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Original research

The clinical efficacy of vertebroplasty on osteoporotic vertebral compression fracture: A meta-analysis

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HIGHLIGHTS

- Efficacy of vertebroplasty on osteoporotic vertebral compression fracture (VCF) was accessed.
- Vertebroplasty had significant efficacy on pain relief in osteoporotic VCF.
- Vertebroplasty had similar adjacent vertebral fracture incidence with traditional treatment.

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ABSTRACT

We investigated the clinical efficacy of vertebroplasty (VP) for the treatment of osteoporotic vertebral compression fracture (OVCF). We searched the online databases such as MEDLINE, EMBASE, EBSCO, Springer, Ovid and Cochrane library citations up to May 2012 and 5 eligible studies were included in this study. The meta-analysis was conducted using software RevMan 5.0. For the continuous data, the weighted mean difference (WMD) and its 95% confidence interval (CI) were calculated and the odds ratio (OR) and the corresponding 95% CI were calculated for the dichotomous data. The results demonstrated that the Visual Analogue Scale (VAS) score of patients treated with VP was significantly lower than that treated with traditional treatment at each time point (one week: WMD = −2.55, 95% CI, −3.08 to −2.02, $P < 0.0001$; 12 weeks: WMD = −0.90, 95% CI, −1.22 to −0.57, $P < 0.0001$; 24 weeks: WMD = −1.75, 95% CI, −2.30 to −1.19, $P < 0.0001$; 48 weeks: WMD = −1.75, 95% CI, −2.30 to −1.19, $P < 0.001$). For The incidence of adjacent vertebral fracture, the overall estimate (OR = 2.06, 95% CI: 0.26 to 16.29, $P = 0.50$) indicated that there was no statistically significant difference between VP and traditional treatment. In conclusion, the OVCF patients treated by VP had statistically significant improvements in pain relief compared with the traditional treatment and there was the similar incidence of adjacent vertebral fracture between the patients treated by VP and traditional treatment.

1. Introduction

Osteoporosis (porous bones) as a systemic skeletal disease, is characterized by low bone mass and microarchitectural deterioration of bone tissue with a consequent increase of bone fragility and susceptibility to fractures [1]. Vertebral compression fracture (VCF) is the most common complication of osteoporosis [2]. The risk of VCF was increased with age [3]. Osteoporotic VCF (OVCF) is a leading cause of disability and morbidity in the elderly [4]. As the most common fractures in the elders with osteoporosis, it was occurred in 20% of people older than 70 years and in 16% of postmenopausal women [5]. It was reported that there were more than 700,000 osteoporotic VCFs per year in the United States and approximately 85% of these fractures were due to primary osteoporosis [6].

Traditional treatments for the patients with OVCF include bed rest, oral or parenteral analgesics, muscle relaxants, external back bracing, and physical therapy [7]. Because the narcotic agents and a variety of expensive spinal orthoses are commonly used in the traditional treatment [8], the effectiveness of them may be limited due to the high cost and the long-time treatment. Thus, finding a treatment with high efficacy and low cost is a major task in clinical study for OVCF.

Vertebroplasty (VP) is a minimally invasive technique in vertebral body lesion therapy. It was reported that VP could effectively

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treat pain and immobility which caused by VCF [9–12]. Although the efficacy and safety of VP is affirmed constantly [13–15], the disputes on the efficacy and complications of VP are still existed in recent studies. The study of Ploeg et al. reported that there were insufficient evidence to reliably assess efficacy of VP [16], while Blasco J et al. reported that VP achieved faster pain relief but was associated with a higher incidence in vertebral fractures. Therefore, we conducted a meta-analysis to statistically analyze the data from the recent studies in order to provide more reliable basis for the clinical efficacy of VP in treating OVCF.

2. Materials and methods

2.1. Search criteria and strategies

We retrieved the databases such as MEDLINE, EMBASE, EBSCO, Springer, Ovid and Cochrane library up to May 2012. The keywords included "vertebroplasty", "osteoporosis" and "vertebral compression fracture". The studies should meet the following inclusion criteria: (1) researches were clinical randomized controlled trials (RCTs) related to VP in the treatment of OVCF; (2) studies were published abroad; (3) the patients in experimental group should be treated with VP and the patients in the control group were treated by the traditional treatment including bed rest, oral anti-osteoporotic drugs and painkillers, wearing the spinal orthosis, reset, or functional exercise; (4) the Visual Analogue Scale (VAS) score for pain or/and complications were investigated. The studies were excluded if (1) the patients in the studies suffered cardiopulmonary dysfunction and other serious diseases, (2) there was no specific data except the curves of the indicators, (3) the patients were not confirmed by diagnosis and (4) the studies were non-RCTs.

