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A comparison between unilateral transverse process-pedicle and bilateral puncture techniques in percutaneous kyphoplasty

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ABSTRACT

PURPOSE

Percutaneous kyphoplasty (PKP) is a widely used vertebral augmentation procedure for treating painful vertebral compression fractures. A percutaneous bilateral approach is typically used to access the vertebral body. Many previous studies have reported excellent clinical results with PKP. In contrast, numerous complications and problems have also been reported, such as puncture difficulty, cement leakage, adjacent vertebral fracture. The purpose of the prospective comparative study was to assess the clinical and radiologic outcomes in the treatment of osteoporotic vertebral compression fractures (OVCF) compared by unilateral transverse process-pedicle and bilateral PKP.

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METHODS

This prospective study included 316 patients with lumbar 1 OVCF. From January 2009 to January 2012, patients were randomized underwent PKP using two different puncture techniques. The patients were followed-up postoperatively and were assessed mainly with regard to clinical and radiologic outcomes. Clinical outcomes were evaluated mainly with use of visual analog scale (VAS) for pain and Short Form 36 (SF36) questionnaire for health status. Radiologic outcomes were assessed mainly on the basis of radiation dose, bone cement distribution, vertebral body height, and kyphotic angle.

RESULTS

One hundred and fifty-eight patients were treated with unilateral method and 151 patients were treated with bilateral method. In the unilateral group, the volume of the injected cement and radiation dose were significantly less than bilateral group. All patients in both groups had significantly less pain after the procedures, compared with their preoperative period. No statistically significant differences were observed when VAS and SF-36 were compared between the groups. Both unilateral and bilateral group significantly reduced the kyphotic angle during follow-up. The kyphotic angle in the unilateral group improved significantly than bilateral group. In the bilateral group, 16 patients had obvious pain in the puncture sites at 1 month postoperatively caused by facet joint violation. With local block treatment, the pain disappeared in all patients at the last follow-up.

CONCLUSIONS

Both bilateral and unilateral PKP are relatively safe and effective treatment for patients with painful OVCF. But unilateral PKP received less radiation dose and operation time, offered a higher degree of deformity correction and resulted in less complication than bilateral.

Key words: vertebral fracture; osteoporosis; percutaneous kyphoplasty; puncture

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Figures and Tables

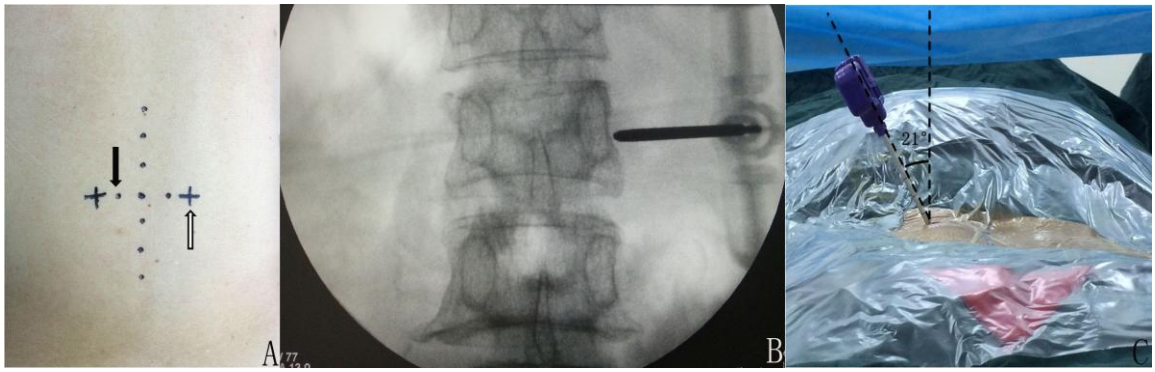

Figure 1. (A) Skin incision design for percutaneous kyphoplasty. Black arrow represents bilateral puncture point; white arrow represents unilateral puncture point. (B) In the frontal view, the puncture needle locates at 5 mm from the lateral margin of the pedicle where it intersects the midportion of the transverse process. (C) The extraversion angle was range from 10° to 30°.

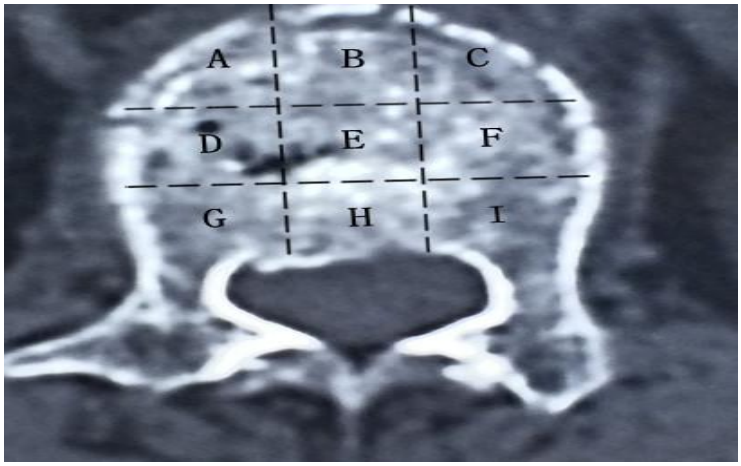

Figure 2. The axial vertebral body view can be divided into nine areas, from A to I.

