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Review

Does vertebral augmentation lead to an increasing incidence of adjacent vertebral failure? A systematic review and meta-analysis

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HIGHLIGHTS

- The technology of vertebral augmentation did not increase the incidence of new vertebral fractures in adjacent levels.
- No difference in the incidence of new vertebral fractures in adjacent levels between KP and VP for different observation.
- RCTs with large-scale samples, elaborate design and high-quality are urgently necessary.

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ABSTRACT

Background: The aim of the present study was to evaluate whether vertebral augmentation technology increases the occurrence of adjacent vertebral fractures in patients with osteoporotic vertebral compression fractures (OVCFs).

Materials and Methods: Databases, including MEDLINE, EMBASE and Cochrane library, were retrieved via PRISMA covering 1987 to 2015. The number of patients who suffered from adjacent secondary vertebral fractures was calculated. A meta-analysis, using indexes of odds ratios (OR) and 95% confidence intervals (95% CI), was conducted with STATA software. Subgroup investigations were conducted according to the operation methods and the duration of observation. Sensitivity analysis and publication bias were also evaluated.

Results: Ten randomized controlled trials (RCTs) met our inclusion criteria. Our results indicated there was no statistically significant difference in the occurrence rate of adjacent vertebral fractures between manipulation of vertebral augmentation and non-surgical treatment (OR = 0.89, 95% CI = 0.58–1.37). Neither subgroup investigations based on selection of operation nor duration of follow-up time showed marked differences. A sensitivity analysis did not identify specific trails seriously deflected. No obvious publication bias was identified.

Conclusion: Despite various limitations in the present study, our data demonstrated that using vertebral augmentation was not related to increasing incidence of subsequent adjacent vertebral fractures.

1. Introduction

Vertebral augmentation technology, which includes vertebroplasty (VP) and kyphoplasty (KP), has shown promising and encouraging outcomes in relieving pain, improving function and shortening recovery time during its wide use as a therapy for osteoporotic vertebral compression fractures (OVCFs) [1,2]. However, recent studies have questioned its efficacy and deemed it necessary to investigate the complications induced by vertebral augmentation, such as new vertebral fractures, cement leakage, and pulmonary and cerebral embolism [3–5].

New vertebral fracture following vertebral augmentation is one of the most serious postoperative complications and can greatly reduce therapeutic effectiveness. Subsequent fractures can occur at adjacent, non-adjacent or even previously treated vertebral levels [6]. Multiple basic and clinical studies have found that vertebral augmentation may increase the incidence of adjacent vertebral failure, which is supposed to be attributed to the alteration of the

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biomechanics of load transfer due to the increased stiffness of the managed vertebral bodies [7,8]. However, most clinical studies are retrospective analyses or other observational studies; high-quality randomized controlled trials (RCTs) specific to adjacent vertebral failure following vertebral augmentation are quite rare.

Recently, most of the evidence of adjacent vertebral fractures was always provided by supplementary results or adverse effects of clinical research concerning the intervention of VP or KP. Furthermore, recent systematic reviews or meta-analyses have provided some constructive information through exploring the relation between new vertebral fractures and vertebral augmentation operation [9–11]. However, none of these studies have detailed the influence on subsequent adjacent vertebral fractures. In this study, we explored, through the methodology of systematic review and meta-analysis, whether the augmentation technology increases the incidence of adjacent vertebral fractures.

2. Materials

2.1. Literature research and study selection

Two independent reviewers conducted a computerized retrieval in online databases, including MEDLINE, EMBASE and Cochrane library, by searching PRISMA for studies published from 1987 to September 2015. The following keywords were adopted for the research: osteoporotic vertebral fracture, vertebroplasty, kyphoplasty, vertebral augmentation, secondary fracture, subsequent fracture and conservative treatment. The studies were included if the research was limited to clinical randomized controlled trials (RCTs) using vertebral augmentation, including VP and KP. For the remedy of osteoporotic vertebral fractures, the location of the secondary vertebral fracture were recorded in detail. We also searched the references of the selected articles to avoid omitting any additional studies. No restrictions about the language were imposed when searching.

