

# The Role of Percutaneous Vertebroplasty in Traumatic Fractures of the Thoracolumbar Spine

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**Background:** Percutaneous vertebroplasty (PVP) is a well known minimally invasive method: main indications are vertebral compression fractures, especially of osteoporotic origin. In the last few years PVP is also gaining popularity in the treatment of vertebral body instability caused by infiltrative tumor or trauma.

**Methods:** The author used the method of PVP in treatment of 15 patients with traumatic vertebral fracture. The indication for the surgery were: 1. anterior column traumatic vertebral fractures, 2. preserved posterior wall (towards spinal canal), 3. local pain.

**Results:** Comparing pre- and postoperative pain, there was a significant improvement on visual analogue scale (VAS).

**Conclusion:** PVP is a feasible method in treating in certain types of traumatic vertebral fractures by abolishing pain soon, superseding the need for spine-stabilizing surgery, facilitating the process of healing, load ability and return to work, lowering the costs of treatment. PVP can be done as a one-day surgery.

**Keywords:** vertebroplasty, vertebral fractures

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## Introduction

The incidence of vertebral fractures in western countries is 60/10000 inhabitants. Surgical intervention is decided based on 3 criteria, as follows: nerve involvement, the degree of angulations and the stability of the fracture. The traditional method of operating an unstable spine was fixation with plates, screws, orthodesis and was considered a big surgery, with a painful postoperative period and 3–4 months recovery time. The uncomfortable corset needed to be worn for 2–3 months.

During the past few years vertebroplasty (PVP) begun to gain ground in the treatment of vertebral fractures of various etiology. It was employed in cases where the fracture involved the frontal segment of the spine, but the narrowing of the spinal canal did not occur.

The PVP is such a spinal augmentation, during which bone cement is injected through a filling tube into the vertebral body, where it solidifies and results in stability. This procedure is done percutaneously and is minimally invasive. The technique is simple and can be done quickly. The vertebral body becomes stable once the bone cement solidifies. The author has used this procedure in traumatic vertebral fractures also.

Our goal is to judge PVP in the treatment of traumatic vertebral fractures involving the frontal segment of the spine and using data compiled by us.

## Material and method

Between October 1, 2010 and January 1, 2012 we performed PVP on 15 patients (1 female and 14 male) who suffered traumatic vertebral compression fractures (Table I). The average age of the patients was 53 years. Patients

examined did not have any known pathological spine involvement except osteoporosis or factors predisposing for osteoporosis.

Surgery was indicated when 3 criteria were present together:

1. vertebral fracture that was a result of a compressing force, did not involve the posterior segment of the spine and did not cause significant narrowing of the spinal canal;
2. the fracture has not healed yet and the MRI showed edema of the vertebral body;
3. localized pain as a result of the fracture.

Contraindications were:

1. healed fracture;
2. active infections;
3. coagulopathy;
4. traumatic narrowing of the spinal canal (bone fragment in the spinal canal).

Every patient had to go through physical exam, 2 directional x-ray, MRI and CT. The MRI (mainly the STIR) showed the edema of the vertebral body, the CT helped in the visualization of the vertebral body's posterior wall soundness (Figure 1).

The intensity of the pain was measured by the VAS scale before the surgery and 2 days after as well as during the controls.

The surgery was performed under general anesthesia then as a first step the patient was placed in prone position and in some cases ligamentotaxis was done. After this the fractured vertebral body was filled with acrylic based bone cement, using a para- or transpedicular entry and under x-ray control. The patients were mobilized 1 day post-operatively and after x-ray control.

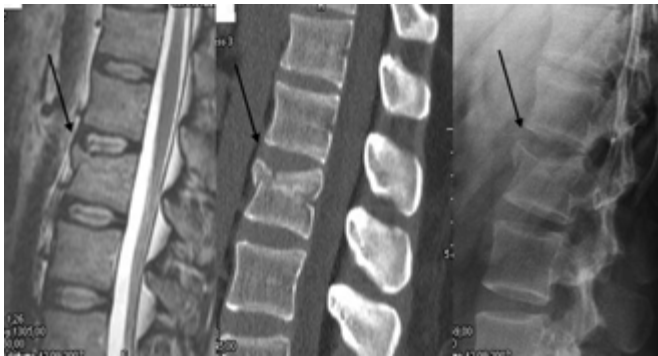


Fig. 1. MR, CT and X-ray examination show the fractures of the L2 vertebra.

