INPLASY

Arthroscopic-Assisted Versus Open Reduction and Internal Fixation in Schatzker Type I–III Tibial Plateau Fractures: A Meta-Analysis

INPLASY202660126

doi: 10.37766/inplasy2026.6.0126

Received: 26 June 2026

Published: 26 June 2026

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ADMINISTRATIVE INFORMATION

Support - This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Review Stage at time of this submission - Completed but not published.

Conflicts of interest - None declared.

INPLASY registration number: INPLASY202660126

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 26 June 2026 and was last updated on 26 June 2026.

INTRODUCTION

Review question / Objective The primary objective of this meta-analysis is to provide a quantitative evaluation of the comparative clinical effectiveness of ARIF and ORIF in treating Schatzker type I–III tibial plateau fractures. We hypothesised that, compared with ORIF, ARIF would yield superior functional outcomes and a lower perioperative complication rate in these fracture types. Key endpoints included functional outcomes and perioperative complication rates. By integrating currently available data, this study intends to offer higher-quality evidence to inform clinical decision-making for patients with Schatzker-type I–III tibial plateau fractures.

Condition being studied Tibial plateau fractures are common intra-articular knee fractures in clinical practice. Mechanisms of injury are closely related to age, with fractures in young and middle-aged patients usually caused by trauma and those in elderly patients more often the result of falls.

METHODS

Search strategy A comprehensive search for potentially relevant studies was performed across five electronic databases: PubMed, Embase, the Cochrane Library, Web of Science and the China National Knowledge Infrastructure. The search encompassed all records from database inception up to November 2025. Initial search procedures applied no restrictions regarding publication language.The overarching search strategy for each database was designed and independently reviewed by a senior medical information specialist to optimise sensitivity and comprehensiveness.
The literature search was designed to purposefully identify true directly comparing ARIF and ORIF in the surgical management of tibial plateau fractures. Controlled vocabulary terms (including Medical Subject Headings and Emtree terms, where applicable) were combined with free-text keywords encompassing three principal concepts: tibial plateau fractures, arthroscopic or minimally invasive techniques and open reduction with

internal fixation. These terms were further combined with an established methodological filter designed to identify randomised and controlled clinical trials.

Participant or population Patients who have undergone surgery for tibial plateau fractures.

Intervention Studies involving adult patients (aged ≥18 years) presenting with closed, low-energy tibial plateau fractures of Schatzker type I, II or III; studies that used ARIF as the intervention.

Comparator Studies that used conventional ORIF as the comparator.

Study designs to be included The literature search was designed to purposefully identify true directly comparing ARIF and ORIF in the surgical management of tibial plateau fractures. Controlled vocabulary terms (including Medical Subject Headings and Emtree terms, where applicable) were combined with free-text keywords encompassing three principal concepts: tibial plateau fractures, arthroscopic or minimally invasive techniques and open reduction with internal fixation. These terms were further combined with an established methodological filter designed to identify randomised and controlled clinical trials.

Eligibility criteria The inclusion criteria for the included studies were as follows: (1) RCTs; (2) studies involving adult patients (aged ≥18 years) presenting with closed, low-energy tibial plateau fractures of Schatzker type I, II or III; (3) studies that used ARIF as the intervention; (4) studies that used conventional ORIF as the comparator; and (5) studies that reported at least one of the following pre-specified outcomes:

- the proportion of patients achieving 'excellent' or 'good' functional results based on validated knee scoring systems (i.e. Rasmussen, Hospital for Special Surgery [HSS] or Lysholm)
- the incidence of perioperative complications (e.g. surgical site infection, wound dehiscence, haematoma, deep vein thrombosis, compartment syndrome, joint stiffness and revision surgery).

The exclusion criteria were as follows: (1) studies with noncomparative designs, such as case reports, case series, narrative reviews and editorial commentaries; (2) studies that included open or pathological fractures; (3) studies that enrolled paediatric populations or animal models; (4) duplicate publications or studies lacking sufficient data for quantitative extraction; (5) studies for which the full-text article was unavailable in either English or Chinese; and (6) studies that included cases with pre-existing tibial or knee pathologies, including prior ipsilateral tibial fractures, bone tumours, chronic infection/osteomyelitis and pre-existing knee osteoarthritis.

