



Cement Augmented MIS Screw Vertebroplasty, Hybrid Procedure - A Technical Note

Atif Naseem*, Ayush Sharma, Vijay Singh, Manoj B Gaddikeri, Harsh Agrawal, Nandan Marathe, Aakash Shakya and Pratik Sidhdhapuria

Department of Orthopaedics, Dr. Bhimrao Ambedkar Memorial Hospital, Central Railway Byculla-Mumbai, India

***Corresponding Author:** Atif Naseem, Department of Orthopaedics, Dr. Bhimrao Ambedkar Memorial Hospital, Central Railway Byculla-Mumbai, India.

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Abstract

Osteoporotic Vertebral compression fracture occurs in approximately 20% of individuals over 70 years of age. A significant majority of fractures approx 60% to 75% occur around the thoracolumbar region. The fractures can result in persistent pain, inability to perform daily activities, and a marked decrease in the quality of life. Reduction of pain and stabilization of vertebrae and prevention of deformity are the goals of treatment in vertebral compression fracture. The purpose of this technical note is to demonstrate the usefulness of minimal invasive cement augmented screw vertebroplasty along with short segment fixation at junctional vertebral compression fracture and its intraoperative effectiveness in preventing devastating complications.

Keywords: Vertebroplasty; Cement; PMMA

Introduction

Vertebroplasty was first performed in 1984 by French radiologists for treatment of a hemangioma. Since then Vertebroplasty eventually went on to revolutionize the treatment of painful osteoporotic vertebral compression fractures and few vertebral body tumors. Nowadays vertebroplasty is mainly performed by orthopedics and spine surgeons. Though there are very few complications in this procedure [1] like cement leakage in adjacent areas, however, sometimes PMMA (cement) venous embolization can be life threatening causing complications such as pulmonary embolism, acute respiratory failure secondary to respiratory distress, intracranial embolic stroke, inferior vena cava syndrome and cardiac complication - which are noted in various studies. These life-threatening complications are uncommon but can be easily prevented by thorough planning, mitigation and safe technique. The purpose of this technical note is to demonstrate the usefulness of minimal invasive screw vertebroplasty along with short segment

fixation [2] at junctional VCF and its intraoperative effectiveness in preventing devastating complications.

Osteoporosis is a systemic bone disorder characterized by a reduction in bone mass. Vertebral compression fracture occurs in approximately 20% of individuals over 70 years of age.

The fractures can result in persistent pain, inability to perform daily activities, and a marked decrease in the quality of life.

Reduction of pain and stabilization of vertebrae are the goals of treatment in vertebral compression fracture. Percutaneous vertebroplasty [1,7] is a minimally invasive method involving injection of polymethylmethacrylate (PMMA) into the vertebral body to stabilize the fracture. Pain relief is usually observed within first 72 hours after treatment. There are concerns regarding procedural complications, which are mostly related to leakage of PMMA into adjacent structures, or injection into the vertebral venous plexus.

Such venous leaks cause compression of the spinal cord or nerves or could also cause pulmonary embolism. The overall complication rate was reported to range from 1 to 10%, with a higher incidence of complication in cases with the metastatic lesion. Several other surgical methods of treatment include balloon kyphoplasty, vertebroplasty combined with pedicle screw stabilization (hybrid procedure), cement augmented pedicle screw stabilization [5,6], decompression, and stabilization. The aim of our study was to analyze the technical consideration of hybrid procedure combined with cement augmented pedicle screw and the prevention of complication arising out of traditional vertebroplasty surgery.

Technique

MIS screw vertebroplasty under image intensifier was planned in a 70-year female with D12 vertebral body osteoporotic wedge compression fracture.



Figure 1: Cobbs 40.1 deg, Local kyphotic angle - 30 deg.