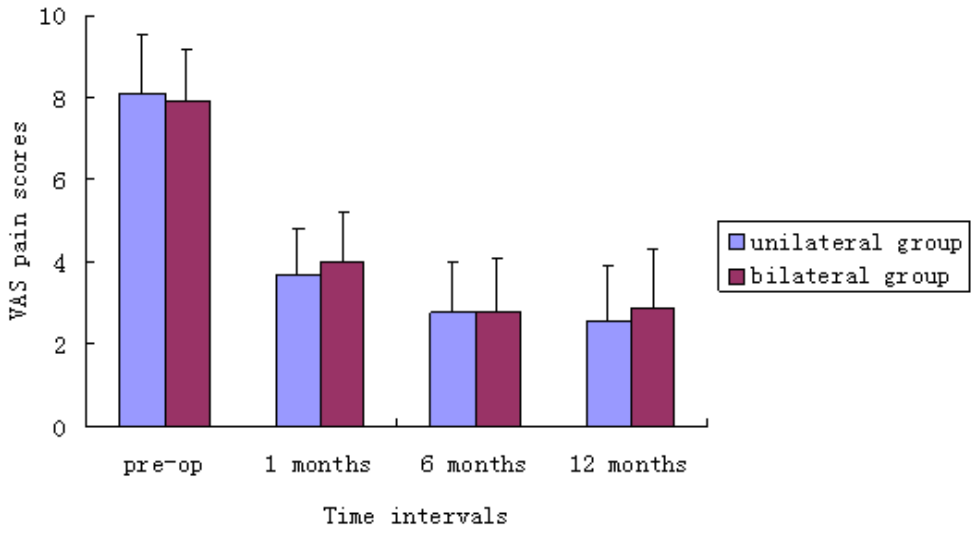

Figure 3. Preoperative and postoperative mean VAS scores for the unilateral and bilateral groups.

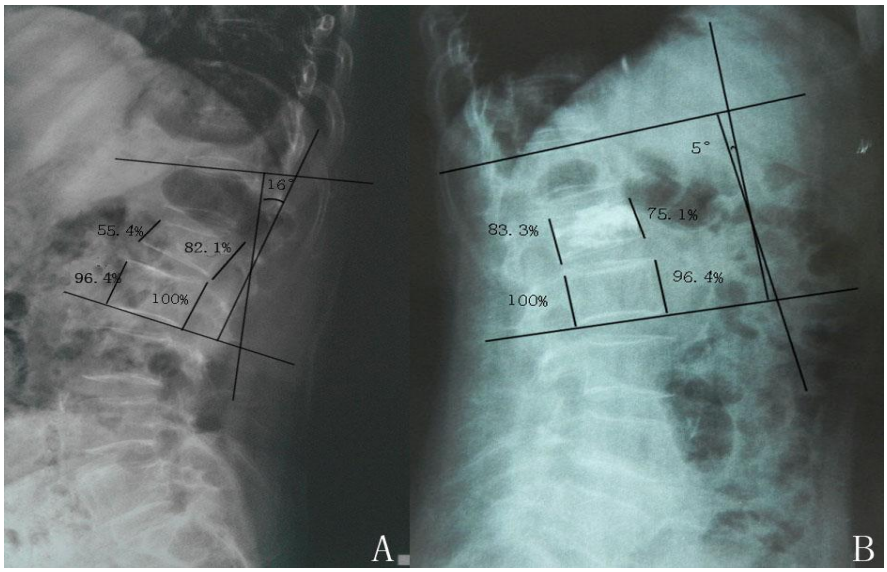

Figure 4. Measurement of vertebral height and kyphotic angle before (A) and after (B) treatment. The posterior height of caudal healthy vertebra which was adjacent to OVCF was measured and transferred as 100% on the radiograph. The kyphotic angle was measured as the angle between the superior endplate at 1 level above the fractured vertebrae and inferior endplate at 1 level below the fractured vertebrae.

