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Original Article

Rapid efficacy of percutaneous kyphoplasty (PKP) in treating thoracolumbar fractures in elderly patients

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Abstract: Objective: This study aims to investigate the effects of percutaneous kyphoplasty (PKP) on the elderly patients with thoracolumbar fractures and its influence on their complications and quality of life. Methods: Totally 175 elderly patients with thoracolumbar fractures admitted to our hospital from June 2017 to January 2019 were selected as the research participants. Seventy patients in the control group (CG) were treated with conventional therapy, and 105 in the research group (RG) were treated by percutaneous kyphoplasty (PKP). The surgical indications (time of hospitalization and ground exercise), pressure injury and pain (VAS score) of patients in both groups were tested and compared. The ODI score, quality of life GQOLI-74 scale score, height of anterior vertebral border and cobb angle of patients were compared, and their total effective and complication rates were statistically analyzed. Results: The surgical indications of patients in the RG were better than those in the CG. Those with pressure injury in stages 1 and 2 were fewer, and VAS and ODI scores were lower; GQOLI-74 scale score was higher, height of anterior vertebral border was higher than that in the CG, and the cobb angle was smaller The total effective rate was higher and the incidence of complications was lower than that in the CG. Conclusion: PKP is more effective and faster in treating thoracolumbar fractures in elderly patients with fewer postoperative complications, and can promote the recovery of function and quality of life.

Keywords: PKP, thoracolumbar fracture, height of anterior vertebral border, cobb angle

Introduction

Thoracolumbar fractures are the most common fractures of the spine. They not only make patients feel pain, but also affect their normal work and life. Serious fractures may even lead to functional loss of their ability to perform other activities, spinal deformity and sometimes paralysis [1, 2]. In addition, thoracolumbar fractures usually have serious consequences for medical, social and economic conditions [3, 4]. Clinically, conservative treatment is recommended and the goal is usually to correct kyphosis and reduce the pressure of the tube when the nerve function is defective [5]. Relevant surgical treatment can be combined with decompression, reduction, transplantation and/or internal fixation as required, and also posterior, anterior or combined methods [6, 7].

PKP is the improvement of percutaneous vertebroplasty, which can quickly relieve the pain of patients and achieve spinal stability [8]. The purpose of this therapy is to correct kyphosis and restore vertebral height [9] through balloon dilatation. Compared with general percutaneous vertebroplasty, PKP has a larger cement injection volume, and it can relieve pain in a short period of time, and improve the posterior lobe and morbidity [10]. However, PKP treatment for patients has many defects (such as cement leakage, unsatisfactory reduction [11-12]) and the probability of postoperative complications (such as fracture of adjacent vertebrae and fracture of injured vertebrae [13, 14]). Although pedicle screw internal fixation is beneficial to restoration, it will increase the probability of trauma. In addition, if the patient has senile osteoporosis, screw loosening will often occur; Meanwhile, there may be late kyphosis

[15]. Clinically, there are few studies on the complications caused by PKP and its impact on quality of life. Therefore, we will mainly explore PKP's impact on elderly patients with thoracolumbar fractures regarding the efficacy, postoperative complications, quality of life and other indicators.

Materials and methods

General data

Totally 175 elderly patients with thoracolumbar fractures admitted to the Second Affiliated Hospital of Xinjiang Medical University from June 2017 to January 2019 were selected and divided into research group (RG) and control group (CG) according to different treatment methods. There were 105 cases in the RG (55 males and 50 females), while there were 70 in the observation group (OG) (38 males and 32 females). Inclusion criteria: patients were confirmed as osteoporosis via DXA method; patients had single vertebral fracture; patients had old fracture with a course of over three weeks; patients had no contraindications for related operations. Exclusion criteria: patients had incomplete bone in posterior wall of vertebral body; patients were lumbago caused by lumbar instability and discogenic lumbago; patients had related contraindications to surgery; patients had communication problems. This research was approved by the ethics committee of the Second Affiliated Hospital of Xinjiang Medical University, and all subjects related signed an informed consent form.