2.2. Quality assessment and data extraction

Two investigators independently assessed the study quality and extracted the data. Disagreements were resolved by discussion. The study quality was evaluated based on the random allocation method, blind method and evaluation of withdrawal. The extracted data included general information (first author, year and region) and study characteristics (design, follow-up time, sample size, age and gender of subjects and the data of outcomes).

2.3. Statistical analysis

The meta-analysis was conducted using the Cochrane software RevMan 5.0. For continuous data, the weighted mean difference (WMD) and its 95% confidence interval (CI) were calculated. For dichotomous data, the odds ratio (OR) and the corresponding 95% CI were calculated. The *Z*-test was used for assessing the significance of the pooled OR and WMD, with $P < 0.05$ considered statistically significant. Heterogeneity among the included studies was evaluated by chi-square test and I^2 statistic. If no significantly heterogeneity ($P > 0.05$ or $I^2 < 50\%$) was found, the effect size was pooled based on the fixed-effects model. Otherwise, random-effects model was used.

3. Results

3.1. Literature search

After the initial search in the databases, a total of 1073 potentially relevant literature were identified. Then 12 articles were remained by omitting the duplicated and obviously irrelevant literature. Based on exclusion and inclusion criteria, two reviewers, one non-RCT and four literature which did not report the treatment of OVCF with VP were excluded. As a result, 5 literature were identified (Fig. 1).

3.2. Characteristics of included studies

According to the inclusion and exclusion criteria, a total of five eligible studies [17–21] were included in this meta-analysis. The published year was ranged from 2007 to 2012. All the included subjects were elders aged over 50 years old. The duration of follow-up in these studies was ranged from 2 weeks to 36 months. All the included studies were RCTs. Among them, the study of Farrokhi et al. [18] was a single-blind RCT and the study of Rousing et al. [20] was a double-blind RCT. The other three studies did not define the blind method (Table 1).

3.3. Statistical analysis

3.3.1. Comparison of VAS score

Two included studies [18,19] investigated the VAS score at one week after treatment. Fixed effects model was used because no significant heterogeneity was found ($P = 0.06$, $I^2 = 71\%$). The pooled estimate (WMD = −2.55, 95% CI: −3.08 to −2.02, $P < 0.00001$) showed that there was statistically significant difference between the experimental and control group. The result indicated that the VAS score of the patients in VP group were significantly lower than that in control group at one week after treatment (Fig. 2A).

The VAS score at 12 weeks after treatment was shown in two included studies [19,20]. There was no significant heterogeneity among the studies ($P = 0.18$, $I^2 = 44\%$), so fixed effects model was used. The pooled WMD (−0.90, 95% CI: −1.22 to −0.57, $P < 0.00001$) showed that the statistically significant difference was existed between the two groups. It suggested that the VAS score of patients in VP group was significantly lower than that in control group at 12 weeks after treatment (Fig. 2B).

Two included studies [18,19] involved in VAS score at 24 weeks after treatment. Fixed effects model was used for no significant heterogeneity between the studies ($P = 0.59$, $I^2 = 0\%$). The overall WMD was −1.75 (95% CI: −2.30 to −1.19, $P < 0.00001$), which showed the statistically significant difference between the two groups. It indicated that the VAS score of the patients in VP group was significantly lower compared with that in control group at 24 weeks after treatment (Fig. 2C).

A total of three studies [18–20] showed the VAS score at 48 weeks after treatment. Fixed effects model was used for no significant heterogeneity among the studies ($P = 0.06$, $I^2 = 65\%$). The pooled estimate (WMD = −1.12, 95% CI: −1.43 to −0.81, $P < 0.00001$) showed a statistically significant difference between

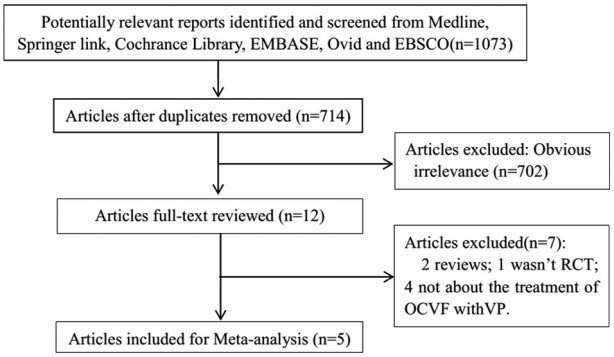

Fig. 1. The flow diagram of literature screening.