

Study on the Clinical Effect of Percutaneous Vertebroplasty in the Treatment of Old Unstable Osteoporotic Spinal Fractures

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Abstract: *Objective:* To evaluate and analyze the actual efficacy of percutaneous vertebroplasty in the treatment of old unstable osteoporotic spinal fractures. *Methods:* From March 2023 to March 2024, 46 patients with old unstable osteoporotic spinal fractures in our hospital were included in this study. They were divided into the conventional group and the observation group based on treatment differences, with 23 patients in each group. The conventional group received conservative drug therapy, while the observation group underwent percutaneous vertebroplasty. The following indicators were compared and analyzed between the two groups: clinical treatment effect and improvement in physical function indicators. *Results:* The treatment efficiency of the observation group was 95.65% (22/23), while that of the conventional group was 69.57% (16/23). There was a significant difference between the groups, and the treatment effect of the observation group was significantly better ($P < 0.05$). After treatment, the scores of physical status, daily living ability, functional independence, and life obstacles in the observation group were (89.33 ± 4.08) , (88.72 ± 4.08) , (90.41 ± 2.89) , (72.35 ± 3.22) , respectively, while those in the conventional group were (68.54 ± 4.21) , (67.42 ± 4.11) , (73.48 ± 2.75) , (72.35 ± 3.22) . There was a significant difference between the groups, and the improvement in physical function indicators in the observation group was more pronounced ($P < 0.05$). *Conclusion:* For patients with old unstable osteoporotic spinal fractures, the basic value of percutaneous vertebroplasty is significant. It can not only improve clinical efficacy and safety but also promote the gradual recovery of patients' physical function indicators. It is recommended for clinical reference and practical application.

Keywords: Old unstable osteoporotic spinal fractures; Percutaneous vertebroplasty; Treatment effect

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1. Introduction

For most middle-aged and elderly people, there is a higher probability of developing old and unstable osteoporotic vertebral fractures^[1,2]. Patients with this disease often experience age-related calcium loss, leading to osteoporosis.

Unexpected violent impacts can result in spinal fractures. Since the affected site is the spinal column, it can directly impact the patient's upper limb motor function to a certain extent, disrupting the stability of the spinal structure. This, in turn, leads to severe local pain and limited physical movement. Surgical intervention can help adjust the structure and morphology of the fractured spine, which is practically significant for the patient's postoperative recovery^[3,4]. Conservative treatment methods may not yield significant results. Following such treatments, patients may develop kyphosis, compromising spinal stability. The use of minimally invasive percutaneous vertebroplasty can achieve remarkable treatment effects and avoid various postoperative adverse reactions. In this study, patients in the conventional group received conservative drug treatment, while patients in the observation group underwent percutaneous vertebroplasty. A comparative analysis was conducted on the following indicators between the two groups: clinical treatment effect and improvement in physical function indicators. The specific details are elaborated below.

2. Materials and methods

2.1. General information

This study included 46 patients with old unstable osteoporotic spinal fractures treated in the hospital between March 2023 and March 2024. The patients were divided into a conventional group and an observation group based on differences in treatment methods, with 23 patients in each group. The conventional group consisted of 15 males and 8 females, aged between 58 and 78 years, with an average age of (66.52 ± 2.09) years old. The observation group included 14 males and 9 females, aged between 57 and 78 years old, with an average age of (66.71 ± 2.46) years old. There was no significant difference in baseline data between the two groups, making them comparable ($P > 0.05$).

2.2. Inclusion criteria

Patients diagnosed with old unstable osteoporotic spinal fractures; patients with stable vital signs; patients with complete medical records and high cooperation between patients and their families.

2.3. Exclusion criteria

Patients with malignant tumors; patients with open traumatic injuries; patients with severe consciousness disorders and unable to communicate normally; patients in the acute infection phase; patients with severe coagulation disorders; and patients who withdrew from the study midway.