Treatment methods

CG: patients received conventional treatment; the medical staff told them to rest in bed, and gave them anti-osteoporosis and drug treatment; they were given the following drugs orally: Langdi calcium carbonate D3 tablets (manufactured by Beijing Kangyuan Pharmaceutical Co., Ltd., with a specification of 500 mg * 36 tablets and SFDA Approval No. H20093675) 500 mg/time, 1-2 times a day, Fenbid ibuprofen sustained-release capsules (manufactured by SK&F., with a specification of 0.3 g per tablet and SFDA Approval No. H20013062), 0.3 g/time, 1-2 times a day. Simultaneously, patients were given intravenous drip of zoledronic acid (Shandong Weifang Pharmaceutical Factory Co., Ltd, SFDA Approval No. H20041976) 4 mg/time, once a day. The medical staff needed to lower the orthopedic reduction pillow at the injured part. After the pain of the patients was relieved, we let them lie on the hard board bed, and carry out functional recovery training for them after operation.

RG: patients were treated by percutaneous kyphoplasty (PKP). They were taken to prone position, and the pedicle surface of injured vertebra under C-arm machine was projected and marked. The medical staff needed to puncture their injured part under the guidance of the orthographic perspective, and needed to determine the direction of the punctured needle tip through the lateral perspective, and adjusted the needle insertion angle at any time. When the punctured needle tip reached l/3 in the anterior middle of the vertebral body, a positive perspective needle tip was needed to ensure that the needle tip was located near the spinous process. After the channel was established, the needle core was pulled out, the expansion balloon was inserted, and the injured vertebra was expanded to a satisfactory height. The prepared bone cement was injected. The volume was generally 3-4 mL (thoracic vertebra) and 4-6 mL (lumbar vertebra). After the bone cement was solidified, the needle was pulled out, and the incision was wound for hemostasis in a sterile environment. Injured vertebra after operation was protected by Waistband, and routine treatment and nursing were given.

Outcome measures

(1) Surgical indications: The surgical indications of patients in both groups were observed and compared: time of hospitalization and ground exercise.

(2) Pressure injury: The skin color, integrity, exudation and tactile sensation of patients in both groups were observed and evaluated. The stages of postoperative pressure injury were evaluated: stage 1: the patient had complete skin and erythema that was not white under pressure; stage 2: the patient had partial skin defects and exposed dermis, with complete or damaged serous blisters.

(3) Pain: The visual analogue scale (VAS) scores [16] of patients before operation, 1 month, 3 and 6 months after operation were counted and compared (0-10 points). The higher the score was, the more severe the pain was.

(4) ODI score: The Oswestry Dysfunction Index (ODI) [17] scores of patients before operation, 1 month, 3 and 6 months after operation were counted and compared. The higher the score was, the more serious the dysfunction was.

(5) Quality of life: The quality of life of patients with GQOLI-74 scale [18] before and 6 months after operation was counted and compared. The scores included physical function, mental function, material life and social function. The higher the score was, the better the quality of life was.

(6) Height of anterior vertebral border, cobb angle: The height of anterior vertebral border and cobb angle were measured and compared before operation, 1 month, 3 and 6 months after operation.

(7) Incidence of complications: The postoperative complications of patients in both groups: spinal cord or nerve root injury, rib fracture, pressure sore, postoperative delirium were counted, and the incidence of complications was counted.

(8) Total effective rate: The total effective rate of patients in both groups was counted. Cure: the patients could take care of themselves and their clinical symptoms disappeared completely; remarkably effective: patients' self-care situation and clinical symptoms had been significantly improved, without the need for painkillers; effective: their part of life could be self-care, clinical symptoms had improved, but they still needed painkillers; ineffective: they were unable to take care of themselves, and their clinical symptoms had not improved or even worsened.

Statistical methods

Data were statistically analyzed via SPSS 25.0 (Asia Analytics Formerly SPSS China). The counting data such as gender, fracture site, hypertension, hyperlipemia, diabetes, stress injury level, complications and total effective data in general data were used for statistical analysis and assessed via X^2 test. The measurement data such as average age, BMI and average course of disease, surgery indication, ODI score, GQOLI-74 scale score, anterior height and cobb angle in general data were expressed as (X±S) and measured by t. The difference was obvious and had statistical significance when $P < 0.05$.

Results

Comparison of general data of patients in both groups

There was no remarkable difference between both groups in general data such as gender, age, BMI, average course of disease, fracture site, etc. ($P > 0.05$) (**Table 1**).