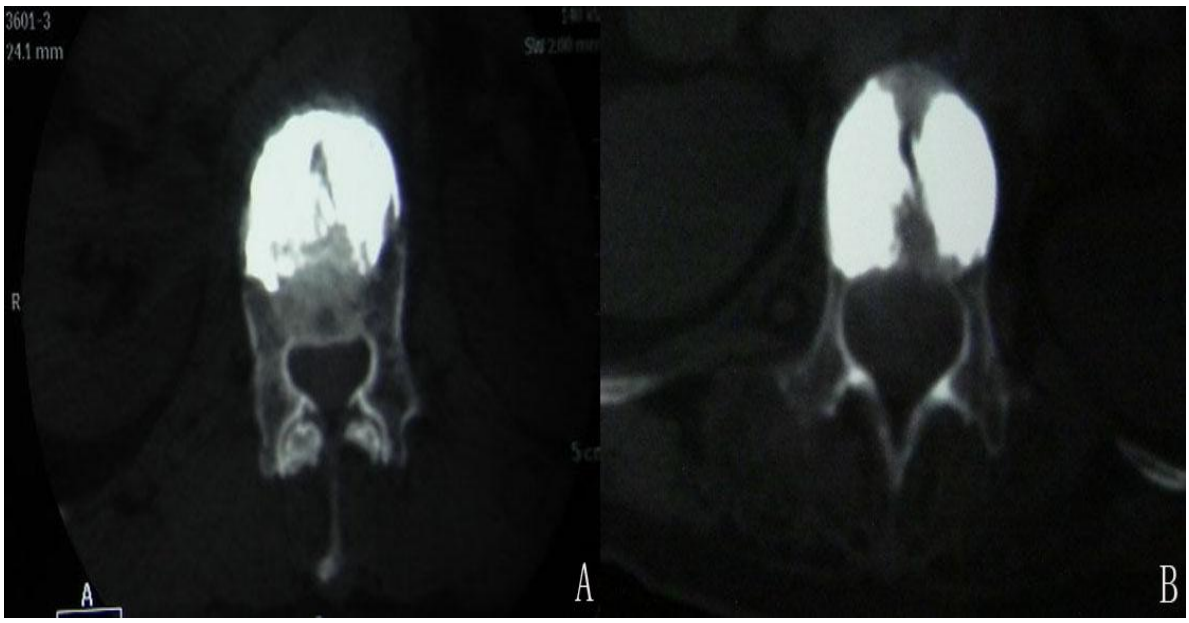

Figure 5. (A) In the unilateral PKP, CT scan revealed that bone cement mainly distributed in the anterior and middle of the vertebral body. (B) In the bilateral PKP, bone cement distributed in the lateral and posterior of the vertebra body. PKP indicates percutaneous kyphoplasty; CT indicates computed tomography.

