

# Effect of Vertebroplasty Combined with Facet Joint Block in Relieving Acute Pain of Osteoporotic Vertebral Compression Fracture

**Sha-Jie Dang**

Xi'an Jiaotong University

**Wen-Bo Wei**

Shaanxi Provincial people's Hospital

**Da-Peng Duan**

Shaanxi Provincial people's Hospital

**Ling Wei**

YangLing Demonstration Zone Hospital

**Jin Xu** (✉ [xujin00308@163.com](mailto:xujin00308@163.com))

Xi'an Jiaotong University

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## Research Article

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## Abstract

**Objective:** To evaluate the efficacy of percutaneous vertebroplasty (PVP) combined with facet joint block (FB) on osteoporotic vertebral compression fractures (OVCFs).

**Methods:** 190 patients were reviewed in the study: PVP (Group P, n=90), PVP combined with FB (Group PF, n=100). Visual analogue scale (VAS) and Oswestry disability index (ODI) were measured during pre-operation, 1 day, 1, 3, 6 and 12 months after the operation, repectively. And hospitalization time, operation time, complications and recurrence were compared in the two groups.

**Results:** Patients showed significantly decreased VAS and ODI at each observation point of the post-operation than the pre-operation in both groups ( $P < 0.05$ ). The VAS and ODI scores in Group PF were significantly lower than that in Group P 1 day and 1 month after the operation ( $P < 0.05$ ). There was no statistically significant difference in hospitalization time, operation time, complication rate, VAS and ODI score at the pre-operation ( $P > 0.05$ ).

**Conclusion:** Both PVP combined with FB and PVP alone are effective treatment methods for OVCFs. But PVP combined with FB could provide better back pain relief than PVP alone in the short term after the operation for OVCFs.

## Introduction

With the increase of the elderly population, the incidence of osteoporotic vertebral compression fractures (OVCFs) is increasing rapidly [1]. In the elderly population, OVCFs commonly cause severe back pain, substantial vertebral deformity, disturbances in activities of daily living, decreased quality of life and increased adjacent spinal fractures and mortality [2]. Many studies report that percutaneous vertebroplasty (PVP), which injects the polymethylmethacrylate (PMMA) into the fractured vertebral body, as minimally invasive surgery, has the advantages of the shorter operation time, less trauma and significant pain relief [3]. It is considered the preferred method for the treatment of osteoporotic vertebral compression fractures. However, the effectiveness of the surgery is still a controversial topic. The percentage of patients who experienced unsatisfactory back pain relief after PVP ranged from 5–22% [4]. The causes of low back pain caused by OVCFs are complex. The pain associated with OVCFs may not only come from the vertebral body but also from the posterior elements [5, 6]. Therefore, facet joint block (FB) would be beneficial for alleviating acute back pain associated with OVCFs [7]. But FB can not restore vertebral height or reverse kyphotic deformity. At present, there are few studies on PVP combined with facet block. Is the PVP combined with FB an effective solution for alleviating the acute pain caused by OVCFs and reduce residual pain after PVP?

Thus, we retrospectively analyzed the clinical effect and radiologic outcomes of PVP combined with FB in the treatment of pain of the OVCFs.

## Methods

## 1.1 Study design

We retrospectively reviewed the medical records of 190 patients treated at the Department of Orthopedic Surgery, Shannxi Provincial People's Hospital, from January 2012 to December 2017. This study was approved by the clinical research ethics committee of Shannxi Provincial People's Hospital (No. 2018-039). This study followed the Good Clinical Practice guidelines and the guidelines of the Helsinki Declaration. The study included 90 cases that underwent PVP (Group P), and 100 cases underwent PVP combined with FB (Group PF).

## 1.2 Patients

In this study, we screened patients who received PVP or PVP combined with FB surgery for OVCFs. The inclusion criteria were 1) older than 65 years, 2) with the back pain less than 6 weeks, and ineffective to medical therapy, 3) the visual analog scale (VAS) pain score was 7 or higher, 4) bone mineral density (BMD) T-scores less than -1.0, and 5) Spinal MRI scan showed bone marrow edema of the affected vertebrae. The exclusion criteria were: 1) infection, 2) radicular and/or cord compression syndrome, (3) patients who are unable to operate due to mental or organ dysfunction, and 4) patients who are lost to follow-up.