Comparison of surgical indications of patients between both groups

The time of hospitalization and ground exercise in the RG were markedly shorter than those of the CG, and all surgical indications were dramatically better than those of the CG ($P < 0.05$) (**Figure 1**).

Comparison of pressure injury of patients between both groups

The pressure injury level of patients in the RG: there were 3 patients in stage 1 and no one in stage 2; the pressure injury level of patients in the CG: there were 7 patients in stage 1 and 7 in stage 2; the pressure injury in the RG was stage 1, and the patients in stage 2 were dramatically less than those in the CG (**Table 2**).

Comparison of pain of patients between both groups

After comparing the results of VAS scores of patients between both groups, we found that the scores of patients in the RG were significantly lower than those in the CG at 1 month, 3 and 6 months after operation ($P < 0.05$) (**Figure 2**).

Comparison of ODI score of patients between both groups

After comparing the results of blood ODI scores of patients in both groups, we found that the scores of patients in the RG were remarkably lower than those in the CG at 1 month, 3 and 6 months after operation ($P < 0.05$) (**Figure 3**).

Comparison of quality of life of patients between both groups

There was no marked difference in GQOLI-74 scale scores of patients between both groups before operation ($P > 0.05$). Six months after operation, the scores of physical function, mental function, material life and social function in

Table 1. General data of patients in the two groups

Classification	Research group (RG) (n=105)	Control group (CG) (n=70)	t/X^2	P
Gender			0.06	0.805
Male	55 (52.38)	38 (54.29)		
Female	50 (47.61)	32 (45.71)		
Age (years)	70.31±9.26	70.98±9.14	0.64	0.638
BMI (kg/m^2)	21.25±1.47	20.87±1.78	1.54	0.126
Average course of disease (months)	11.43±2.65	11.64±2.49	0.53	0.600
Fracture site			0.19	0.666
Thoracic vertebra	53 (50.48)	33 (47.14)		
Lumbar vertebra	52 (49.52)	37 (52.86)		
Hyperlipidemia			0.49	0.486
Yes	43 (40.95)	25 (35.71)		
No	62 (59.05)	45 (64.29)		
Hypertension			0.04	0.851
Yes	60 (55.00)	41 (48.75)		
No	45 (45.00)	29 (51.25)		
Diabetes			0.14	0.710
Yes	57 (54.29)	40 (57.14)		
No	48 (45.71)	30 (42.86)		

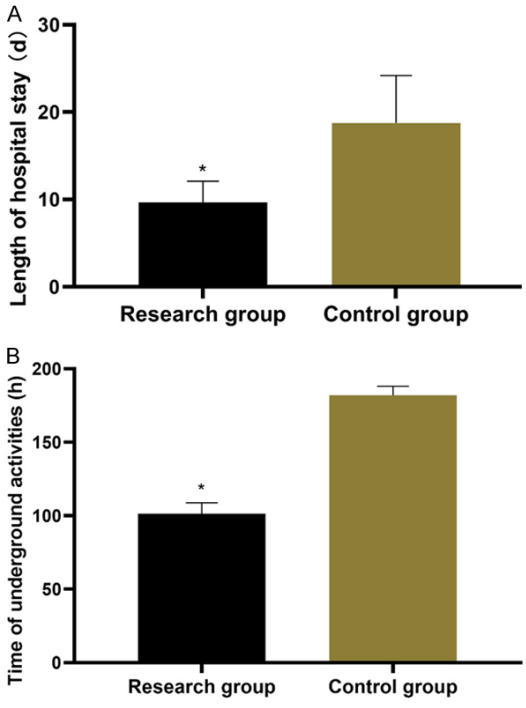

Figure 1. Surgical indications of patients in the two groups: (A) length of stay: it in the RG was markedly shorter than that in the CG ($P < 0.05$). (B) ground exercise time: it in the RG was markedly shorter than that in the CG ($P < 0.05$). Note: * indicates a comparison with the CG ($P < 0.05$).

the RG were markedly higher than those in the CG ($P < 0.05$) (**Figure 4**).

