

# Spinal Pains in Geriatric Group of Osteoporotic Vertebral Body Compression-fracture Relieved with Cath Lab-Vertebroplasty using “Small-Volume Glass Acrylate

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## Abstract

Generalized osteoporosis and “osteoporotic vertebral body compression fractures” (OVBCF) are interrelated geriatric problems. Spinal pains of OVBCF and osteoporosis both are resistant to medicinal treatments. Surgical and C-arm Vertebroplasty are time consuming and difficult-operations. It can cause severe neurological deficits adding more debility to geriatric patients. Percutaneous minimal invasive procedure using glass acrylate (PMMA) and ‘digital subtraction angiography Catheterization laboratory unit’ (Cath lab PVP) can be combined effectively for augmenting pain relief. With Cath lab PVP no more problems related to acrylate viscosity and injection are noticed. Acrylate exudation in intra-dural and intra-neural spaces can easily be averted.

**Objective:** is to 1) Evaluate small volume PMMA in providing stability, safety and efficacy to OVBCF. 2) Effectiveness of Cath lab in reducing PMMA viscous to small volume, in relieving pains related to acute OVBCF pains. 3) To use minimal invasive and small procedural time in geriatric patient.

**Material Method:** Cath-lab is a multi-directional fluoroscopic high resolution digital subtraction angiographic imaging unit. Augmentation procedure performed in Cath lab is called as “Cath lab-Vertebroplasty (Cath lab-PVP). Twenty two OVBCF treated with Cath lab- PVP. Small volume, defined less than 3ML of viscous acrylates. It is injected through trans-pedicular route.

**Results:** Small volume fluid acrylate is well spread within the fractured crevices. Molded vertical cast between cortical plates maintains vertical body strength very effectively. Cath lab speed procedure too becomes effective.

**Conclusion:** Significant (90%) pain relief achieved within 24 to 48 hours in eighteen (81.81%) patients. Cath lab-PVP increases safety, early mobility without analgesics. Small volume PMMA is optimal and less prone for complication. Cath lab PVP fluoroscopy with its increased PMMA radio opacity monitors bone filling well. It has less procedural time and better psychological impact on the minds of geriatric.

## Introduction

Osteoporotic patients are affected with acute spinal pain due to “osteoporotic vertebral body compression fracture” (OVBCF). OVBCF are pathological-non-traumatic dynamic compression induced fractures in osteoporotic body. Clinically intolerable spinal pains centering over fractured body vertebra is the hallmark of OVBCF. Excruciating pains also gets referred over thoracic or abdominal metamer segments. Pain is resistant

to medicinal therapy. Spinal pain does not respond to fomentation or to short wave diathermy. OVBCF immobilizes the patient and with it comorbidities like pneumonia and deep vein thrombosis often develop in the geriatric immobile patients. OVBCF with acute spinal pains are diagnosed by different faculties. Patients are seen by their family-physicians first. History of trauma or fall is often absent. As a result pain management differs. Often becomes symptomatic

and conservative. It becomes lengthy over 30 days.

Prevalence of osteoporosis Worldwide is around 10 million people. OVBCF are more prevalent in post-menopausal osteoporotic females. Long delay is a significant factor in the management of OVBCF. It often results in permanent spinal deformity. Deformity causes more dynamic stress on the upper spine. Increased angulation deformity results in more pains. Every year over 700,000 (7%) of the osteoporotic patients suffer with OVBCF. Almost 15% OVBCF-patients are left untreated with PVP-vertebroplasty.<sup>1</sup> Approximately 20% to 25% of untreated patients return with new painful fractures. Cath lab PVP in these cases becomes difficult.<sup>2</sup> Cath lab PVP in these cases becomes difficult.