## Results

The frontal two thirds of the vertebral body were filled by the bone cement in every case, resulting in the stability of the frontal column (Figure 2).

Without exception all the patients were mobilized. Ten patients required corset because of an incomplete burst fracture, damage to the posterior segment was suspected, but without spinal canal involvement. The patients wore the corset for 4 weeks.

VAS scores got reduced by 5 points in average (Table I.) The reduction of pain with PVP remained constant during the follow up period.

Average hospital stay was 4.3 days. Patients were released on the 2<sup>nd</sup> postoperative day on average.

Bone cement got displaced into the paravertebral venous system in one case, but clinical signs were not observed. Sepsis or allergies to the bone cement were not recorded. After the PVP procedure we did not encounter compression fractures of neighboring vertebral bodies.

## Discussions

Neurological symptoms as a result of a spinal fracture, exceeding 50% of spinal canal narrowing are indications for surgical treatment involving the spinal canal and nerve channels liberation and recalibration. When the angulation at the dorso-lumbar transition exceeds 20 degrees, it will result in further vertebral body compression and chronic low back syndrome, thus surgery is indicated in these cases as well.

A more complex question is the stability judging of the vertebral fractures. Interpeduncularolisthesis, involvement of the posterior wall and the interruption of the spinal arch are point to instability, and as such, require surgery. In the cases above internal fixation is used that are either dorsal, ventral or the two combined.

Those vertebral fractures that do not require it is not possible to do internal fixation for other reasons, open surgical stabilization, conservative treatment (corset for 3 months) is recommended.

The requirements of the conservative treatment are the under 15 degree of angulation, less than 50% narrowing of the spinal canal. In special cases this patient group also

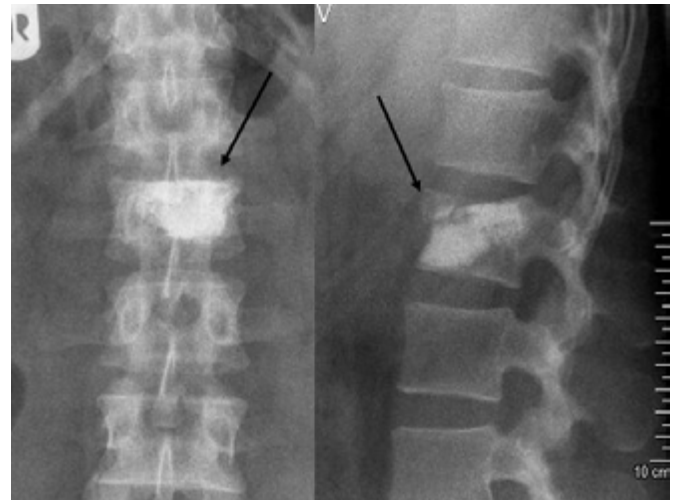


Fig. 2. X-ray pictures after operation. The bone cement fills well the fractured L2 vertebra.

requires surgery (extreme obesity, severe chest trauma that makes the corsets wearing difficult). Alternatives between the open surgery and the conservative treatment were not available until recently.

Wood et al. showed that during stable burst fractures long term follow up resulted no differences in kyphosis when treated by surgery or conservative methods. 25% of the patients however complained about strong residual pain [11]. Resch et al. also came to similar conclusions: they found that in fractures severe but lacking deformity, in bad general health conservative treatment was a logical alternative to surgery [10].