Comparison of height of anterior vertebral border and cobb angle of patients between both groups

There was no remarkable difference in anterior vertebral height and cobb angle of patients between both groups before operation ($P > 0.05$). One month, three, and six months after operation, the height of anterior vertebral border in the RG was dramatically higher than that in the CG, and cobb angle was markedly lower than that in the CG ($P < 0.05$) (**Figure 5**).

Comparison of incidence of complications of patients between both groups

There were no spinal cord or neural root trauma, rib fractures, 2 pressure sores and 1 postoperative delirium in the RG, with a complication rate of 2.50%. In the CG, there were 3 cases of spinal cord or neural root trauma, 1 case of rib fracture, 6 cases of pressure sore, and 4 cases of postoperative delirium. The incidence of complications was 20.00%. The incidence of complications in the RG was dramati-

Table 2. Pressure injury levels of patients in the two groups

Classification	Research group (RG) (n=105)	Control group (CG) (n=70)	t	P
Stage 1	2	7	3.98	0.046
Stage 2	0	7	10.94	< 0.001

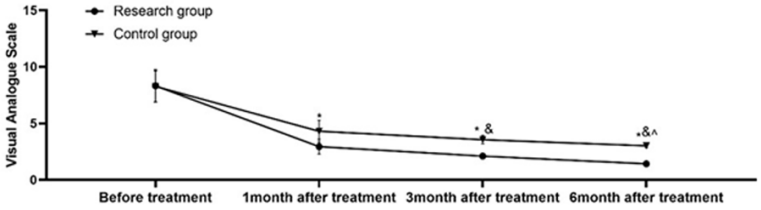

Figure 2. VAS scores of patients in the two groups: the two groups reduced dramatically at 1 month, 3 and 6 months after operation, while the scores of patients in the RG were significantly lower than those in the CG at 1 month, 3 and 6 months after operation ($P < 0.05$). Note: * means a comparison with before operation ($P < 0.05$), & means a comparison with 1 month after operation ($P < 0.05$) and ^ means a comparison with 3 months after operation ($P < 0.05$).

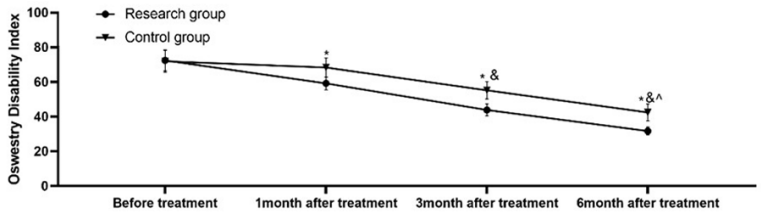

Figure 3. ODI score of patients in the two groups: the ODI score reduced significantly at 1 month, 3 and 6 months after operation, and the ODI score level of patients in the RG was significantly lower than that of the CG at 1 month, 3 and 6 months after operation ($P < 0.05$). Note: * means a comparison with before surgery ($P < 0.05$), & means a comparison with 1 month after operation ($P < 0.05$) and ^ means a comparison with 3 months after operation ($P < 0.05$).

cally higher than that in the CG ($P < 0.05$) (**Table 3**).

Comparison of total effective rate of patients between both groups

In the RG, 40 cases were cured, 32 were markedly effective, 28 were effective and 5 were ineffective, with a total effective rate of 95.00%. In the CG, 22 cases were cured, 18 were markedly effective, 14 were effective and 14 were ineffective, with a rate of 80.25%. The total effective rate of the RG was dramatically higher than that of the CG ($P < 0.05$) (**Table 4**).

Summary

Percutaneous kyphoplasty (PKP) plays a better part in stabilizing the fracture site and restoring the height of bone. Because PKP can effectively relieve the pain caused by fracture, it has gained more and more popularity worldwide [19, 20]. The purpose of this study is to compare the effect of PKP on thoracolumbar fractures, complications and the quality of life of elderly patients after conventional conservative treatment.