Information sources A comprehensive search for potentially relevant studies was performed across five electronic databases: PubMed, Embase, the Cochrane Library, Web of Science and the China National Knowledge Infrastructure. The search encompassed all records from database inception up to November 2025. Initial search procedures applied no restrictions regarding publication language.

The literature search was designed to purposefully identify true directly comparing ARIF and ORIF in the surgical management of tibial plateau fractures. Controlled vocabulary terms (including Medical Subject Headings and Emtree terms, where applicable) were combined with free-text keywords encompassing three principal concepts: tibial plateau fractures, arthroscopic or minimally invasive techniques and open reduction with internal fixation. These terms were further combined with an established methodological filter designed to identify randomised and controlled clinical trials.

Main outcome(s) The systematic search of the five databases initially identified 10,682 records, with no further studies added through manual searches. Following deduplication, 10,014 records underwent title and abstract screening, and 9,894 were excluded on this basis. The remaining 120 articles proceeded to full-text assessment. Of the 120 full-text articles assessed, 82 were excluded in the first round – 58 for lacking a comparative design, 22 that were not RCTs and 2 that were published in languages other than English or Chinese. The remaining 38 articles underwent further detailed review. In this second round of review, an additional 20 articles were excluded because their interventions did not meet the prespecified inclusion criteria (n = 19) or their outcomes did not include the prespecified dichotomous functional outcome results or complication rates (n = 1). Eighteen studies ultimately satisfied all the inclusion criteria and were selected for both qualitative synthesis and meta-analysis.

Quality assessment / Risk of bias analysis Two reviewers using the revised Cochrane risk-of-bias tool (RoB 1.0) independently assessed the methodological rigour of the randomised studies. Evidence certainty rating for primary outcomes was performed using the GRADE framework [9]. Evidence originating from randomised trials was

initially adjudged high certainty but downgraded if warranted by predefined GRADE considerations.

Strategy of data synthesis Data synthesis and all meta-analyses were performed using RevMan 5.3 (Nordic Cochrane Centre, Copenhagen, Denmark) and StataSE 17.0 (StataCorp LP, College Station, TX, USA). For dichotomous variables, pooled odds ratios (ORs), accompanied by 95% confidence intervals (CIs), were calculated. The degree of heterogeneity across studies was assessed, with a p-value 50% deemed to represent substantial heterogeneity. If substantial heterogeneity (I^2 > 50%) was detected, subgroup analyses were planned to explore potential sources of clinical heterogeneity. Anticipating inherent clinical and methodological diversity, random-effects models were applied to all meta-analytic comparisons to generate conservative summary estimates. Outcomes involving ten or more studies were further subjected to publication bias assessment through funnel plot examination and formal statistical tests (Egger's and Begg's methods). Risk-of-bias assessments were presented as graphical summaries generated by the RevMan software.

Subgroup analysis Data synthesis and all meta-analyses were performed using RevMan 5.3 (Nordic Cochrane Centre, Copenhagen, Denmark) and StataSE 17.0 (StataCorp LP, College Station, TX, USA). For dichotomous variables, pooled odds ratios (ORs), accompanied by 95% confidence intervals (CIs), were calculated. The degree of heterogeneity across studies was assessed, with a p-value 50% deemed to represent substantial heterogeneity. If substantial heterogeneity (I^2 > 50%) was detected, subgroup analyses were planned to explore potential sources of clinical heterogeneity. Anticipating inherent clinical and methodological diversity, random-effects models were applied to all meta-analytic comparisons to generate conservative summary estimates. Outcomes involving ten or more studies were further subjected to publication bias assessment through funnel plot examination and formal statistical tests (Egger's and Begg's methods). Risk-of-bias assessments were presented as graphical summaries generated by the RevMan software.

Sensitivity analysis Leave-one-out sensitivity analyses were performed to assess the robustness of the pooled results for both primary outcomes (excellent/good functional outcome rates and perioperative complication rates). In these analyses, each individual study was sequentially omitted, and the remaining studies were repooled using the same random effects model. The stability of the pooled OR and its associated 95% CI was examined visually using forest plots of the leave-one-out estimates.

Country(ies) involved China; Croatia.

Keywords tibial fractures, arthroscopy, internal fixation, randomised controlled trials, clinical outcomes.

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Author 2 - Zelin Huang.
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