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Comparative Effectiveness of Different Osteotomy Techniques for Hallux Valgus: A Systematic Review and Network Meta-analysis of Randomized Controlled Trials

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ADMINISTRATIVE INFORMATION**Support** - There was no financial support for this study.**Review Stage at time of this submission** - Completed but not published.**Conflicts of interest** - None declared.**INPLASY registration number:** INPLASY202690069

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 15 September 2026 and was last updated on 15 September 2026.

INTRODUCTION

Review question / Objective To compare the effectiveness and safety of commonly used osteotomy techniques for hallux valgus in adults using evidence from randomized controlled trials. The review will evaluate four prespecified surgical categories: open distal Chevron/Austin osteotomy, open Scarf osteotomy, minimally invasive/percutaneous osteotomy, and traditional open distal osteotomy. The primary outcomes are the American Orthopaedic Foot and Ankle Society (AOFAS) score, postoperative hallux valgus angle (HVA), postoperative first-second intermetatarsal angle (IMA), and infection/wound-related complications. A frequentist network meta-analysis will be used to integrate direct and indirect evidence and compare the relative effects of these surgical techniques.

Condition being studied Hallux valgus is a common forefoot deformity characterized by lateral deviation of the great toe and medial

deviation of the first metatarsal, often accompanied by pain, functional impairment, and difficulty with footwear. Surgical treatment is generally considered when symptoms persist despite conservative management. Numerous osteotomy techniques have been developed, including open distal Chevron/Austin osteotomy, Scarf osteotomy, minimally invasive/percutaneous osteotomy, and traditional open distal osteotomies. However, the relative effectiveness and safety of these procedures remain uncertain.

METHODS

Participant or population Adult patients with hallux valgus undergoing surgical correction. Participants with mild, moderate, or severe hallux valgus were eligible, provided that they were enrolled in a randomized controlled trial comparing at least two eligible osteotomy techniques. No restrictions were applied based on sex.

Intervention Eligible interventions were classified into four prespecified osteotomy categories: open distal Chevron/Austin osteotomy, open Scarf osteotomy, minimally invasive/percutaneous osteotomy, and traditional open distal osteotomy. Minimally invasive/percutaneous procedures included techniques such as SERI, MICA, PECA, MITO, percutaneous Chevron, and minimally invasive Scarf. Traditional open distal osteotomies included Mitchell, Wilson, Lindgren, and Lindgren–Turan procedures. Each eligible surgical category could serve as either an intervention or comparator within the treatment network.

Comparator Eligible comparators were any of the other prespecified osteotomy categories within the treatment network: open distal Chevron/Austin osteotomy, open Scarf osteotomy, minimally invasive/percutaneous osteotomy, and traditional open distal osteotomy. Because this was a network meta-analysis, no single comparator was designated; each eligible surgical category could serve as a comparator depending on the direct comparison reported in the randomized controlled trial.

Study designs to be included Randomized controlled trials (RCTs) comparing at least two eligible osteotomy techniques for hallux valgus were included. Nonrandomized studies, observational studies, case series, reviews, conference records without full-text results, trial registrations without reported outcomes, biomechanical studies, and studies without extractable outcome data were excluded.

Eligibility criteria Additional eligibility criteria were as follows: studies were required to have a minimum follow-up duration of 6 months and to report at least one prespecified outcome with extractable data. Conference records without full-text results, trial registrations without reported results, biomechanical studies, and studies from which usable outcome data could not be obtained were excluded.

Information sources PubMed, Embase, Web of Science, and the Cochrane Library were searched from inception to May 21, 2026. The search combined controlled vocabulary terms and free-text terms related to hallux valgus, osteotomy techniques, minimally invasive/percutaneous surgery, open surgery, and randomized controlled trials.

Main outcome(s) The main outcomes were the American Orthopaedic Foot and Ankle Society (AOFAS) score, postoperative hallux valgus angle

(HVA), postoperative first-second intermetatarsal angle (IMA), and infection/wound-related complications. For studies reporting outcomes at multiple follow-up time points, data at 12 months postoperatively were preferentially extracted; when 12-month data were unavailable, the time point closest to 12 months that met the prespecified minimum follow-up of 6 months was used. Continuous outcomes (AOFAS, HVA, and IMA) were summarized using mean differences (MDs) with 95% confidence intervals (CIs), whereas infection/wound-related complications were summarized using risk ratios (RRs) with 95% CIs.

Quality assessment / Risk of bias analysis The risk of bias of the included randomized controlled trials was assessed at the outcome level using the Cochrane Risk of Bias 2 (RoB 2) tool. Five domains were evaluated: bias arising from the randomization process, bias due to deviations from intended interventions, bias due to missing outcome data, bias in measurement of the outcome, and bias in selection of the reported result. Each domain and the overall risk of bias were judged as low risk, some concerns, or high risk. Two reviewers independently performed the assessments, and disagreements were resolved through discussion, with consultation of a third reviewer when necessary.

Strategy of data synthesis A frequentist random-effects network meta-analysis will be performed using the meta and netmeta packages in R version 4.5.1. Continuous outcomes will be summarized as mean differences (MDs) and dichotomous outcomes as risk ratios (RRs), both with 95% confidence intervals. Heterogeneity will be assessed using τ^2 and I^2 . Global and local inconsistency will be evaluated using the design-by-treatment interaction model and node-splitting analyses, respectively. Treatment rankings will be based on P-scores. Sensitivity analyses will include exclusion of studies with estimated standard deviations, the bilateral paired-foot study, minimally invasive surgical subtypes, and double-zero-event studies; odds ratios will also be used for infection/wound-related complications.

Subgroup analysis No formal subgroup analyses were planned or performed because of the limited number of studies within individual treatment comparisons. Potential sources of clinical heterogeneity were instead explored through sensitivity analyses, including separate exclusion of different minimally invasive surgical subtypes.

Sensitivity analysis Sensitivity analyses will be conducted to assess the robustness of the primary

findings. These will include exclusion of studies with estimated standard deviations, exclusion of the bilateral paired-foot study, use of odds ratios instead of risk ratios for infection/wound-related complications, and exclusion of double-zero-event studies. Additional analyses will sequentially exclude different minimally invasive surgical subtypes. The robustness of treatment-node definitions will also be examined through alternative node-classification scenarios. Changes in effect estimates, heterogeneity, inconsistency, and treatment rankings will be evaluated across sensitivity analyses.

Country(ies) involved China.

Keywords hallux valgus; osteotomy; minimally invasive surgery; network meta-analysis; randomized controlled trial.

Contributions of each author

Author 1 - Lei Zhang - contributed to the study conception and design, literature search, data extraction, statistical analysis, visualization, and drafting of the manuscript.

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