The surgical indication data of patients in the two groups were compared. Those in the RG using PKP had better surgical indications, and their time of hospitalization and ground exercise were shorter than those in the CG using conservative therapy. Meanwhile, comparing the height of anterior vertebral border and cobb angle, we found that the height in the RG treated with PKP was higher than that in the CG, while cobb angle was smaller. Height of anterior vertebral border is an indicator for detecting postoperative recovery of thoracic and lumbar spine and other orthopedic diseases [21]. The higher the recovery height is, the better the recovery is [22]. Cobb angle can be used to judge the degree of spinal curvature and has now been used as a standard parameter to quantify the amplitude of scoliosis curve [23, 24]. During PKP treatment, a balloon is inserted to leak bone cement to restore the height of anterior vertebral border. Therefore, it works well in the recovery of vertebral height, and the correction effect of kyphosis deformity by using this method is better [25]. Based on the comprehensive surgical indications, height of anterior border and cobb angle, patients receiving PKP can walk faster and have shorter hospital stay, which indicates that they recover faster. The height of anterior vertebral border is higher than that of the CG, and the cobb angle is smaller, which indicates that the recovery effect is better. These results demonstrated that patients in the RG have a higher total

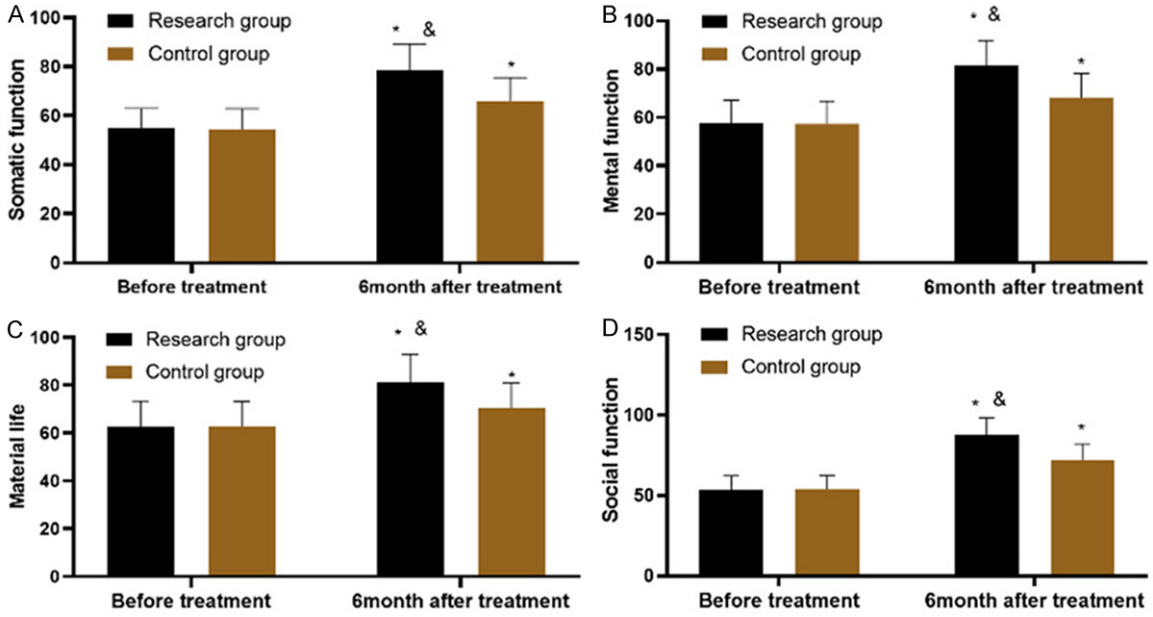

Figure 4. GQOLI-74 scale scores of patients in the two groups: (A) physical function: the physical function scores increased significantly 6 months after operation, and the scores of patients in the RG were dramatically higher than those in the CG ($P < 0.05$). (B) mental function: the mental function scores increased significantly 6 months after operation, and the scores of patients in the RG were remarkably higher than those in the CG ($P < 0.05$). (C) material life: the material life scores of both groups increased significantly 6 months after operation, and the scores of patients in the RG were markedly higher than those in the CG ($P < 0.05$). (D) social function: the social function scores increased significantly 6 months after operation, and the scores of patients in the RG were markedly higher than those in the CG ($P < 0.05$). Note: * means a comparison with before operation ($P < 0.05$) and & means a comparison with CG ($P < 0.05$).