Similar to routine vertebroplasty [7] the patient was positioned and the procedure was carried out under general anesthesia in prone position. Localization of the pedicles was performed with the aid of the c-arm fluoroscopy. We used the transpedicular route to reach the vertebral body. Pedicles provides a definite anatomical landmark for needle targeting and prevent damage to adjacent structures. Using the transpedicular route, the Jamshedi needle was centered at the 8 o'clock over the left pedicle or 4 o'clock over the right pedicle on the AP view. One may have to start the entry

pointslightly more superior so that the needle is able to traverse thevertebrae without penetrating the fractured and collapsed superior end plate. The needle was medialized through thecylinder of the pedicle to reach the middle of the vertebra.

Once the first cortex was pierced and a footprint was obtained by the needle in the pedicle, and the position was considered ideal on the AP view, advancement of the needle was done under the guidance of the lateral fluoroscopy such that tip should not cross medial wall of pedicle.



Figure 2



Figure 3

Care should be taken in osteoporotic bone where penetrating the bony cortex and advancing the needle into the vertebral body is easy. The tip of the needle should lie beyond the midpoint of the vertebral body on the lateral view. The ideal endpoint was the junction between the anterior and middle thirds of the vertebral body.

In our practice of screw vertebroplasty Radioopaque dye was not used, after crossing pedicle we removed the stellate and inserted guide wire into the vertebral body and then safely removed Jamshedi needle keeping guide wire secured. This procedure was done for D11-D12-L1 vertebrae [2] on one side and then repeated on contralateral side, this step is followed by dilatation tapping and screw placement of adequate length. At fractured level we used fenestrated cannulated dural thread polyaxial pedicular screw. Dural threads add more sturdy holds in pedicle while rest of the screw are MIS cannulated screws.



Figure 4

After screw placement cementing apparatus consist of sleeves and cement pusher which further add up to safety concerns [4] and preventing consequences of cement leakage. Preparation of cement was done with the help of mixing device once all screw had been placed followed by simultaneous cementing with the help of plunger. In our practice we also cement upper and lower vertebrae in osteoporotic spine.

The procedure is continuously monitored with fluoroscopy. We usually put 1-2ml of cement on either side, more in fractured vertebrae. After final placement of rod on both sides closure done in layers.



Figure 5: DePuy-synthes cement augment system.



Figure 6

Discussion

A significant majority of fractures, 60% to 75%, occur around the thoracolumbar region. This segment is between T12 and L2 and is considered a transition zone from the more rigid thoracic vertebral column to the relatively mobile lumbar vertebral column. This anatomic relationship makes the thoracolumbar junction more prone to fractures than the rest of the spine [10]. Approximately 30% of fractures can develop painful nonunion, progressive kyphosis, and neurological deficit. For patients who develop severe pain not responding to nonoperative measures and painful nonunion, percutaneous cement augmentation procedures including vertebroplasty or kyphoplasty have been suggested. For fractures with severe collapse and that lead to neurological deficit and increasing kyphosis, instrumented stabilization is advised [12]. For posterior

stabilization, percutaneous minimally invasive pedicle screw fixation and stabilization can be performed to minimize muscle injury and enable early rehabilitation. The application of posterior minimally invasive techniques reduces the approach-related morbidity like iatrogenic muscle denervation, ischemia, pain and functional impairment [11]. Augmentation of pedicle screws with PMMA is the most effective and practical technique to improve the hold of the screws in the bone. The combination of Kyphoplasty or Percutaneous vertebroplasty and instrumentation, so called hybrid stabilization, can effectively shorten the entire construct and therefore help to minimize the surgical trauma. Additionally, percutaneous instrumentation further decreases the invasiveness of the procedure [12]. Percutaneous Vertebroplasty alone appeared to provide better vertebral height restoration but could not improve segmental kyphosis or even thoracolumbar kyphosis leading to higher incidence of new ASFs compared to conservative treatment [13]. Screw vertebroplasty as a hybrid procedure at this level should be planned with aid of CT scan [9]. Hence there should not be any burst fracture or posterior wall damage or damage to pedicles, CT scan also help in assessment of pedicle morphology before we execute to final planning of screw vertebroplasty. DEXA Scan should be performed to conclude systemic osteoporosis. MRI will also aid in planning when it comes to neuro-deficit or posterior tension band damage or chance fracture. Therefore at junctional level through cement augmented screw vertebroplasty we could achieve several parameters like anterior reconstruction through cement, stabilizing posterior tension band via short segment fixation, correction of local kyphotic deformity and prophylaxis for prevention of future adjacent segment Fractures in osteoporosis.