## 1.3 Procedures

U-shaped pillows are under patient's chest and ilium to make the patient's abdomen is suspended. Guided by C-arm fluoroscopy, the patient is placed in the prone position. The injection site was sterilized with antiseptic fluid and draped with surgical towels. Both PVP and FB were performed by spine surgeons in our department

In the PVP procedure, PVP was performed by bilateral or unilateral transpedicular approach. After satisfactory local anesthesia, the puncture needle was inserted into the fractured vertebral body through the pedicle. Fluoroscopy showed that the puncture needle was in a proper position. Under fluoroscopy, 3–6 ml polymethylmethacrylate (PMMA) was injected into the fractured vertebral body to ensure full filling and avoid pulmonary embolism or intraspinal leakage due to bone cement leakage.

In the FB procedure, under the guidance of a fluoroscope, a No. 23 gauge needle was inserted. The target was the juncture of the superior articular process and transverse process for L1–4 levels and at the junction of the superior articular process and the top border of the sacral crest for the L5 level. Confirmation of the position of the needle with the AP and lateral images acquired using fluoroscopy. The mixture solution was composed of 80 mg methylprednisolone, 10 mL 2% lidocaine and 5 mL 1% ropivacaine, then 2 ml of mixture solution was injected around the facet joint (Fig. 1)

After the operation, the patient was given standardized anti-osteoporosis treatment (Calcium carbonate 600mg and Calcitriol 0.25 $\mu$ g were administered daily), and the patient was advised to wear a brace for functional exercise within 3 months. Cox-2 inhibitors would be given as required if patients had surgical site pain within 3 days after operation.

Gender, Age, BMI, Bone Mineral Density (BMD), operating time, hospitalization time complications and recurrence were recorded. The visual analog scale (VAS) and the Oswestry Disability Index (ODI) score were measured during pre-operation, 1 day, 1, 3, 6 and 12 months after the operation, respectively. The VAS score was evaluated from 0 to 10, 0 indicates no pain, and 10 indicates the most severe pain. The ODI assesses low back pain-related disability, the higher the score means the worse the disability.

#### 1.4 Outcomes

The primary outcomes were VAS and ODI score pre-operation, 1, 3, 6, and 12 months after the operation. The secondary outcomes included operation time, hospitalization time, complication and recurrence.

#### 1.5 Statistical analysis

The statistical analysis was performed using SPSS 24.0 (SPSS, Inc., IBM). Numeric variable was expressed as Mean  $\pm$  SD and categorical data was expressed by N (%). Numeric variable was analyzed by t-test and categorical data was analyzed with  $\chi^2$  test. The VAS and ODI score in different time were analyzed by repeated measures of ANOVA test, and Bonferroni's correction was used for post hoc analysis. The value of  $P < 0.05$  is treated as significant differences.

## Results

#### 2.1 General information

There was no significant difference in gender, age, BMI, BMD, hospitalization time, VAS and ODI score ( $P > 0.05$ ). Compared to Group P ( $39.02 \pm 7.49$ ), Operation time of Group PF ( $41.42 \pm 9.79$ ) was longer, but they showed no significantly difference ( $P > 0.05$ ). In Group P, bone cement leakage occurred in 5 cases, and adjacent segment fractures occurred in 2 cases. In group PF, 4 cases had bone cement leakage, and 3 cases had adjacent segment fractures. There was no significant difference of the complication such as pulmonary embolism, spinal cord injury, paraplegia in both groups ( $P > 0.05$ ) (Table 1).

Table 1  
Comparison of general data between Group P and Group PF

	<b>Group P (n = 90)</b>	<b>Group PF (n = 100)</b>	<b>t/(x<sup>2</sup>)</b>	<b>P</b>
Male/female	36/54	43/57	(0.176)	0.768
Age (years)	77.17 ± 7.30	77.60 ± 8.25	-0.382	0.703
BMI (kg/m <sup>2</sup> )	24.38 ± 5.15	24.43 ± 5.01	0.076	0.892
BMD	-2.65 ± 0.47	-2.61 ± 0.43	-0.601	0.548
Hospitalization time (days)	4.16 ± 1.32	3.80 ± 2.31	1.859	0.065
Operation time (min)	34.36 ± 7.41	36.16 ± 11.34	-1.283	0.201
VAS	7.56 ± 1.00	7.69 ± 1.07	0.741	0.410
ODI	69.45 ± 7.53	70.76 ± 6.68	0.937	0.362

**Notes:** Numeric data were expressed as Mean ± SD and analyzed by Independent-Samples T-test. Categorical data were expressed by the number of patients (%) and were analyzed with the  $\chi^2$  test. Group P: PVP group; Group PF: PVP combined with FB group.

