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Different management strategies in spinal infection after Vertebroplasty or Kyphoplasty A Systematic Review and meta-analysis

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ADMINISTRATIVE INFORMATION**Support** - No support.**Review Stage at time of this submission** - The review has not yet started.**Conflicts of interest** - None declared.**INPLASY registration number:** INPLASY202680031**Amendments** - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 6 August 2026 and was last updated on 6 August 2026.**INTRODUCTION**

Review question / Objective To systematically compare the efficacy of four management strategies (conservative treatment, anterior-only surgical debridement, posterior-only surgical debridement, combined anterior-posterior debridement) in patients with spinal infection following vertebroplasty (PVP) or kyphoplasty (PKP). Primary outcomes included postoperative VAS pain score and ODI functional score; secondary outcomes covered pathogen distribution, neurological recovery, all-cause mortality and postoperative adverse events.

Rationale PVP/PKP are widely applied for osteoporotic vertebral compression fractures, while postoperative spinal infection is a rare but severe complication with high disability and mortality. No unified consensus exists regarding optimal surgical approach for infectious lesions. This meta-analysis pooled real-world observational data to quantify pain and functional improvement among different treatment strategies, providing

clinical evidence for individualized surgical decision-making.

Condition being studied Spinal infection secondary to percutaneous vertebroplasty (PVP) or percutaneous kyphoplasty (PKP), including early-onset infection (2 months). Pathogens covered pyogenic bacteria and *Mycobacterium tuberculosis*.

METHODS

Search strategy This systematic review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) Statement. A comprehensive literature search was performed in PubMed, Embase, Web of Science, China National Knowledge Infrastructure (CNKI) and Wanfang Database to identify all potentially eligible studies published between January 1, 2000, and May 31, 2026. The final literature search was completed on May 31, 2026. Based on the different database conditions, a combined retrieval of subject terms

and free words was conducted to ensure the comprehensiveness and completeness of the search. The search terms mainly included “Vertebroplasty”, “Kyphoplasty”, “vertebral augmentation”, “balloon kyphoplasty”, “Spondylitis”, “Osteomyelitis”, “spinal infection”, “Tuberculosis, Spinal”, “Disease Management”, “Therapeutics”, “surgical debridement”, “treatment”. The reference lists of all eligible studies and relevant review articles were manually screened to identify additional potentially eligible publications. All retrieved records were imported into EndNote 21 for duplicate removal before title and abstract screening.

Participant or population Adult patients (≥ 50 years old) diagnosed with spinal infection after receiving PVP or PKP, with complete baseline and follow-up outcome data (VAS/ODI scores, treatment grouping, clinical prognosis). Exclude pediatric patients, spinal infection unrelated to PVP/PKP, incomplete outcome data.

Intervention Four management groups:
Conservative treatment: long-term intravenous antibiotic therapy without surgical debridement;
Anterior-only approach: single anterior debridement, fusion and internal fixation;
Posterior-only approach: single posterior debridement, vertebral resection, bone graft and instrumentation;
Combined anterior-posterior approach: two-stage or one-stage anterior debridement plus posterior fixation.

Comparator Pairwise comparison among conservative treatment, anterior-only, posterior-only and combined anterior-posterior surgical groups.

Study designs to be included Retrospective cohort studies, retrospective case series, retrospective comparative studies. Exclude case reports, review articles, conference abstracts without raw quantitative data, animal experiments.

Eligibility criteria Inclusion: (1) Human adults with confirmed PVP/PKP postoperative spinal infection; (2) Clearly reported grouping of treatment strategies; (3) Documented preoperative and postoperative VAS/ODI scores with mean and standard deviation; (4) Full-text English/Chinese articles published before August 2026.
Exclusion: (1) Single case report (< 3 infected patients); (2) No available quantitative pain/functional data; (3) Duplicate published cohort; (4) Non-spinal infection after PVP/PKP.

Information sources Electronic databases: PubMed, Embase, Cochrane Library, Web of Science, CNKI, Wanfang. Grey literature: conference abstracts, clinical trial registries. Reference lists of included literatures were manually screened for additional eligible studies. Electronic databases: PubMed, Embase, Web of Science, CNKI, Wanfang, VIP Chinese database. Grey literature: conference abstracts, clinical trial registries. Reference lists of included literatures were manually screened for additional eligible studies.

Main outcome(s) 1. Postoperative Visual Analogue Scale (VAS) pain score at final follow-up (continuous variable, weighted mean difference WMD as effect size);
2. Postoperative Oswestry Disability Index (ODI) score (continuous variable, WMD).

Additional outcome(s) Pathogen distribution, neurological function improvement rate, all-cause follow-up mortality, incidence of postoperative adverse events, interval time from index surgery to infectious onset.

Data management Two independent reviewers screened literatures, extracted raw data into standardized Excel form. Disagreements resolved by third senior orthopedic researcher. Quantitative meta-analysis performed via Stata 19.0 software.

Quality assessment / Risk of bias analysis The JBI Critical Appraisal Checklist for Case Series and Cohort Studies was adopted to assess the methodological quality and risk of bias of all included retrospective observational studies. Each item of the JBI checklist was scored as “yes”, “unclear” or “no”. Studies with a total JBI score less than 60% of the maximum attainable score were regarded as having a high risk of bias.

Strategy of data synthesis Continuous outcomes (VAS score, ODI score) were pooled with weighted mean difference (WMD) and 95% confidence interval (CI). Heterogeneity was assessed via I^2 statistic; $I^2 > 50\%$ indicated substantial heterogeneity, and random-effect model was adopted; $I^2 \leq 50\%$ indicated low heterogeneity, and fixed-effect model was used for pooling. For descriptive qualitative synthesis of pathogen distribution, mortality and complication data without stratified quantitative values, narrative summary was performed.

Subgroup analysis Subgroup analysis was not performed. The number of included studies for each pairwise comparison was less than 10, which

led to insufficient statistical power for valid subgroup stratification.

Sensitivity analysis Sensitivity analysis was performed by sequentially excluding individual studies to test the stability of the pooled WMD results for VAS and ODI scores.

Language restriction China, South Korea, Germany, Taiwan (China).

Country(ies) involved China.

Keywords Vertebroplasty; Kyphoplasty; Spinal infection; Anterior approach; Posterior approach; Combined anterior-posterior; Conservative treatment; VAS score; ODI score; Meta-analysis.

Contributions of each author

Author 1 - Jin Qin - Conceptualization, study design, literature retrieval, data extraction, statistical meta-analysis, manuscript drafting, revision and final approval of the manuscript.

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Author 2 - Jian Li - Literature screening, data verification, partial manuscript revision, figure and table arrangement, final approval of the manuscript.

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Author 3 - Jianbo Yang - Quality assessment of included studies using JBI checklist, rational discussion polishing, language modification, final approval of the manuscript.

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