

## Analysis of Risk Factors for Nonoperative Vertebral Refracture after Vertebroplasty for Single-Segment Vertebral Fracture

Jian-feng Li<sup>1</sup>, Chengshao Zhang<sup>2</sup>, Qiang Li<sup>2</sup>, Yong-sheng Zhao<sup>2</sup> 

<sup>1</sup>Qingdao University, Qingdao 266000, Shandong

<sup>2</sup>Department of Orthopaedics, Qingdao Municipal Hospital, Qingdao 266000, Shandong

**Abstract:** Objective: To analysis the risk factors of nonsurgical vertebral refracture by making retrospectively study about patients with osteoporotic vertebral compression fractures (OVCF) had accepted vertebroplasty. Methods: From June 2016 to December 2017, there were 161 cases of OVCF patients were treated with single-segment vertebroplasty in our department, and follow-up data including age, gender, bone density, bone cement volume, bone cement puncture route, bone cement leakage and vertebral refracture were collected. T-test and chi-square test were used to analyze the possible risk factors for postoperative vertebral refracture. Results: Among 161 patients treated with vertebroplasty, 19 of them had refracture. Among the refracture group, including 2 males and 17 females, bone density (-3.49 + 0.20) in the refracture group, and bone density (-2.95 + 0.57) in the nonrefracture group. The difference was statistically significant ( $t=-4.162, P<0.001$ ). Eight patients in the refracture group had cement intervertebral leakage, 11 patients in the nonre-fracture group had cement intervertebral leakage, 24 patients in the nonre-fracture group had cement intervertebral leakage, and 138 patients in the nonre-fracture group had cement intervertebral leakage. The difference was statistically significant (chi-square = 6.928,  $P= 0.008$ ). However, there was no statistically significant difference in age, gender, bone cement content, fracture history, surgical method, surgical site, puncture route and other factors. Conclusions: Decreased bone density and intervertebral leakage of bone cement may be risk factors for postoperative nonoperative vertebral refracture. Therefore, reasonable anti-osteoporosis treatment should be adhered to, and intervertebral leakage of bone cement should be minimized, to reduce the occurrence of postoperative refracture.

**Keywords:** Refracture, Risk factors, Vertebroplasty, Osteoporosis

### Introduction

At present, there are more and more patients with senile osteoporosis in China, and there are more and more patients with OVCF. Vertebroplasty is the most commonly used surgical procedure for the treatment of OVCF, that has been widely used, because it has many advantages such as small trauma, rapid pain relief, quick recovery and so on<sup>[1]</sup>. But some patients have refracture after surgery. And the cause of refracture is not completely clear yet. This article will analyzes the patients who underwent vertebroplasty and discuss the possible risk factors for refracture.

### Materials and methods

There were 161 patients with OVCF who underwent vertebroplasty from June 2016 to December 2017 were enrolled. And the follow-up period ranged from 6 months to 24 months. The patients were divided into the refracture group and the non-refracture group. There 19 patients in the fracture group, including 2 males and 17 females, aged 64-91 years old, averaged (79.26±8.21) years old. And there were 142 patients in the non-refracture group, including 27 males and 115 females, aged 55-95 years, with an average of (75.78±9.16) years old.

The inclusion criteria were OVCF patients who underwent single-segment vertebroplasty. The exclusion criteria were burst fractures; symptoms or signs of spinal cord, cauda equina or nerve root damage; refractory coagulopathy or bleeding tendency; and infection.

### Parameters observed

Observations and statistical indicators include gender, age, bone mineral density (BMD), preoperative fracture history, surgical vertebral body site, surgical approach, bone cement dose, bone cement puncture route, bone cement leakage, etc.

### Statistical method

Data processing was performed using SPSS 19.0 statistical software. Risk analysis was performed on the statistical data using the t test or the Chi-squared test. If  $P < 0.05$ , the difference was statistically significant.

### Results

All the 161 patients underwent vertebroplasty and were followed up for 6 months to 24 months. And there were 155 female and 27 male patients with a mean age of 69.7 years (range 49–91 years) there were 32 patients

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Yong-sheng Zhao (Correspondence)

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(19.9%) had cement leakage in the vertebral body and 19 patients (11.8%) had refracture after operation.