## 2.2 Comparison of VAS

In the two groups, VAS score showed no difference before the operation and 3, 6 and 12 months after the operation ( $P > 0.05$ ), VAS score 1 day, 1, 3, 6, and 12 months after the operation showed significantly less compared to the pre-operation ( $P < 0.05$ ). In Group PF, VAS score 1 day and 1 month after the operation was significantly lower than that in Group P ( $P < 0.05$ ) (Table 2).

Table 2  
Comparison of VAS between Group P and Group PF at different time

Group	Pre-operation	Post-operation				
		1 day	1 months	3 months	6 months	12 months
Group P (n = 90)	7.56 ± 1.00	2.78 ± 1.14 <sup>a</sup>	2.77 ± 0.96 <sup>a</sup>	2.54 ± 0.96 <sup>a</sup>	2.21 ± 0.88 <sup>a</sup>	2.22 ± 1.03 <sup>a</sup>
Group PF (n = 100)	7.69 ± 1.07	2.11 ± 0.85 <sup>ab</sup>	2.27 ± 1.03 <sup>ab</sup>	2.03 ± 0.77 <sup>a</sup>	1.99 ± 0.79 <sup>a</sup>	1.89 ± 0.80 <sup>a</sup>
Time F, P	876.312, <0.001					
Group F, P	20.958, < 0.001					
Time * Group F, P	5.025, < 0.001					

**Notes:** Data are presented as mean ± SD. The groups were compared by repeated measures analysis of variance (ANOVA). Bonferroni correction was used to correct multiple comparisons. Group P: PVP group; Group PF: PVP combined with FB group; vs pre-operation in the same group, <sup>a</sup>P < 0.05; vs Group P in the same time, <sup>b</sup>P < 0.05.

**Abbreviations:** VAS, visual analog scale; PVP, percutaneous vertebroplasty; FB, facet joint block.

### 2.3 Comparison of ODI

In the two groups, ODI score showed no difference before the operation and 6 and 12 months after the operation ( $P > 0.05$ ), ODI score 1 day, 1, 3, 6, and 12 months after the operation showed significantly less compared to the pre-operation ( $P < 0.05$ ). In Group PF, ODI score 1 day, 1 and 3 months after the operation was significantly lower than that in Group P ( $P < 0.05$ ) (Table 3).

Table 3  
Comparison of ODI between Group P and Group PF at different time

Group	Pre-operation	Post-operation				
		1 day	1 month	3 months	6 months	12 months
Group P (n = 110)	69.45 ± 7.53	48.19 ± 7.71 <sup>a</sup>	48.21 ± 8.66 <sup>a</sup>	45.97 ± 5.83 <sup>a</sup>	36.46 ± 4.53 <sup>a</sup>	36.18 ± 4.50 <sup>a</sup>
Group PF (n = 120)	70.76 ± 6.68	41.98 ± 7.35 <sup>ab</sup>	39.58 ± 6.70 <sup>ab</sup>	37.60 ± 4.88 <sup>ab</sup>	36.01 ± 5.59 <sup>a</sup>	35.09 ± 3.86 <sup>a</sup>
Time F, P	1962.307, < 0.001					
Group F, P	84.910, < 0.001					
Time * Group F, P	23.213, < 0.001					

**Notes:** Data are presented as mean ± SD. The groups were compared by repeated measures analysis of variance (ANOVA). Bonferroni correction was used to correct multiple comparisons. Group P: PVP group; Group PF: PVP combined with FB group; vs pre-operation in the same group, <sup>a</sup>P < 0.05; vs Group P in the same time, <sup>b</sup>P < 0.05.

## Discussion

Osteoporosis is a progressive systemic disease, which often induces osteoporosis vertebral compression fractures. Recent studies have shown that, vertebroplasty can significantly reduce severe pain in acute OVCF patients within 6 weeks [8]. However, the incidence of residual pain in low back after PVP is not uncommon, with the lowest incidence of about 5% and the highest up to 22%, which seriously affects the postoperative quality of life of patients [6, 9–11].

The pain caused by OVCFs is mainly as a result of the fracture of the injured vertebra itself. Vertebroplasty (PVP) can reduce the micro motion of the fracture site and reshape spinal stability through the role of interface fixation. At the same time, the heat generated by polymethylmethacrylate (PMMA) can alleviate the nerve stimulation in the vertebral body, thereby reducing the pain in the fractured vertebral body [12]. However, in recent years, some scholars believe that the structure of the posterior appendage of the vertebral body is also an important source of pain [5], especially for the facet joints. In the elderly, the facet joints, muscles, ligaments and other tissues of the spine will degenerate, and fractures will further aggravate the above injuries [13, 14]. In addition, the medial branch of the posterior branch of the spinal nerve is mainly distributed in the joint capsule, surrounded by abundant nerve endings. After vertebral compression fracture, the corresponding pathological changes appear in the posterior column of the spine, which stimulates the dorsal nerve branch and causes pain [15, 16].

