, 31.13%), L<sub>2</sub> (n=30, 17.96%) and D<sub>10</sub>, D<sub>11</sub> each (n=15, 08.98%), and D<sub>9</sub> (n=06, 03.59%). The age, sex, occupation, and the

level of involvement had no significant difference ( $p > 0.05$ , chi-squared test) [Table-I]. The duration of the hospital stay was 6 hours to 1 day. No serious complications (e.g. infection, cement leakage related pulmonary embolism, radiculopathy or myelopathy) related to the procedure occurred except one vertebral level (02.30%) had mild cement leakage which was evident on postoperative X-ray but was asymptomatic even on the last follow up.

All the patients were followed up in a period for minimum 12 months. Table-II describes, the pain intensity of all the patients was assessed by Visual Analogue Score (VAS) and had significantly improvement ( $p < 0.05$ , paired t test) at the 10<sup>th</sup> postoperative day (from mean  $08.50 \pm 0.50$  to mean  $03.50 \pm 0.30$ ) with similar improved pain status at even 1 year follow up (mean  $02.80 \pm 0.50$ ). The mean preoperative disability score by Oswestry Disability Index (ODI) was  $71.11 \pm 09.69$  (range 69.75% to 78.57%) which was improved significantly ( $p < 0.05$ , paired t test) to  $17.34 \pm 04.11$  (range 11.75% to 23.56%) at 10<sup>th</sup> postoperative day and even upto  $09.76 \pm 04.83\%$  at 1 year follow up. All the patients returned to their normal daily living. The kyphotic angle was corrected to  $05^\circ \pm 02.50^\circ$  at the 12 months follow up radiograph [Table-II].

**Table-I: Demographic variables of the study population. (n=121)**

Age		Sex		Level of involvement	
Groups	No (%)	Groups	No (%)	Groups	No (%)
65-75 years	74(60.97%)	Male	29 (24%)	01 vertebrae	105 63.41%
75-85 years	47(39.02%)	Female	92 (76%)	02 vertebra	49 29.26%
				03 vertebra	13 7.32%

**Table-II: Outcome variables of the study population. (n=121)**

Variables		Assessment	Follow ups				
			Pre-op	10 days	3 Months	6 Months	12 Months
Clinical And Radiological outcome	Pain	Visual Analogue Score (VAS)	$08.50 \pm 0.50$	$03.50 \pm 0.30$	$03.00 \pm 0.80$	$03.00 \pm 0.30$	$02.80 \pm 0.50$
	Disability	Oswestry Disability Index (ODI) Score	$71.11 \pm 09.69$	$17.34 \pm 04.11$	$13.67 \pm 03.37$	$11.76 \pm 04.25$	$09.76 \pm 04.83$
	Kyphosis correction	Cobb's <sup>22</sup> method	$15^\circ \pm 05.50^\circ$	$10^\circ \pm 05.50^\circ$	$10^\circ \pm 05.50^\circ$	$07.50^\circ \pm 05.50^\circ$	$05^\circ \pm 02.50^\circ$

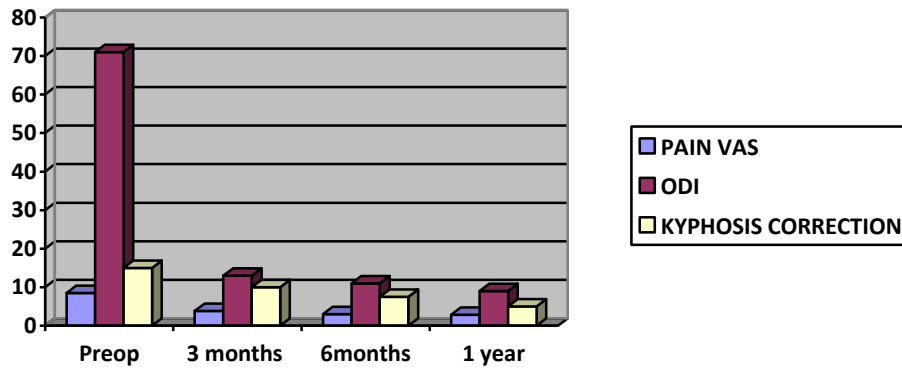
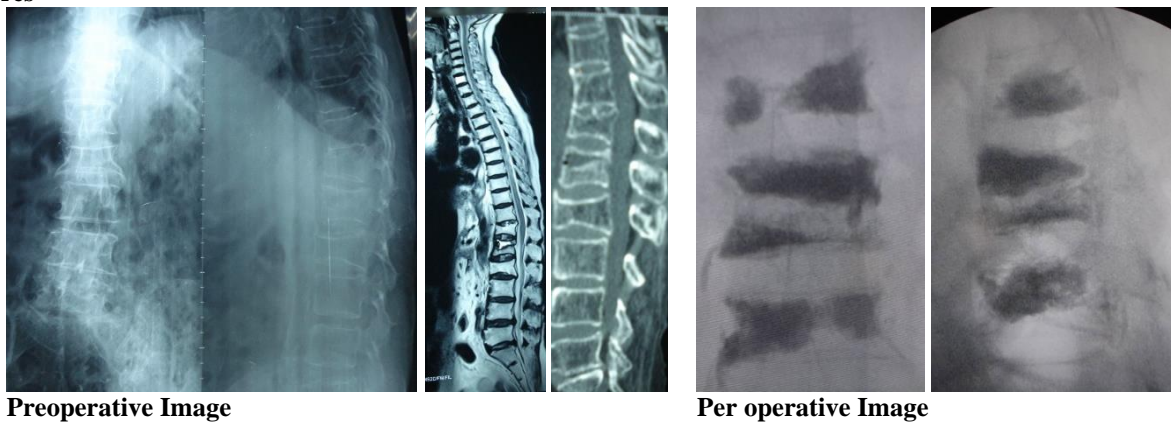
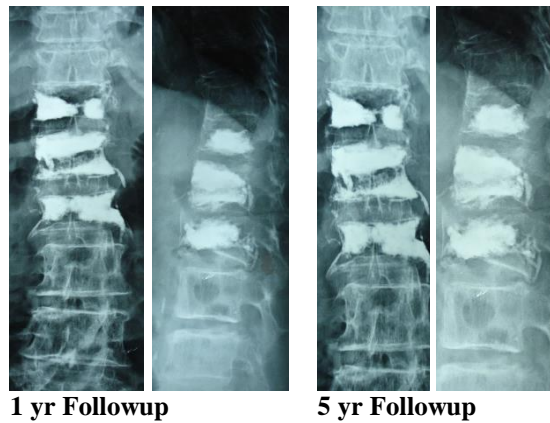