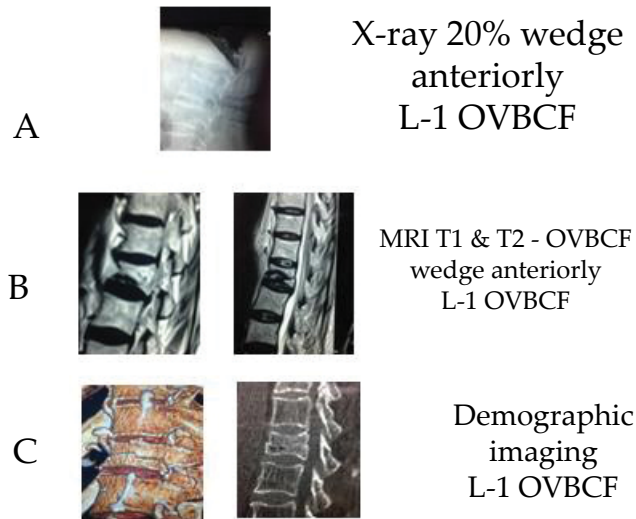
Incidence of OVBCF is almost double in women than that found in men.<sup>3</sup> Its also age related, increases from 27% at 50 years of age to almost 2960/one lac at 85years of age.<sup>4</sup> Risk of developing another clinically evident osteoporotic OVBCF in such cases increases by almost five fold.<sup>4</sup> Generalized OVBCF's incidence in women is 153 per 100,000 per year and in men it is 81 per 100,000per year.<sup>5</sup> Osteoporosis is also more common with post-menopausal-smoking women and in patients with long term steroids. The combined effect has two-fold more prevalence in OVBCF.<sup>6</sup>

X-ray in general shows osteoporosis as decrease in vertebral body-bone density sparing laminae and spinous process. Vertebral pedicles are characteristically intact. Radiologically OVBCF is defined as 15%-20% vertical

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**Fig. 1: 1<sup>st</sup> lumbar vertebra with OVBCF-wedge fracture**

loss of height- greater loss of height anteriorly than posteriorly. There is saddle wedging in the anterior two third segments or 4 mm height reduction of the vertebral body.<sup>7</sup>

Glass acrylate “polymethyl methacrylate” (PMMA) was used for relieving spinal pains resulting from vertebral-hemangiomas of the cervical-C2 body. PMMA-vertebroplasty resulted in immediate and long lasting pain relief. PMMA-Vertebroplasty was first indicated for “vertebral-pain management”. It was performed in 1984 by Deramond and Galibert of Paris, France.<sup>8</sup>

Biologically PMMA esters are harmless and stable compound.<sup>9</sup> Its chemical formula is C<sub>5</sub>H<sub>8</sub>O<sub>2</sub>. Physiologically it has low water absorbing properties. PMMA viscous hardens and solidifies within 20 minutes<sup>10</sup> and within an hour of injection in the vertebral body it achieves approximately 90% of the ultimate strength.

PMMA used later for spinal pains due to spinal body- Giant cell and metastatic tumors. In these cases pain relief was remarkably significant. Indications widened thereafter for spinal pains and applied for benign conditions like OVBCF.<sup>11,12</sup> These were treated with PMMA in the year 1989 at the University of Virginia.<sup>13,14</sup> Pain was relieved significantly in all these five patients.

Glass acrylate PMMA in viscous form even today is used for percutaneous Vertebroplasty. Viscous- PMMA used as filler. Internally it spreads in the

fractured crevices and forms solid cast. It gives vertical stability between the end plates. It prevents further wedging and angular deformation of the OVBCF affected spine.

Earlier, augmentation vertebroplasty was an open surgical procedure. The OVBCF-cavities were filled with small bony particle grafts. C-arm X-ray machine and computerized scanners (CT) were used for imaging purpose. Augmenting the pedicle screws also required PMMA. Later on for decades it was performed under C arm and computerized.

Complications were mainly technical and related to imaging, visualization and volume of injection. Large volume PMMA (more than 3 ML) injected often would exude out of the fractured crevices in to the neural tissues.

