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Incidence and risk factors for new vertebral compression fractures following percutaneous vertebral augmentation: a systematic review and meta-analysis

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ADMINISTRATIVE INFORMATION

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Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 27 April 2024 and was last updated on 27 April 2024.

INTRODUCTION

Review question / Objective The purpose of this meta-analysis is to estimate the incidence and to identify predictive risk factors of new vertebral compression fractures following percutaneous vertebral augmentation.

Condition being studied Osteoporotic vertebral compression fractures (OVCFs) are the most prevalent complication arising from osteoporosis, posing a significant global public health challenge by detrimentally affecting both the quality of life and mortality rates. The condition is characterized by chronic pain, the development of kyphosis, and limitations on physical activity. Traditionally, the management of these fractures has predominantly been conservative, encompassing strategies such as bed rest, pain management with analgesics, and physical rehabilitation. Nevertheless, it is noteworthy that a substantial proportion, ranging from 35% to 41%, of cases managed through conservative means ultimately proved refractory to treatment.

METHODS

Participant or population Patients following percutaneous vertebral augmentation.

Intervention No intervention, because of observational studies.

Comparator Patients with new vertebral compression fractures, and without new vertebral compression fractures.

Study designs to be included Observational studies (Cohort and Case-control).

Eligibility criteria Inclusion criteria:(1) Observational studies written in English language; (2) A population of adult patients with initial OVCF underwent PVA more than 50;(3) Studies consisted of a clearly defined group of patients with OVCF;(4) Studies investigated the incidence and predictive risk factors of NVCF;(5) The follow-up period of at least 12 months.Exclusion criteria:(1) Implementing prophylactic vertebroplasty in patients with

osteoporosis;(2) Duplicate articles, reviews, case reports, letters, comments, editorials, and biomechanical studies.If multiple studies reported the same data set, we included studies with longer follow-ups and more detailed reporting of risk factors.

Information sources Comprehensive online database searches were performed on PubMed, EMBASE, the Cochrane Library, and Web of Sciences, which were published up to March 2024 with no lower date limit on the search results. The combination of keywords with Medical Subject Headings (MeSH) terms, if any, has been used for the PubMed search strategy, and appropriate changes have been made to the underlying search strategy to optimize it for each of the other databases. We also performed a manual search of the references in relevant articles to identify additional potentially eligible studies. This process was performed until no additional studies could be identified.

Main outcome(s) The incidence of new vertebral compression fractures, and all previous those for NVCFs were evaluated, including individual baseline factors (age, sex, and BMI), health and habit factors (hypertension, T2DM, history of steroid usage, use of NSAIDs, history of AOT, smoking status, and alcohol abuse), fracture factors (BMD, history of vertebral fractures, history of fractures, located in T-L junction, and multiple level fractures), surgical factors (cement volume, cement approach, cement distribution pattern, cement leakage, and intradiscal cement leakage), imaging factors (patterns of vertebral fractures, preoperative AVH/VWA/KA/AP ratio, restoration in AVH/CR/KA, IVC, NPEC, and HU value), and assessment indicators (preoperative VAS/ODI, postoperative VAS/ODI, and serum 25(OH)D).

Quality assessment / Risk of bias analysis Methodological quality was rated independently by reviewers (ZBW and TYZ) according to the Newcastle-Ottawa Quality Assessment Scale (NOS) for cohort and case-control studies. The NOS is divided into three sections: selection, comparability, and outcome/exposure, which is graded using the star method, with a maximum of 9 stars awarded across the three domains11. The included studies' overall methodologic integrity was classified as having a low risk of bias (7-9 NOS points), a moderate risk of bias (4-6 NOS points), or a high risk of bias (0-3 NOS points). The "robvis" package (version 0.3.0) in RStudio software was used to outline the risk of bias.
The level of inter-rater agreement was measured using Cohen's kappa coefficient (k) with 95% confidence intervals. Any discrepancies in NOS scores were resolved through discussions until consensus was achieved.

Strategy of data synthesis Since all the included studies had clinical homogeneity (ie, observational studies comparing people with and without NVCFs), they were suitable for inclusion in the meta-analysis. All statistical analyses were conducted using RStudio 2023.12.1+402 and R, version 4.3.3 (R Core Team (2024). R Foundation for Statistical Computing, Vienna, Austria.). Meta-analysis was performed by pooling the mean ± standard deviation (SD) for continuous variables, and by pooling frequencies and percentages for categorical variables separately. Summary statistics were expressed as weighted mean difference (WMD), odds ratio (OR), and 95% confidence interval (CI). Statistical heterogeneity was assessed using the I2 statistic, with I2 > 50% representing significant heterogeneity. All statistical tests were 2-tailed, and the statistical significance threshold was $P < 0.05$.

Subgroup analysis To explore the sources of between-study heterogeneity, we conducted multiple subgroup analyses of the outcomes, which were conducted and stratified by average participant age at surgery (65-70 years, 70-75 years, and >75 years), and NVCF definition ("augmented vertebral fractures", and "adjacent and remote vertebral fractures").

Sensitivity analysis Sensitivity analyses were performed to assess the stability of the results by the Jackknife (leave-one-out) strategy to estimate the impact of an individual study on the combined outcomes.

Language restriction English.

Country(ies) involved China.

Keywords osteoporotic vertebral compression fractures; percutaneous vertebral augmentation; new vertebral compression fractures; incidence; risk factors.

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