PVP has a poor effect on pain relief caused by posterior spinal column injury, which may be the main cause of residual pain after PVP. The posterior medial branch of the lumbar spinal nerve is the only sensory innervation of the facet joints of the lumbar spine, which is an essential link in the signal transmission circuit of low back pain [17]. And the posterior medial branch of the spinal nerve is run in a "bone fiber tube" at the junction of the upper edge of the transverse process of the lower vertebral body and the lateral edge of the superior articular process. The posterior branch block of the spinal nerve inhibits the nerve convergence effect from the level of pain mechanism, thus inhibiting the pain signal input of the block segment [18]. The literature suggests that facet joint block, which can block the posterior medial branch of the spinal nerve, is effective in relieving the acute pain of vertebral compression fractures [19]. Compared with PVP, FB requires less expend and shows less complications, such as vein embolism and neural injury. Wang [20] presented a prospective randomized controlled study, and in this study they compared the pain relief in patients with osteoporotic vertebral compression fractures with the use of vertebroplasty or facet blocking. The results showed that PVP produced better pain relief than facet blocking in the short term, but in the long term the difference between these two techniques was insignificant. FB can't restore vertebral height or reverse kyphotic deformity. Only one third of patients technically suitable for vertebroplasty responded beneficially to FB in David's research [21]. Kim et al. first investigated PVP and FB combined therapy and found that for OVCFs it was a profitable therapy [22]. As there are few studies to compare the efficacy of PVP and FB combined therapy with PVP alone. Thus, our study aims to compare the clinical and radiologic outcomes of these two therapies.

According to this study's follow-up results, we found that there were significant differences in VAS score and ODI in the early postoperative period (immediately and 1 month after surgery) between the two groups. This is result confirmed that PVP combined with FB can provide better pain relief in OVCFs patients in short term. This is similar to that reported by Cheng et al [23]. It is suggested that facet joint block has a significant inhibitory effect on acute postoperative pain. A possible reason is described as follows. Firstly, facet joint block has a definite effect on the posterior medial branch of spinal nerve, and the analgesic effect is clear. Secondly, topical application of glucocorticoids can treat local aseptic inflammation after fracture and relieve pain. For fracture patients, the effect of surgery is the dominate factor for whether the patient can perform early postoperative functional exercises, which is of positive significance for postoperative functional rehabilitation. This is one of the reasons why the ODI index and GPE score of the nerve block group are better than the PVP group. Our study found there was no statistically significant difference of VAS and ODI scores in 6 months after the operation between the two groups. This maybe is related to the complete metabolism of local anesthetics and hormones.

In our study, there was no statistical difference of the mean operation time in both groups ( $P > 0.05$ ). This is different from the report of Cheng et al [23]. During waiting for the cement to solidify, we completed facet joint blocking, so the PVP combined facet joint block did not significantly extend the operation time.

There were several limitations in the study. Firstly, our study is a retrospective study, selection bias in patient selection and missing patient information inevitably happened. Secondly, the cases were from

only one study center, larger clinical trials from more centers are needed for further study.

## Conclusion

The findings indicate that PVP combined with FB more effective and rapidly relieve acute back pain than PVP alone in the short term after the operation for the treatment of OVCFs.

## Abbreviations

OVCFs: Osteoporotic vertebral compression fractures;

FB: Facet joint block;

PVP: Percutaneous vertebroplasty;

ASA: American Society of Anesthesiologists;

VAS: Visual Analog Scale;

ODI: Oswestry Disability Index

## Declarations

### Ethics approval and consent to participate

This study was approved by the clinical research ethics committee of Shannxi Provincial People's Hospital (No. 2018-039). The authors declare that all the patients provided written informed consent and this study followed the Good Clinical Practice guidelines and the guidelines of the Helsinki Declaration.

### Consent to publish

Not applicable.

### Availability of data and materials

The authors will allow the sharing of participant data. The data will be available to anyone who wishes to access them for any purpose. The data will be accessible from immediately the following publication to 6 months after publication, and contact should be made via the first author by email.