2.2. Eligibility criteria

Participants: Only adult patients diagnosed with osteoporotic vertebral compression fractures were included.

Interventions: The intervention for the experimental group was VP and KP.

Comparisons: The intervention for the control group was non-surgical treatment.

Outcomes: The occurrence rate of adjacent vertebral fractures.

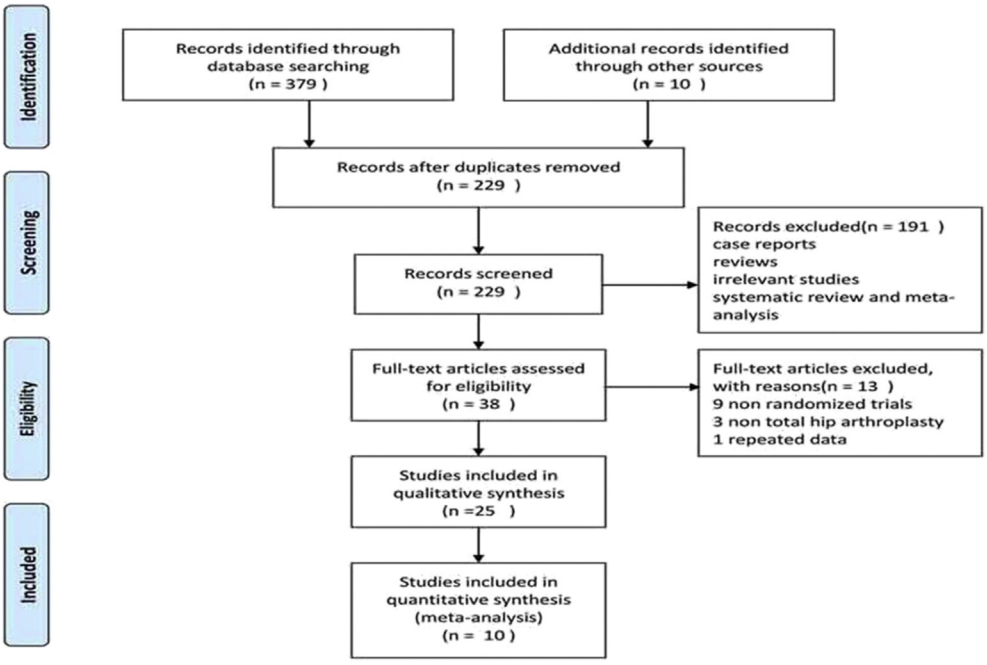

Fig. 1. Flow diagram of the study selection process on meta-analyses of new adjacent vertebral fractures after vertebral augment.

Table 1
Summary of characteristics of included studies.

Author	Year	Intervention	Study design	Follow-up	Sample size	Comparisons	Rate of successful follow-up
Blasco	2012	VP	RCT	≤6 months	125	conservative treatment	76%
Dong	2014	VP	RCT	>6 months	89	conservative treatment	92%
Farrokhi	2011	VP	RCT	>6 months	77	optimal medical therapy	93%
Jan	2013	KP	RCT	≤6 months	223	nonsurgical management	77%
Klazen	2010	VP	RCT	>6 months	176	conservative treatment	87%
Rachelle	2009	VP	RCT	≤6 months	71	sham procedure	91%
Rikke	2009	VP	RCT	≤6 months	47	conservative treatment	92%
Voormolen	2007	VP	RCT	≤6 months	34	pain medication	100%
Yi	2014	VP/KP	RCT	>6 months	290	conservative treatment	100%
Wardlaw	2009	KP	RCT	>6 months	210	non-surgical care	78%

Note: VP, vertebroplasty; KP, kyphoplasty; RCT, randomized controlled trial.