Small volume of PMMA (3 ML) in its viscous form improves the technique. Less than 3 ML viscous is injected percutaneously in the fractured cavity. Percutaneous Vertebroplasty (PVP) performed under digitalized subtraction angiography Cath lab unit is called (Cath lab PVP). It gives multi-direction live fluoroscopic imaging. Cath lab PVP with magnified imaging and increased speed helps reduce PMMA viscous to less than 3 ML volume. The small volume optimally fills the OVBCF cavities in both thoracic and lumbar vertebrae. Cath lab PVP reduces pains significantly. It improves patients’ morbidity, mobility and quality of life. Small volumes of PMMA can be used for multiple level OVBCFs in one sitting.

**Table 1: Pain associated with varied - symptomatology**

Consultation: first by	Number of patients	Symptomatology
1. General physicians	06	Pains and breathing difficulty
2. Orthopaedician	07	Deep spinal pains and immobility
3. Neurosurgeon	06	Spinal radicular pains
4. Chest physician	03	Pains and chest infection, breathing difficulty

## Material and Method

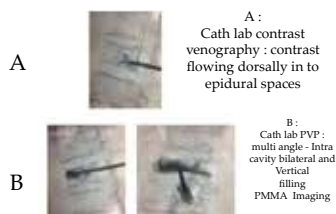
16 females (72.7%) with an average age of 70 years and 6 males (27.3%) with an average age of 77.3 years diagnosed with osteoporotic OVBCF. All twenty two patients had spinal segmental immobility related to the spinal pain due to OVBCF. X ray, MRI and demographic images of the OVBCF- Lumbar spine performed. It showed osteoporotic acute OVBCF. (Figure 1: 1st lumbar vertebra with wedge fracture).

Patients presented with varied presentations such as severe back pain, radiculomyelopathy or pneumatic discomfort. Diagnostic limitations were limited to absence of bone densitometry in defining osteoporosis. Biopsy studies and “Spinal Pain Score-Index” were not considered

The varied symptomatology led to 1st consultation with physician (27.2%), Orthopaedician (27.2%), neurosurgeon (31.8%) and chest physician (13%). Lower thoracic spine OVBCF were 81.8% and 18.2% OVBCF were in the lumbar spinal vertebrae (Table 1).

Augmentation procedure for OVBCF cavities using digital subtraction angiography unit called “Cath lab PVP” was performed. Cath lab PVP performed in the single plane Cath lab unit. Complete sterilization standards maintained. Cath lab PVP performed in all the 22 elderly patients. There were 16 females (72.7%) and 6 male patients (27.3%). All cases treated with small volume Cath lab PVP. Old patients are commonly on antiplatelet and anticoagulant therapy. Pre operatively these medicines are omitted. The ‘Written Consent’ taken for potential procedural risk.

Nonionic contrast solution (Ultravist: 370 mg Iodine/ml –Bayer; Germany or Omnipaque) 1½ cc to 4



**Fig. 2: Step 1: intra cavity venography**

**Table 2: Benefits restored with 'small volume' Cath Lab-PVP against conservative treatment**

Functions	Conservative management	Cath lab PVP
1. Maintain vertical body	Weakness ++ and Increases further	Fully maintains
2. Giving normal physiological motion	Disability ++	Improves mobility
3. Protecting neuronal structures	Not possible	Protects fully

**Table 3B: Comparative results against small volume Cath lab PVP**

Results	Medicinal management OVBCF	Small volume Cath lab PVP
1. Pain relief:	Not even mild relief	85% pain relief
2. Secondary OVBCF:	Yes – present	Not present- 5 year follow up
3. Mobility:	Not acceptable	Immediate mobility
4. Analgesics:	Long term and multiple-side effects	No analgesics required

cc used for intra cavity venography. The contrast needs to be injected into the fractured vertebral body. PMMA mixed with barium sulfate forms the radiographic viscous.

The filler solution poly methyl methacrylate (PMMA) mixed with barium sulfate used. The fractured crevices filled with small volume viscous PMMA. PMMA mixed with Barium sulfate in 30% weight/volume mixture is prepared after placement of the needle tip in the fractured cavity. Three 2 ML or 5ML syringes used for injecting the viscous in to the fractured body.