2.4. Methods

The conventional group received conservative drug therapy intervention: patients maintained bed rest, and after significant relief of low back pain, they engaged in moderate-intensity functional exercise activities for the lower back muscles. The most appropriate time for getting out of bed was determined based on the patient's basic recovery status. Patients were given oral Alfacalcidol tablets at a dose of $0.5 \mu\text{g}$ twice daily, Calcium carbonate D3 tablets at 600 mg once daily, and during hospitalization, they were treated with salmon calcitonin at 100 mg once daily for 7–9 days via subcutaneous injection. After discharge, patients were treated with Alendronate Sodium tablets at 70 mg once weekly.

Patients in the observation group were treated with percutaneous vertebroplasty: patients maintained a prone position with lumbar overextension, and the location of the affected vertebra was accurately positioned using X-ray examination. Local infiltration anesthesia was performed using 1% lidocaine from the skin to the periosteum. Lumbar traction and overextension interventions were performed during the surgery to reduce the fracture site.

Using fluoroscopy, a puncture needle was used to puncture the pedicle of the affected vertebra to the 1/3 position of the vertebral body. After tapping on the front of the vertebra, the needle was smoothly replaced with an injection cannula for bone cement injection. The injection pressure was accurately controlled to avoid the risk of leakage. If leakage occurred, the injection was immediately stopped. During the treatment, it was ensured that the bone cement was evenly distributed within the vertebral body. After the bone cement hardened, the working cannula was smoothly removed, and the surgery was completed by suturing.

2.5. Observation indicators

(1) Observe and study the treatment efficacy of the two groups of patients

If the patient's vertebral body anterior edge height recovers or approaches the normal range, there is no obvious lumbar soreness and backache, and the ability to daily living improves significantly, the actual evaluation criterion is very effective ^[5]. If the patient's vertebral body anterior edge height increases compared to before treatment, occasionally experiences lumbar soreness and backache, and the ability to daily living recovers somewhat, the actual evaluation criterion is effective. If the above criteria are not met, it is indicated as ineffective.

(2) Observe and study the improvement of physical function indicators in the two groups of patients

Based on the Barthel Activity of Daily Living Scale, Life Obstacle Rating Scale, and Functional Independence Measure, the actual items selected include physical status, ability of daily living, functional independence, and life obstacles ^[6]. Each item is scored from 0–100, with scores closer to 0 indicating poorer improvement in the patient's physical function indicators.

2.6. Statistical analysis

SPSS 26.0 software was used for data processing. Measurement data were expressed as “()”, and tested using the *t*-test; count data were expressed as “*n*/%” and tested using the χ^2 test. A *P*-value < 0.05 was considered statistically significant.

3. Results

3.1. Observation of treatment efficacy in two groups of patients

The effective treatment rate in the observation group was 95.65% (22/23), while the effective treatment rate in the conventional group was 69.57% (16/23). There was a significant difference between the two groups, with the observation group showing more prominent treatment efficacy (*P* < 0.05). The specific data are shown in **Table 1**.

Table 1. Comparison of treatment efficacy between the conventional group and the observation group

Group	Very Effective		Effective		Ineffective		Total Effectiveness	
	Number of Cases	Proportion (%)	Number of Cases	Proportion (%)	Number of Cases	Proportion (%)	Number of Cases	Proportion (%)
Observation Group (<i>n</i> = 23)	14	60.87	8	34.78	1	4.35	22	95.65
Conventional Group (<i>n</i> = 23)	10	43.48	6	26.09	7	30.43	16	69.57
χ^2 value	-	-	-	-	-	-	-	5.447
<i>P</i> value	-	-	-	-	-	-	-	0.020

3.2. Observation study on the improvement of physical function indicators in two groups of patients

After treatment, the scores for indicators such as physical status, daily living skills, functional independence, and life obstacles in the observation group were (89.33 ± 4.08), (88.72 ± 4.08), (90.41 ± 2.89), (72.35 ± 3.22) respectively; while those in the conventional group were (68.54 ± 4.21), (67.42 ± 4.11), (73.48 ± 2.75), (72.35 ± 3.22). There were significant differences in the data comparison between the two groups, with the observation group showing more pronounced improvement in physical function indicators ($P < 0.05$). Specific data is shown in Table 2.