Chart 1: Outcome variables of the study population. (n=121)

**Pictures**



**Postoperative Image**



**DISCUSSION**

Conventional PV for OVCFs was originally developed in response to limited results of conservative and surgical modalities to stabilize and strengthen collapsed vertebral bodies [22-24]. Conservative therapy included bed rest, external bracing, analgesics, or calcitonin therapy over several weeks for pain control, [25] along with other treatments (e.g. hormone replacement or biphosphonates for the long-term), but often do not provide adequate immediate or short term pain relief [26]. Moreover a long period of bed rest can lead to demineralization of bone and which may

predispose to further fracture [27]. For these reasons Stanford University underwent a prospective randomized crossover trial comparing PV with conservative therapy for acute OVCFs and showed significant improvement with PV, [28] that include reduced or eliminated fracture pain, less long-term pain or disability, prevention of further collapse, and an early return to mobility [29, 30].

The demographic variables of our study were similar to Zoarski [31] who performed a prospective analysis of 30 patients at 54 levels, with 18 months follow-up. Their mean age was 79 years with female

predominance. Significant improvement of pain was noted by McGraw [32] who prospectively evaluated 100 patients at 156 levels resulting significant pain relief by 24 hours that sustained even upto 21 months. Their VAS score dropped from 8.9 to 2.0. Cortet [25] also had a significant improvement of pain (16 patients, 20 levels) but sustained only for 6 months. Significant disability level improvement was noted by Zoarski [31] at 2 weeks post-procedure that continued up to 18-month whereas 93% of patients of McGraw [32] noted an increased activity level almost similar to us. Mckiernan [33] showed significant quality of life improvement.

Despite the benefits of conventional PV, cement extrusion has been most frequently associated with it [34] (9% to 80% cases), probably due to the low viscosity and the pressure required to inject cement into the cancellous vertebral body matrix [35]. It appears that even with a perfect technique, cement leakage up to a certain percentage is an inevitable and unpredictable complication [36]. Although there had been very few reports of postoperative cement related neural complications (root compression, [37] Cord compression [38]) and fatal pulmonary embolisms [39] one case of cardiovascular collapse requiring pulmonary embolectomy, one lethal pulmonary embolus, and one case of paradoxical cerebral arterial PMMA emboli have been reported [40]. There are also several reports of osteomyelitis requiring corpectomy [41]. Leakage into the paravertebral muscles (can causes severe localized pain), into the venous circulation (can produce generalized toxic reactions) [39] but we did not encounter any of such complicated incidents. The rate of cement leakage of our study (9.2% in vertebroplasty procedures) compares favorably with published rates [35].

Perez-Higueras [30] prospectively assessed radiographic outcomes in 12 patients over a 5-year period. Three patients suffered 04 new fractures over the 5-year follow-up period, two of which were adjacent to treated levels. Cortet [25] was first to note increase in adjacent level fractures on long-term follow-up after PV but we had no such consequences in our 1 year follow up period. Kim [42] noted 72 new fractures (7.9%) over a 3-year follow-up duration but the 1-year fracture-free rate was 93% according to Kaplan–Meier analysis. Re-fractures of already stabilized vertebrae [43] had been reported but we did not encounter such condition. There are reports of persisting pain [44] but it was also absent in our series.

The small number of our study population had no incidence of adjacent level fracture within only one year follow up. Even this small number of cases enrolled was not sufficient to properly assess the statistical outcome. We recommend the assessment in a larger study population with a longer follow up.

## CONCLUSION

Percutaneous Vertebroplasty (PV) is significantly effective technique for immediate and short-term pain relief, disability status improvement in Osteoporotic Vertebral Compression Fractures (OVCFs) with satisfactory radiological outcome.

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