PVP has been used decades ago as a surgical technique for pathological, painful vertebral diseases and also in osteoporotic fractures [2] VP can be done percutaneously through the pedicles into the lumbar vertebral bodies (transpedicular PVP) or through extra pedicular entry into the thoracic vertebral bodies. The PVP can be done fast,

Table I. Clinical parameters of patients who received vertebroplasty to treat their traumatic vertebral fracture

Patient	Age	Fractured vertebral body	VAS at admission	VAS postop 2 <sup>nd</sup> day	VAS improvement
1	42	L.III	8	1	7
2	40	L.IV	7	1	6
3	45	L.I	7	2	5
4	47	L.II	9	1	8
5	48	Th.V	6	2	4
6	53	L.IV	7	1	6
7	53	Th.XII	7	1	6
8	55	L.I	8	2	6
9	56	Th.XII	7	2	5
10	56	L.IV	7	1	6
11	58	L.I	7	1	6
12	60	L.II	6	2	4
13	60	L.V	8	1	7
14	60	L.IV	9	1	8
15	62	Th.IX	8	2	6
Average	53		7.4	1.4	6

the patients can be mobilized right after the solidification of the bone cement. Pain reduction is experienced right after the procedure.

Indications for either procedure has been increasing steadfast compared to the beginning. PVP was used besides the osteoporotic compression fractures, pathological vertebral diseases (hemangiomas, myelomas, metastasizes) during the past years even traumatic vertebral fractures that resulted in no neurological symptoms.

The standard treatments of dorso lumbar transition (DL) fractures were dorsal stabilization. Following that the combined dorso-ventral stabilizations were used. Briem et al showed in their studies that the quality of life despite either of the above mentioned procedures, did not improve even though the radiological results were better after the dorsoventral stabilization. There is no correlation between the quality of life and radiological picture [1]. Christodoulou et al. concluded that in unstable thoracic lumbar fractures treatment PVP has a place provided that it is augmented with posterior transpedicular instrumentation [3]. The principles of the optimal treatment of spinal fractures are not clear as of today and prospective studies are on their way [9]. Huet et al. performed PVP on traumatic vertebral fractures when conservative or surgical treatment was followed by new compression fracture. In other cases they decided by PVP after inter disciplinary consultation, traumatology and or general medical point of view, aiming to reduce immobilization and or hospitalization [4]. In our material the sample was decided upon the criteria of traumatic fractures localized onto the frontal column, minimal angulation and the intact spinal canal.

Important during PVP the placement of the percutaneous work channel within the vertebral body. Kasó et al. stated the importance of the point of the needle when injecting. Puncture near the center could result in the entering of the cement into the basi vertebral venous system and the material can end up in the epidural space and cause cauda or myelon compression [5]. Similar complications were not recorded in our cases. Bone cement particles can cause pulmonary emboli when passing through the vena azygos, hemiazygos systems. Injection of the bone cement into the lateral third of the vertebral body reduces the chance for bone cement accumulation in ventral epidural or extra vertebral space [5]. PVP needle shall not enter the fracture line in traumatic vertebral fractures.

In our studies the work channel was positioned in a sagittal plane close to vertebral body's frontal contour. Before the procedure, the optimal transpedicular introduction can be planned based on the MRI. The MRI slide that shows the involved pedicle in its widest can be used to mark the way through which the vertebral body is going to be reached by the work channel. This line and its intersection with the surface of the skin gave the distance of the point of entry from the midline, the angle between this line and the sagittal plane gave the angle of the work channel [6]. This method proved useful during our work. PVP done in

osteoporotic vertebral fractures if the work channel can be preplanned and introduced into the center of the vertebral body, the ventral third of the sagittal diameter, then the one sided injection is enough [6]. In our opinion in case of traumatic vertebral fractures it is not enough to inject from one side, since the fracture lines are usually multiple and the positioning of the needle point is limited for this we preferred bilateral PVP.

Kasó et al stated that PVP can be performed in vertebral body metastasis even when the epidural space is involved (dorsal contour of the vertebral body) as long as the spinal cord or cauda compression neurological symptoms aren't present [7]. In our opinion this statement can be adopted to traumatic vertebral fractures as well. As other authors [4] neither did we experience displacement of bone cement at the end of the vertebral body's dorsal contour.