**Single factor analysis of postoperative fractures in patients**

Univariate analysis showed that bone mineral density (BMD) and cement leakage were risk factors for refracture after PKP. The results are shown in Table 1 and Table 2 below.

Table 1 Analysis of risk factors for re-fracture after vertebroplasty

Risk factor	Refracture group	Non-e-fracture group	t	p
Age	79.26±8.21	75.78±9.16	t=1.574	0.117
Bone density T value	-3.49±0.20	-2.95±0.57	t= -4.162	<0.001
Bone cement amount (ml)	5.47±1.22	5.44±1.05	t= 0.123	0.902

Table 2 Analysis of risk factors for re-fracture after vertebroplasty

Risk factor	Refracture group	Non-e-fracture group	$\chi^2$	p
<b>Gender</b>				
Male	2	27		
Female	17	115	$\chi^2 = 0.344$	0.558
<b>History of fractures</b>				
Have	7	41		
None	12	101	$\chi^2 = 0.509$	0.476
<b>Surgical procedure</b>				
PVP:	13	79		
PKP)	6	63	$\chi^2 = 1.119$	0.290
<b>Surgical site</b>				
T11-L2	13	108		
Non-thoracolumbar	6	34	$\chi^2 = 0.194$	0.659
<b>Puncture route</b>				
Unilateral	16	131		
Bilateral	3	11	$\chi^2 = 0.540$	0.462
<b>Cement intervertebral space leakage</b>				
Have	8	24		
None	11	138	$\chi^2 = 6.928$	0.008

**Discussion**

There are many risk factors for non-surgical vertebral fractures in vertebroplasty. Some studies have found that cement intervertebral space leakage is an important influencing factor for new vertebral fractures [2,3], which is consistent with the conclusions drawn by this study. Sun et al [4] found that if the bone cement is only confined within the trabecular bone range, there is no leakage, the risk of re-fracture of the adjacent vertebral body of the surgical vertebral body is 7%; the cement reaches the endplate level, then the adjacent vertebra The risk of fracture increased to 29%; when the cement reached the level of the intervertebral disc, the risk of

an adjacent vertebra fracture increased to about 44%. Regarding the mechanism of bone cement leakage and non-surgical vertebral body refracture, the author believes that the bone cement may increase the disc and endplate damage after exudation into the intervertebral space, which accelerates the degeneration of the intervertebral disc and lamina. The stress conduction imbalance between the surgical vertebral body and the non-surgical vertebral body increases the risk of nonsurgical vertebral body refracture.

At the same time, studies have also found that osteoporosis caused by decreased bone density is an

important risk factor for postoperative refracture [3,4], which is consistent with the conclusions reached in this study. Decreased bone density is bound to lead to osteoporosis. Under slight external force and pressure between the vertebral bodies, the vertebral body may have refracture. Therefore, after vertebroplasty, we should adhere to reasonable antiosteoporosis treatment, try our best to improve the patient's osteoporosis and reduce the risk of postoperative fracture.

Studies have found that the endplate displacement of the adjacent vertebrae caused by bone cement strengthening and increased pressure of the intervertebral disc are important causes of adjacent vertebrae fractures [5]. Baroud et al [6] found that due to the strengthening of bone cement, the strength of the surgical vertebral body increased by 35 times that of the normal vertebral body, and the stiffness was also increased by 12 times, which increased the stress on the adjacent intervertebral disc and the adjacent endplate. The pedicle of the adjacent vertebral endplate is relieved, the vertebral body is changed, and the risk of fracture is increased. The author believes that although the reinforcement of the bone cement fixes the fracture block, it may also reduce the possibility of re-collapse fracture of the surgical vertebral body after surgery, but it also inevitably changes the stress balance between the internal bone and the vertebral body of the vertebral body, if added osteoporosis and leakage of cement intervertebral space, then the internal stress and vertebral body stress balance between the vertebral body will be further damaged, which may increase the risk of postoperative non-operative vertebral body fracture.

In this study, the reduction of bone density and leakage of cement intervertebral space may be the risk factors for non-surgical vertebral fractures. Therefore, we should carefully operate during the operation to minimize the intervertebral space leakage of bone cement. Long-term anti-osteoporosis treatment should be done to reduce the risk of post-fracture.

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