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### Author Contributions

All authors participated in the interpretation of study results, and in the drafting, critical revision, and approval of the final version of the manuscript, and all authors agree to be accountable for all aspects of the work. WBW was in charge and contributed to all stages of the present study; LW was responsible for participated in the design of the study, made revisions of the manuscript and approved the final version. WBW and SJD contributed to interpreting the data and writing the final manuscript; MXX were contributors in writing and editing the manuscript.

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## Competing interests

The authors report no conflicts of interest in this work.

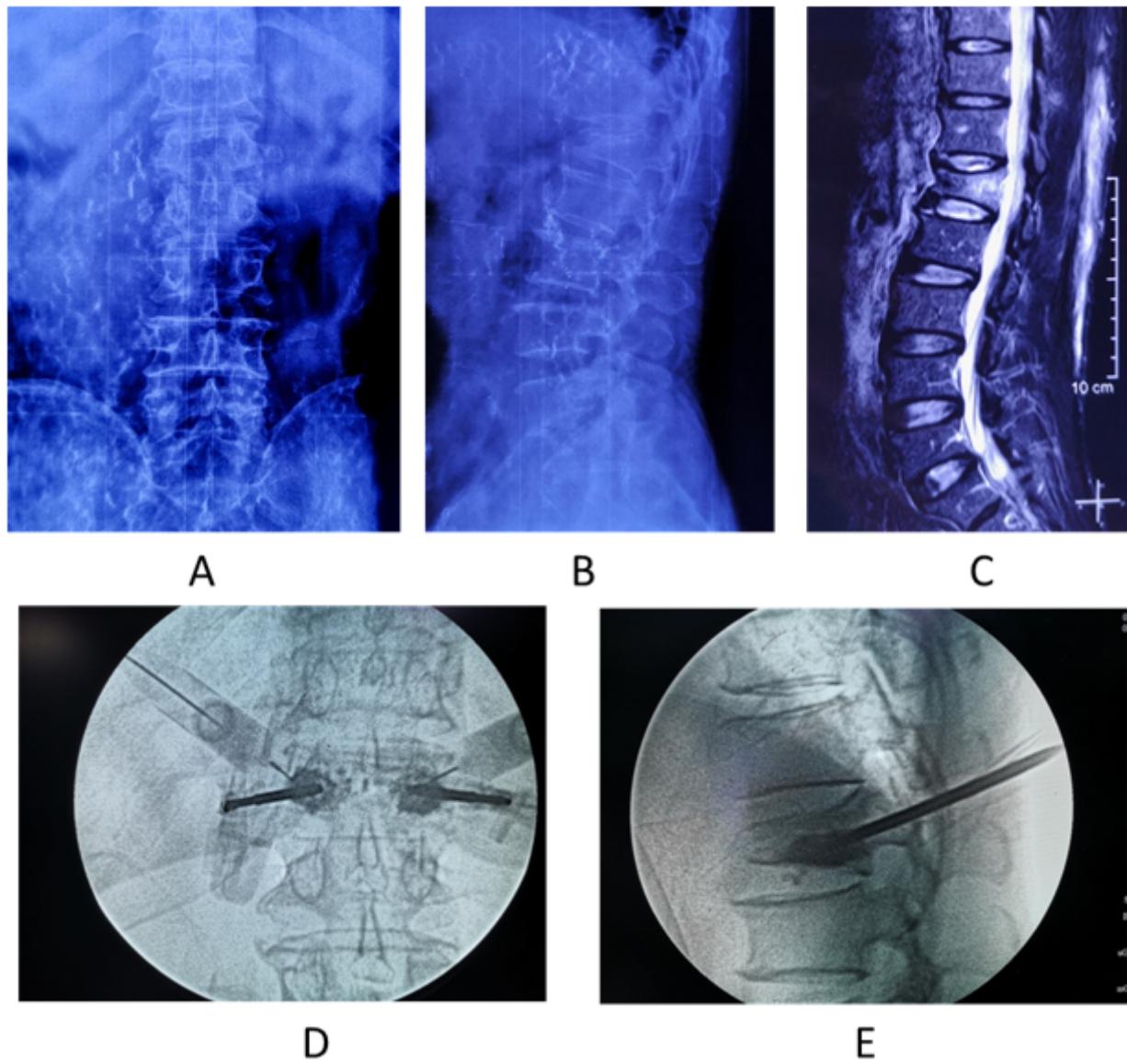
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## Figures



**Figure 1**

(A)(B)Anteroposterior and Lateral view shows the compressed L1 vertebra. (C) Short tau inversion recovery sequences magnetic resonance image. (D)(E) Anteroposterior and Lateral view shows the needle was inserted the juncture of the superior articular process and transverse process.