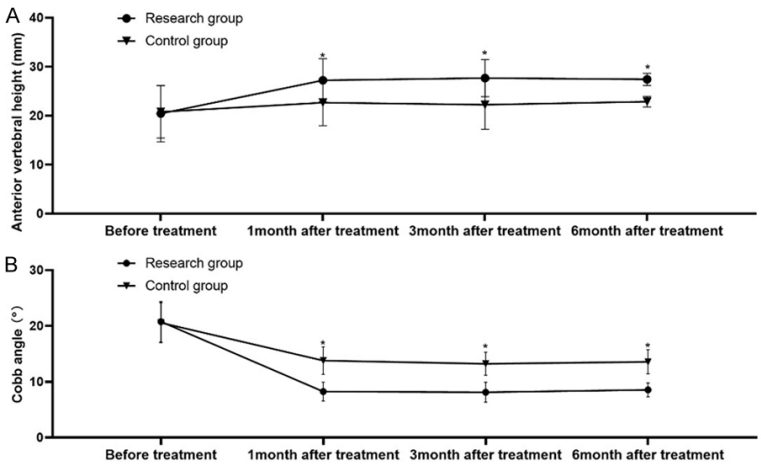

Figure 5. Height of anterior vertebral border and cobb angle of patients in the two groups: (A) height of anterior vertebral border of patients: the height of the two groups reduced obviously at 1 month, 3 and 6 months after operation, and the ODI score level of patients in the RG was obviously lower than that of the CG at 1 month, 3 and 6 months after operation ($P < 0.05$). (B) cobb angle of patients in the two groups: height of anterior vertebral border of patients: cobb angle of both groups reduced significantly at 1 month, 3 and 6 months after operation, and cobb angle of patients in RG was significantly lower than that of CG at 1 month, 3 and 6 months after operation ($P < 0.05$). Note: * indicates a comparison with before surgery ($P < 0.05$).

effective rate. PKP is more effective and faster in treating thoracolumbar fractures in elderly patients.

We also compared the results of patients with pressure injury. The results showed that patients in the RG using PKP suffered from postoperative pressure injury of stages 1 and 2 were significantly less than those in the CG. In the meantime, patients using PKP have lower incidence of complications. Previous studies have indicated that PKP may cause a series of complications after operation, including nerve injury [26, 27]. But in our research, it showed less incidence of complications. We also compared patients' ODI with the GQOLI-74 scale

Table 3. Incidence of complications of patients in the two groups

Classification	Research group (RG) (n=105)	Control group (CG) (n=70)	X^2	P
Spinal cord or neural root trauma	0 (0.00)	3 (4.29)	-	-
Rib fractures	0 (0.00)	1 (1.42)	-	-
Pressure sores	2 (1.90)	6 (8.57)	-	-
Postoperative delirium	1 (0.96)	4 (5.72)		
Incidence	3 (2.86)	14 (20.00)	6.64	0.010

Table 4. Total effective rate of patients in the two groups (n=50)

Classification	Research group (RG) (n=105)	Control group (CG) (n=70)	X^2	P
Cure	40 (38.10)	22 (31.43)		
Markedly effective	32 (30.48)	18 (25.71)	-	-
Effective	28 (26.66)	16 (22.86)	-	-
Ineffective	5 (4.76)	14 (20.00)	-	-
Total effective rate (%)	100 (95.24)	56 (80.00)	10.08	0.002

scores. Patients using PKP have lower ODI score after surgery, while GQOLI-74 scale score is higher. Compared with other evaluation criteria, ODI score can more accurately judge the dysfunction of patients [28], so the dysfunction of those patients has been well recovered after surgery. It should also be that patients' various functions are recovered better, and the higher GQOLI-74 scale score can also be well explained. As to the complications, PKP did have many complications; but judging from the postoperative quality of life and ODI score, patients' postoperative dysfunction is not as severe with relatively good quality of life. At the same time, the incidence of complications is also low. This study did not detect and investigate their degree of adaptability, and investigate their satisfaction after surgery. In the future clinical research, we need to detect and analyze the degree of intraoperative cooperation of patients, and to investigate postoperative satisfaction, so as to improve this therapy.

To summarize, PKP has obvious and faster efficacy on thoracolumbar fractures in elderly patients. It has fewer postoperative complications and can promote recovery of function and quality of life.

Disclosure of conflict of interest

None.

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