

## Treatment of Thoracolumbar burst fractures with Polymethyl methacrylate vertebroplasty and Short-segment Pedicle Screw Fixation

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**OBJECTIVES:** We aimed to evaluate the efficacy of reinforcing short-segment pedicle screw fixation with polymethyl methacrylate (PMMA) vertebroplasty in patients with thoracolumbar burst fractures.

**METHODS:** We enrolled 70 patients with thoracolumbar burst fractures for treatment with short-segment pedicle screw fixation. Fractures in Group A (n = 20) were reinforced with PMMA vertebroplasty during surgery. Group B patients (n = 50) were not treated with PMMA vertebroplasty. Kyphotic deformity, anterior vertebral height, instrument failure rates, and neurological function outcomes were compared between the two groups.

**RESULTS:** Kyphosis correction was achieved in Group A (PMMA vertebroplasty) and Group B (Group A, 6.4 degrees; Group B, 5.4 degrees). At the end of the follow-up period, kyphosis correction was maintained in Group A but lost in Group B, 2.3% Group A, 0.33-degree loss; Group B, 6.20-degree loss) (P < 0.001). After surgery, greater anterior vertebral height was achieved in Group A than in Group B (Group A, 12.9%; Group B, 2.3%) (P < 0.001). During follow-up, anterior vertebral height was maintained only in Group A (Group A, 0.13 ± 4.06%; Group B, -6.17 ± 1.21%) (P < 0.001). Patients in both Groups A and B demonstrated good postoperative Denis Pain Scale grades (P1 and P2), but Group A had better results than Group B in terms of the control of severe and constant pain (P4 and P5) (P < 0.001). The Frankel Performance Scale scores increased by nearly 1 in both Groups A and B. Group B was subdivided into Group B1 and B2: Group B1 consisted of patients who experienced instrument failure, including screw pullout, breakage, disconnection, and dislodgement (n = 11). Group B2 comprised patients from Group B who did not experience instrument failure (n = 39). There were no instrument failures among patients in Group A. Preoperative kyphotic deformity was greater in Group B1 (23.5 ± 7.9 degrees) than in Group B2 (16.8 ± 8.40 degrees), P < 0.05. Severe and constant pain (P4 and P5) was noted in 36% of Group B1 patients (P < 0.001), and three of these patients required removal of their implants.

**CONCLUSION:** Reinforcement of short-segment pedicle fixation with PMMA vertebroplasty for the treatment of patients with thoracolumbar burst fracture may achieve and maintain kyphosis correction, and it may also increase and maintain anterior vertebral height. Good Denis Pain Scale grades and improvement in Frankel Performance Scale scores were found in patients without instrument failure (Groups A and B2). Patients with greater preoperative Kyphotic deformity had a higher risk of instrument failure if they did not undergo reinforcement with vertebroplasty. PMMA vertebroplasty offers immediate spinal stability in patients with thoracolumbar burst fractures, decreases the instrument failure rate, and provides better postoperative pain control than without vertebroplasty.

### Editor's Comments:

The authors report a novel albeit somewhat controversial treatment option for thoracolumbar burst fractures. Spine surgeons are faced with the challenge of treating such unstable fractures with and without neurological deficits. The authors site that in some reports, recumbence is a very reasonable treatment when there is no neurological deficit, kyphotic deformity of less than 20 degrees, spinal canal diameter uncompromised more than 50% and/or vertebrae that are not compressed along the posterior height greater than 50%. In these circumstances, spine surgical solutions need to address the problems of multi-level spine fixation, fusion methodology, decompression, prevention of angulation deformity, and device failure and pullout. Many articles have been published on the anterolateral approach to these fractures and often it has been stated that the optimum is the anterolateral approach with reconstruction of the anterior column with vertebrectomy, bone grafting, and correction of a kyphotic deformity (if it exists) as well as intra-operative stabilization. That procedure may preclude a posterior surgery. The authors describe

their experience with reinforcement of the anterior column with PMMA followed by short segment pedicle screw fixation with laminectomy for canal decompression when retropulsed vertebral fragments could not be reduced.

The authors report a series of 70 patients with thoracolumbar burst fractures that underwent pedicle screw fixation. The indications for surgery included: neurological deficits, spinal instability including kyphosis, canal compromise, vertebra collapse, and intractable back pain with progressive documented kyphosis. The coterie was divided into three groups A) 20 patients with pedicle screw fixation and reinforcement with PMMA; B) 50 patients with pedicle screw fixation only-- B1 subgroup having instrument failure and B2 subgroup without instrument failure. The latter subgroups were created to better analyze device failures.

There are some issues not described by the authors including fusion success rate, causes for and the evaluation of fusion failures other than device failure, including bone density and the time course of the vertebral collapse, etc. Since this is a retrospective study and with relatively small numbers of patients, a prospective study would be seem worthwhile including consideration for other methods of vertebral reconstruction or restoration such as hydroxyapatite or another injectable osteoconductive substance that can be introduced percutaneously. PMMA is controversial in an acute trauma setting and long-term studies for its use in vertebral restoration are lacking.

The authors report excellent results in the Group A patients with PMMA reconstruction followed by short-segment pedicle screw reconstruction. The technique is ideal in patients without significant spinal canal compromise and they describe spinal reduction by distraction to reduce spinal kyphosis and retropulsed burst fragments (assuming an intact posterior spinal ligament). When the fracture was reduced intraoperatively, the fractured body was injected transpedicular with contrast medium and if there was no leakage of dye into the epidural space, PMMA was injected. Generally, one transpedicular injection was sufficient. Fusion was done using a posterolateral technique with autograft.

The authors thoroughly evaluated the two groups including kyphotic deformity, kyphosis correction, anterior vertebral height, surgical outcomes and complications. Follow-up revealed that Group A with PMMA vertebroplasty had less kyphosis correction loss, less loss of vertebral height, less post-operative pain, and no instrument failures. PMMA vertebroplasty did not result in any obvious or severe clinical cement complications.

The authors are to be thanked for reporting their experience with this method for thoracolumbar burst fracture reconstruction. Spine surgeons have used PMMA in osteoporotic vertebral compression fracture reconstruction by vertebroplasty or kyphoplasty. PMMA has also been used to strengthen osteoporotic vertebrae at the time of pedicle screw placement. This article may stimulate interest in a larger prospective study on the use of PMMA or another substance for fracture reconstruction.

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