11-gauge trocar and cannula system is used for percutaneous vertebroplasty.

Local anesthetic injected deep into percutaneously from the local site. The entire needle tract and periosteum of the involved bone is injected with the local anesthetic 2% Xylocaine solution.

Intra cavity venography performed in all these cases. While trocar tip is being introduced, tracking of the

**Table 3A: Pains relieved with intra cavity small volume PMMA cast**

1. Etiology	2. Pain relief	3. Reduction in analgesics	4. Increased mobility	5. Complications
: Osteoporotic	: More than 85%	: Within 24 to 48 hours	: Within 24 hours	: Nil

needle tip is monitored appropriately. It is confirmed in both anteroposterior and lateral projections. Approximately 5-8ML of contrast (Ultravist) used for venography. Contrast venography (Figure 2) shows venous routes through intracavity contrast imaging. Its' extravasation in the epidural, paravertebral and epi-pleural spaces shows the fractured body anatomy. Embolization of fluid-cement in to paravertebral veins could cause pulmonary embolization. Large volume PMMA viscous spread into epi-dural spaces can cause radiculo myelopathy and paraplegia.

Step 2: Uni-pedicular single injection of 3 cc PMMA (+ Barium Sulphate 30% weight/volume):

Filling and its distribution across the midline monitored on lateral and postero-anterior views

Using small amount of viscous PMMA and monitoring its dorsal vertical and contralateral spread are two important steps. High-resolution, fluoroscopic real-time visualization helps monitor its spread. Its restricted just before it reaches the dorsum of the fractured body. The lateral projection monitored constantly to prevent leaks into the epidural space. PMMA-viscous filled in the central part between superior and inferior endplates of the fractured vertebra. Real time imaging effectively monitors the contralateral, vertical and dorsal spread of PMMA-viscous. Visualization of the viscous PMMA cast with increasing speed achieved in 180 degrees. As a result optimizing the volume to less than 3ML achieved in all cases.

Cath Lab with its high resolution live fluoroscopy imaging increases speed and accuracy of the procedure. Intra-cavity distribution of small volume PMMA, spread across the midline, vertical spread between the cortical plates (Figure 2). Intra-dural leaks if any; visualized very early during live fluoroscopy

Step 3: post procedure: Patients are given supine position. Cath lab PVP performed using small volume PMMA resulted in immediate significant pain. They were generally refrained from sitting for 6 hours. Trocar needle site local pains and tenderness at the

puncture site treated with analgesics and antibiotic for 2-3 days.

**Results**

1<sup>st</sup> Lumbar OVBCF using small volume was a short statured obese female (height 58" and weighing: 64 kg,) with hypertension and diabetes mellitus. Intra cavity small volume PMMA relieved pains effectively. It maintained the vertical height and thereby prevented further wedge collapse as seen in the follow-up.

The T7 cases the delay was varied. Patient with T- 7 spine had mobility problem due to additional canal stenosis. However her acute VBCF-pains got relieved by almost 85%. No complications related to PMMA noted.

The earliest PVP done was within 1-4 days; and extreme delay was 30 days. The T8-T12 segment was affected in 12 cases. Three cases had VBCF involving the upper lumbar L1-L3 segment. In seven female patients, VBCF was seen in the T7 vertebral body (31.81%).

Five patients had almost 85% pain relief and required no analgesics, early mobility reported within 12 hours. The remaining 12 patients had significant 85% pain relief within 24 hours. Four patients' radicular pains diminished completely within 48hours. (Table 3A) One patient (L1 spine-pvp) had temporary paraesthesia in both lower limbs following contrast venography. Three days later Cath lab PVP performed. She received significant pain relief. Significant pain relief, safety and mobility observed with small volume Cath lab PVP in our series (Table 3B).