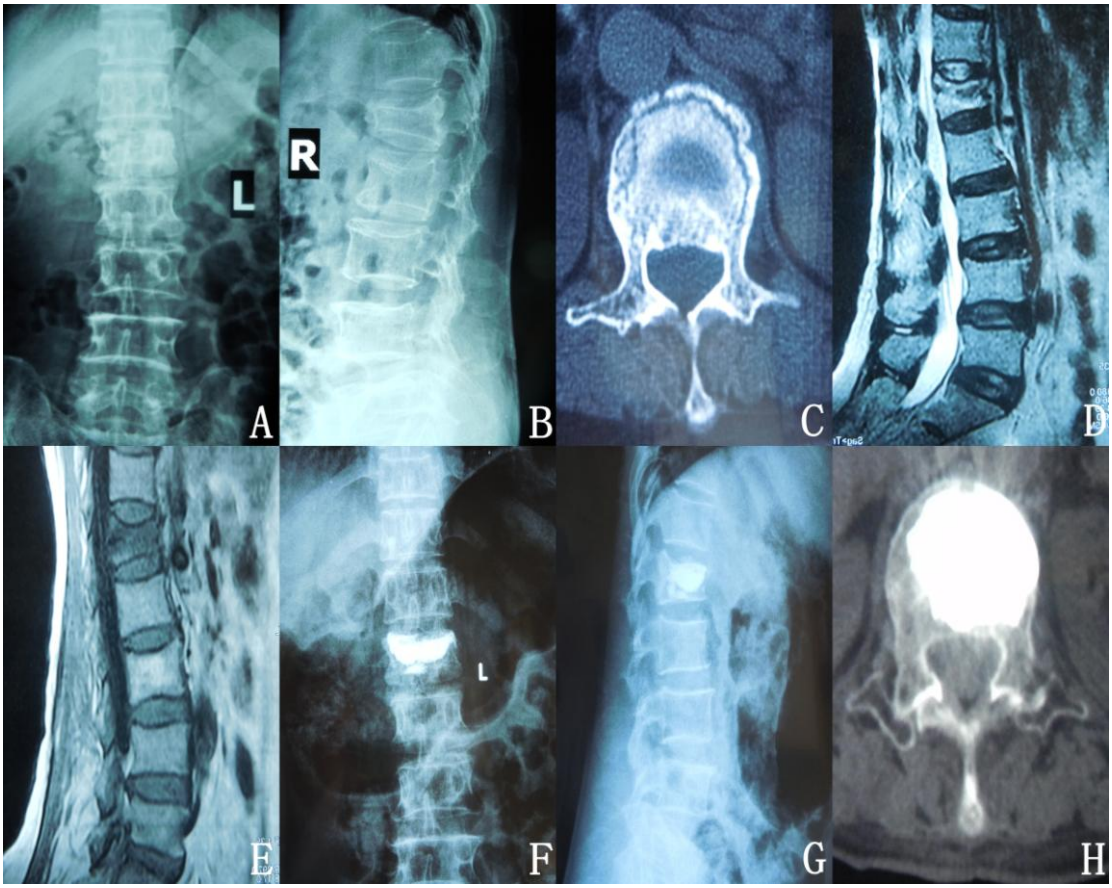

Figure 6. A 61-year-old woman with lumbar 1 OVCF treated by unilateral PKP. (A, B) Preoperative anteroposterior and lateral radiographs showed a L1 fracture. (C) Preoperative axial CT scans showed integrity of posterior margin of vertebral body. (D, E) MRI showed hypointense signal on T1-weighted images and hyperintense signal on T2-weighted images. (F, G) Postoperative anteroposterior and lateral radiographs showed satisfied bone cement distribution and vertebra height restoration. (H) Postoperative CT scans showed bone cement mainly distributed in the anterior and middle of the vertebral body. OVCF indicates osteoporotic vertebral compression fractures; PKP indicates percutaneous kyphoplasty; CT indicates computed tomography; MRI indicates magnetic resonance imaging.

Table1. Characteristics of the Study Population

Characteristic	Unilateral Group	Bilateral Group	*P* value
No. of patients	158	151	
Mean age (yr)	71.9±4.2	71.1±3.7	0.08
No. of women (%)	112 (70.9)	108 (71.5)	0.21
BMD T score	-3.2±0.8	-3.1±0.7	0.24
Intraoperative measurement			
Operation time (min)	33.2±5.1	52.5±10.9	＜0.01
volume of the injected cement	3.4±0.8	5.5±0.7	＜0.01
radiation dose			
Patient	0.89±0.34	1.98±1.20	＜0.01
Operator	0.23±0.12	0.24±0.14	0.50

Table2. Comparison of the effects of two groups on eight dimensions of SF-36 in our patients

	Unilateral Group				Bilateral Group			
Dimensions	Pre-op	1 months	6 months	12 months	Pre-op	1 months	6 months	12 months
PF	33.6±6.7	78,2±11.2	78,4±10.9	78.3±11.4	34.1±7.6	77.9±10.7	78.1±11.4	78,3±11.2
RP	23.7±12.3	75±15.2	75.3±10.7	75.6±10.9	24.1±17.2	78.1±13.9	78.5±12.8	75.2±13.3
BP	29.8±9.8	68,3±10.4	69.5±11.6	67.4±10.9	30.4±10.1	69.7±9.9	70.2±10.2	69.6±9.8
GH	59.5±9.0	75.6±5.7	74.9±7.4	74.2±7.9	60.8±9.6	74.0±7.4	74.3±8.1	74.4±7.9
VT	52.6±11.4	67.2±9.8	70.1±8.7	70.7±85	52.8±11.5	69.7±11.7	68.9±14.7	68.6±15.2
SF	53.4±12.2	69.3±15.6	70.2±18.6	70.8±17.1	54.1±11.9	70.2±14.2	71.6±14.8	71.7±13.9
RE	58.2±17.8	75.3±14.5	74.9±13.9	75.0±14.5	58.6±19.7	74.7±16.2	75.1±18.7	75.7±17.9
MH	63.7±11.2	74.5±10.9	72.9±9.8	73.1±10.1	66.1±11.7	74.2±11.6	74.9±10.9	74.5±11.2

Table3. Preoperative and postoperative radiographic assessment of two groups

	AH (%)			PH (%)			kyphotic angle（°）		
	Pre-op	12 months	Improvement	Pre-op	12 months	Improvement	Pre-op	12 months	Improvement
Unilateral group	50.13±11.28	79.24±12.36	29.07±7.25*#	81.47±13.63	89.23±12.13	7.46±2.82	18.83±8.22	9.25±5.41	9.34±3.16#
Bilateral group	51.46±13.11	70.37±12.48	19.88±8.43*	83.22±10.29	87.33±13.21	4.21±2.13	17.98±7.18	12.29±5.36	5.55±2.11

*, Pre-op VS 12 months follow-up, P＜0.05

#, Unilateral VS Bilateral, P＜0.05

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Disclosure of Conflicts of Interest

We certify that all our affiliations with or financial involvement in, within the past 3 years and foreseeable future, any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript are completely disclosed.