Huet et al stated that when the frontal two thirds of the vertebral body is filled with bone cement, the injection should be suspended, preventing the broken pieces of the vertebral body to move in a dorsal direction [4]. If bone cement seepage presents along the fracture line, the point of the needle needs to be repositioned or have to wait with additional filling until the bone cement solidifies. Bone cement seepage into the intervertebral disc is a common complication [4] we recorded one in our studies. Our opinion is coinciding with the literature, PVP performed treating the traumatic vertebral fracture is technically more complex than the pathological vertebral fracture or vertebral hemangiomas treatment with PVP. Overall based on our experience PVP performed treating traumatic vertebral fracture keeping the corresponding criteria, effectively reestablishes the stability of the frontal column. After surgery the patients do not require internal fixation.

## Conclusions

PVP is a method that was developed during the past decade to treat vertebral body fractures. During our current study we treated fractured vertebral bodies of traumatic origin with this method. Patient selection was limited to fractures of the frontal column. Narrow spinal canal excluded the patient from being selected. Localized pain was present in every case and was measured by the VAS scale. The procedure was done on 15 patients and in each case the pain was significantly reduced. In one case post operative X-ray image showed non symptomatic complications. By and large we can state that PVP is an extremely efficient method for treating traumatic thoracic and lumbar vertebral body fractures. Coinciding with the literature PVP carries very little risk. The procedure replaces a more complex fixation and reduces the time of hospitalization and healing.

## References

1. Briem D, Lehmann W, Ruecker AH, Windolf J, Rueger JM, Linhart W. Factors influencing the quality of life after burst fractures of the thoracolumbar transition. *Arch Orthop Trauma Surg.* 2004;124(7):461-8.
2. Chiras J, Depriester C, Weill A, Sola-Martinez MT, Deramond H. vertebral surgery. *Technics and indications.* *J Neuroradiol.* 1997;24:45-59.

3. Christodoulou A, Ploumis A, Terzidis I, Pournaras I. Vertebral body reconstruction with injectable hydroxyapatite cement for the management of unstable thoracolumbar burst fractures: a preliminary report. *Acta Orthop Belg.* 2005;71(5):597-603.
4. Huet H, Cabal P, Gadan R, Borha A, Emery E. Burst-fractures and cementoplasty. *J Neuroradiol.* 2005;32(1):33-41.
5. Kasó G, Horváth Zs, Kövér F, Ezer E, Dóczy T. The use of vertebroplasty, neuro navigation and kyphoplasty in treating osteoporotic multiplex compression fractures of the vertebra. *Clinical neuroscience.* 2006;59(7-8):282-87.
6. Kasó G, Stefanics J, Kövér F, Dóczy T, Horváth G. Percutaneous-transpedicular acrylic vertebroplasty in the treatment of lumbar vertebral body hemangioma – case study. *Clin Neuroscience.* 2003;56(1-2):41-46.
7. Kasó G, Stefanics J, Kövér F, Hudvágner S, Dóczy T. The possible treatment of different etiologic vertebral body pathology with vertebroplasty. *Clin Neuroscience.* 2002;55(7-8):244-252.
8. Teng MMH, Wei CJ, Wei LC, Luo CB, Lirng JF, Chang FC, Chang CY. Kyphosis correction and height restoration effects of percutaneous vertebroplasty. *Am J Neuroradiol.* 2003;24:1893-1900.
9. Reinhold M, Knop C, Beisse R, Audigé L, Kandziora F, Pizanis A, Pranzl R, Gercek E, Schultheiss M, Weckbach A, Bühren V, Blauth M. Operative treatment of traumatic fractures of the thoracic and lumbar spinal column: Part I: Epidemiology. *Unfallchirurg.* 2009;112(3):294-316.
10. Resch H, Rabl M, Klampfer H, Ritter E, Povacz P. Surgical vs. conservative treatment of fractures of the thoracolumbar transition. *Unfallchirurg.* 2000;103(4):281-88.
11. Wood K, Buttermann G, Mehbod A, Garvey T, Jhanjee R, Sechriest V, Butterman G. Operative compared with non operative treatment of thoracolumbar burst fracture without neurological deficit. A prospective randomized study. *J Bone Surg Am.* 2003;5:773-81.