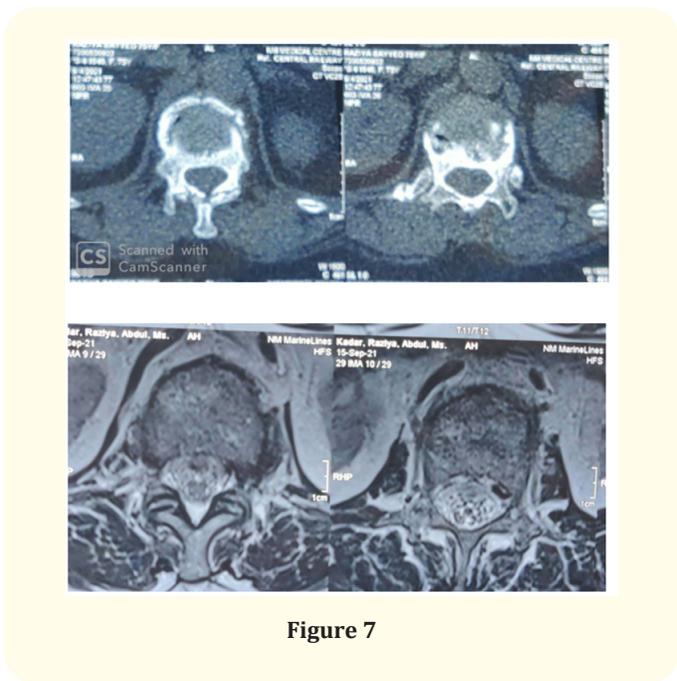


Figure 7

Conclusion

The procedure of cement augmented screw vertebroplasty with short segment fixation as a hybrid procedure through minimal invasive spine approach can really achieve milestones particularly at junctional level VCF's. On view of safety concerns, this technique reduces venous leakage of cement significantly, and risk of complications can be nullified.

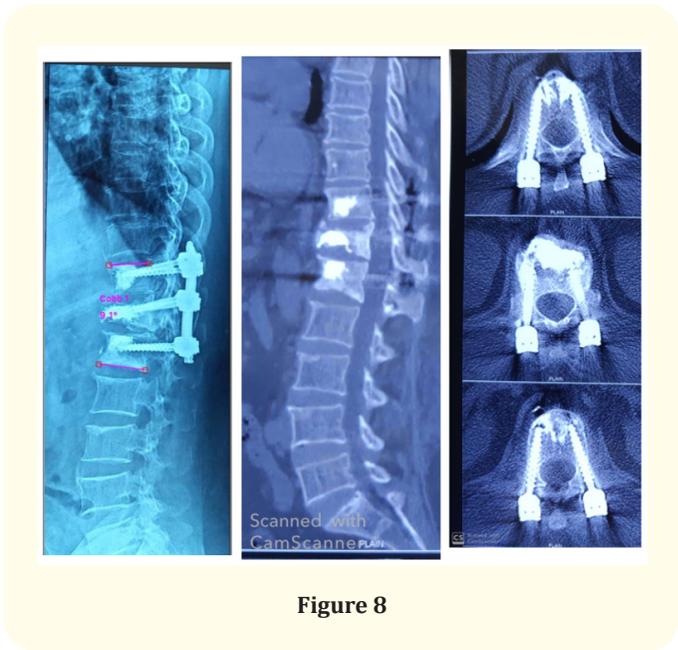


Figure 8

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