All these patients experienced improvement after Cath lab PVP. They could walk and were discharged in satisfactory condition. Patient experienced relief from pre-operative type pains. Patients were discharged after two days; only two other patients (9%) were discharged after 3 days.

Technical complications like CSF leak; PMMA- exudation were avoided. Clinical follow-up showed no symptoms and signs of spinal pains, radiculopathy or compression syndrome. Three basic functions restored with acrylate PVP. 1) maintaining the vertical height, 2)

**Table 4: Cath lab-Vertebroplasty of thoracic and Lumbar OVBCF**

Cath lab PVP	Thoracic Cath lab PVP	Lumbar Cath lab PVP
1. PMMA	Small volume cord compression -NIL	Intra dural leakage -NIL
2. Needle complication	a) CSF -leak -Nil	CSF -leak -NIL
3. Venography	Pulmonary embolism -NIL	Pulmonary embolism -Nil
4. Paresthesia / bleeding :	Nil	Nil

giving normal physiological motion to the body and 3) protecting neuronal structures within the canal (Table 2). Cath lab PVP required minimal time and therefore low dose local anesthesia.

They were no pain, no recurrence at any other sites. In all these cases pain relief was satisfactory with minimal volume PMMA cast (Table 4). There were no local complications at the injection sites of trocar needle of Cath lab PVP.

Complications not seen in thoracic as well as lumbar OVBCF treated with Cath lab PVP. Patients clinically followed on three monthly intervals for 2 years. OVBCF left untreated: Recurrence of OVBCF was seen in one untreated female patient during follow up period of 4 to 5 years. She had OVBCF of the L3 body and recurrence of OVBCFs.

## Discussion

**SPINAL PAINS** - Diagnostic difficulties: One patient with Cath lab PVP had a pre-procedural delay of 30 days. In our series, because of the varied presentations; 40.92 % OVBCF patients were first seen by general physicians or pulmonologist. 31.81% by orthopedic surgeons and 27.27% by neurosurgeons on their first consultations. Patients suffer from spinal pains for a long time. Delay may results in reduction of height between the cortical plates of the OVBCF.

Osteoporotic vertebra affected: Spinal pain segment from T8 to T12 was maximally affected (54.54%); and lumbar segment from L1 to L3 was affected with pains 13.63% due



A & B: Lumbar - L5 : haemangioma - grade-2  
A and B: Same patient with  
Multiple VBCF and Lumbar haemangioma -  
L5 chronic VBCF : L3  
differentiating from acute - VBCF : L1 & L2

**Fig. 3: Recurrence occurred in the upper T12 and L1 segment spine**

to OBCVF. The osteoporotic T1 to T6 -vertebral segment was not seen affected with OVBCF.

Intra cavity viscous optimization and spread is the key to maximum safety: Intraosseous venography gives anatomical features and venous- flow dynamics in the fractured body. It gives clinico-radiological understanding. Venography feedback helps for a) re-positioning the trocar needle tip in the fractured body to avoid embolization of the PMMA and if required b) monitoring viscosity of the PMMA. Increased PMMA viscosity and its usage in small volume prevent extra corporal embolization. Acute OVBCF bleeds and bleeding results in pleural and dural irritation.

Possible mechanism of pain relief: PMMA probably restores structural properties of the bone. It helps absorb hydrostatic pressures, compressive stresses imposed on to it. The exact mechanism for relief of spinal pains could be related to the mechanical stability.<sup>15</sup> PMMA also has thermogenic and chemical effects on the vertebral pain receptors.<sup>16</sup> Solid cast PMMA internally prevents wedging and thereby angular deformation of the spine.

## Conclusion

Cath lab-PVP increases safety. Significant (85%) pain relief, achieved within 24 to 48 hours in eighteen (81.81%) patients.

Mobilization is early and without analgesics. The long standing internal stability is seen in all patients.

Cath lab PVP with less procedural time has better psychological impact on the minds of old aged people

than that of the surgical or medicinal management.

Small volume PMMA - Cath lab PVP; very scientifically standardizes management of OVBCF-pain.

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