Table 2. Comparison of improvement in physical function indicators between the conventional group and the observation group (Scores, mean $\pm$ SD)

Group	Physical Status		Daily Living Skills	
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
Observation Group ($n = 23$)	56.89 ± 3.32	89.33 ± 4.08	61.33 ± 3.68	88.72 ± 4.09
Conventional Group ($n = 23$)	56.71 ± 3.65	68.54 ± 4.21	61.85 ± 3.25	67.42 ± 4.11
<i>T</i> value	0.175	17.007	0.508	17.617
<i>P</i> value	0.862	0.000	0.614	0.000

Group	Functional Independence		Life Obstacles	
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
Observation Group ($n = 23$)	66.52 ± 3.89	90.41 ± 2.89	63.38 ± 3.02	91.48 ± 3.05
Conventional Group ($n = 23$)	66.49 ± 3.71	73.48 ± 2.75	63.52 ± 3.66	72.35 ± 3.22
<i>T</i> value	0.027	20.353	0.141	20.686
<i>P</i> value	0.979	0.000	0.888	0.000

4. Discussion

Patients with old unstable osteoporotic vertebral fractures often face high incidence, complex etiology, and difficulty in complete eradication of the disease. Without early targeted treatment, the condition may progress to bone deformation, leading to fractures and healing difficulties^[7,8]. In the clinical treatment of patients with old unstable osteoporotic spinal fractures, the effect of conservative treatment is not significant. Long-term bedridden patients have poor comfort and may also experience bone loss. The use of percutaneous vertebroplasty to inject cement can reduce pain sensitivity and ensure vertebral stability. Percutaneous vertebroplasty takes advantage of minimally invasive surgery, employing puncture methods to insert cannulas and trocars, and utilizes materials and medical equipment for intervention to reasonably adjust the structure and morphology of the vertebrae^[9,10]. This surgical approach does not require expanding the incision range, ensures sufficient operating space, can directly target the affected area without damaging surrounding tissues, and offers relatively prominent operational timeliness. Based on the actual characteristics of the patient, preoperative understanding of the patient's condition and disease progression allows for reasonable planning of needle depth and angle. A high-pressure injector is used to smoothly inject bone cement into the patient's vertebrae. After the bone cement solidifies, the actual stability of the structure and the basic shape of the spine are scientifically adjusted. This not only aids in the recovery of spinal

function but also improves the practical operability of the surgery, reduces trauma, and enhances treatment safety. The results of this study showed that after treatment, the observation group's scores for physical status, daily living ability, functional independence, and life obstacles were (89.33 ± 4.08) , (88.72 ± 4.08) , (90.41 ± 2.89) , and (72.35 ± 3.22) , respectively, while the conventional group's scores were (68.54 ± 4.21) , (67.42 ± 4.11) , (73.48 ± 2.75) , and (72.35 ± 3.22) . There were significant differences between the groups, and the improvement of physical function indicators in the observation group was more pronounced ($P < 0.05$). From the above data analysis results, it is not difficult to understand that the application of percutaneous vertebroplasty in a minimally invasive surgical form not only reduces pain levels but also promotes significant recovery of spinal dysfunction, increases vertebral height, and facilitates fracture site recovery. Compared with conservative treatment, minimally invasive surgery has significant advantages. Injecting bone cement into the diseased vertebra can reduce lateral bending compliance can effectively repair the diseased bone tissue, and lay a solid foundation for subsequent treatment^[11,12]. Using a transpedicular approach to inject bone cement into the patient's vertebrae can significantly enhance vertebral stability and gradually increase strength. Injecting bone cement not only avoids damage to the patient's vertebral height but also reduces the likelihood of vertebral collapse, effectively relieving and improving pain symptoms, and enhancing physical function and quality of life.

5. Conclusion

In summary, for the treatment of patients with old unstable osteoporotic spinal fractures, the value of choosing percutaneous vertebroplasty as a minimally invasive surgery is prominent. It not only improves clinical efficacy and safety but also promotes the gradual recovery of patients' physical function indicators. It is recommended for clinical reference and practical promotion.

Disclosure statement

The authors declare no conflict of interest.

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