Interventions for Treating Olecranon Fractures in Adults: Protocol for a Systematic Review and Meta-analysis of Randomized Controlled Trials

Intervenções para o tratamento de fraturas do olécrano em adultos: Protocolo para uma revisão sistemática e metanálise de estudos clínicos randomizados

Daniel Andrade Coelho[1,2] Jorge Sayum Filho[1] João Carlos Belloti[1] Marcel Jun Tamaoki[1]

[1] Department of Orthopedics and Traumatology, Escola Paulista de Medicina, Universidade Federal de São Paulo, São Paulo, SP, Brazil
[2] Department of Orthopedics and Traumatology, Hospital Universitário Ciências Médicas de Minas Gerais, Belo Horizonte, MG, Brazil

Address for correspondence Daniel Andrade Coelho, MD, Departamento de Ortopedia e Traumatologia, Escola Paulista de Medicina, Universidade Federal de São Paulo (UNIFESP)., Rua Borges Lagoa, 786, Vila Clementino, CEP: 04038-002, São Paulo, SP, Brazil (e-mail: ac.daniel37@gmail.com).

Rev Bras Ortop 2026;61(4):s00461829417.

Abstract

Objective To compare the effectiveness and safety of treatments for adult olecranon fractures, including conservative and surgical approaches, using a systematic review and meta-analysis.

Methods The present protocol follows the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) guidelines and is registered in the International Prospective Register of Systematic Reviews (PROSPERO; CRD42024520697). Randomized controlled trials evaluating surgical and nonsurgical interventions for acute olecranon fractures in adults will be included. A comprehensive search was conducted in MEDLINE, Excerpta Medica dataBASE (EMBASE), Cochrane Central Register of Controlled Trials (CENTRAL), Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS), and Scientific Electronic Library Online (SciELO) on June 21, 2025, with an updated search planned prior to submission of the final manuscript. Study selection, data extraction, and risk of bias assessment will be performed independently by two reviewers using the Risk of Bias 2 (RoB 2) tool. Primary outcomes will include functional outcomes, according to the Disabilities of the Arm, Shoulder and Hand questionnaire (DASH), its short form QuickDASH, or the Mayo Elbow Performance Score (MEPS), as well as treatment-related complications and pain. Two prespecified primary comparisons will be performed: operative versus

Keywords
- conservative treatment
- elbow fractures
- meta-analysis
- olecranon fractures
- orthopedic procedures
- systematic review

The present study was performed at the Department of Orthopedics and Traumatology, Escola Paulista de Medicina, Federal University of São Paulo, São Paulo, SP, Brazil.

received
February 7, 2026
accepted
July 15, 2026

DOI https://doi.org/10.1055/s-0046-1829417.
ISSN 0102-3616.

Editor-in-Chief: Geraldo da Rocha Motta Filho.

© 2026. The Author(s).
This is an open access article published by Thieme under the terms of the Creative Commons Attribution 4.0 International License, permitting copying and reproduction so long as the original work is given appropriate credit (https://creativecommons.org/licenses/by/4.0/)

Thieme Revinter Publicações Ltda., Rua Rego Freitas, 175, loja 1, República, São Paulo, SP, CEP 01220-010, Brazil

nonoperative management, and tension band wiring versus plate fixation. Meta-analyses will be conducted using a random-effects model, and the certainty of evidence will be assessed using Grading of Recommendations, Assessment, Development, and Evaluation (GRADE).

Planned Analyses Study selection will be summarized using a PRISMA 2020 flow diagram. Quantitative synthesis will be performed where studies are sufficiently homogeneous; otherwise, results will be presented using narrative synthesis. Subgroup analyses will be conducted according to fracture classification and participants' characteristics, including age group, when data are available. Sensitivity analyses will be performed to assess the robustness of findings by excluding studies at high risk of bias or with incomplete outcome data.

Resumo

Objetivo Comparar a eficácia e a segurança dos tratamentos de fraturas do olécrano em adultos, incluindo abordagens conservadoras e cirúrgicas, por meio de uma revisão sistemática e metanálise.

Métodos Este protocolo segue as diretrizes Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) e está registrado no International Prospective Register of Systematic Reviews (PROSPERO; CRD42024520697). Serão incluídos estudos clínicos randomizados que avaliem intervenções cirúrgicas e não cirúrgicas para tratamento de fraturas agudas do olécrano em adultos. Uma busca abrangente foi realizada nas bases Excerpta Medica dataBASE (EMBASE), Cochrane Central Register of Controlled Trials (CENTRAL), Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS), e Scientific Electronic Library Online (SciELO), em 21 de junho de 2025; uma busca de atualização está planejada para ser feita antes da submissão do manuscrito final. A seleção dos estudos, extração de dados e avaliação do risco de viés serão realizadas de forma independente por dois revisores, utilizando a ferramenta Risk of Bias 2 (RoB 2). Os desfechos primários incluirão desfechos funcionais, com base nos questionários Disabilities of the Arm, Shoulder and Hand (DASH), sua versão abreviada QuickDASH, ou Mayo Elbow Performance Score (MEPS), assim como complicações relacionadas ao tratamento e dor. Serão realizadas duas comparações primárias pré-especificadas: tratamento cirúrgico versus não cirúrgico e fixação com banda de tensão versus fixação com placa. As metanálises serão conduzidas usando um modelo de efeitos aleatórios, com avaliação da certeza da evidência pelo sistema Grading of Recommendations Assessment, Development and Evaluation (GRADE).

Análises Planejadas A seleção dos estudos será resumida em um fluxograma PRISMA 2020. A síntese quantitativa será realizada quando os estudos apresentarem homogeneidade suficiente; caso contrário, os resultados serão apresentados por meio de síntese narrativa. Análises de subgrupos serão conduzidas de acordo com a classificação da fratura e as características dos participantes, incluindo a faixa etária, quando os dados estiverem disponíveis. Análises de sensibilidade avaliarão a robustez dos achados, excluindo estudos com alto risco de viés ou com dados incompletos sobre os desfechos.

Palavras-chave
- fratura do olécrano
- fraturas do cotovelo
- metanálise
- procedimentos ortopédicos
- revisão sistemática
- tratamento conservador

Introduction

Olecranon fractures are a common elbow injury, accounting for around 18% of proximal forearm fractures, with an incidence of 12 per 100 thousand per year.[1] These fractures are more prevalent in patients over 65-years-old, predominantly in women, who represent 65% of all cases in this age group.[2]

Among the different fracture patterns, displaced fractures with a simple configuration, classified as Mayo Elbow

Table 1 Eligibility criteria according to the PICO framework

Domain	Criteria
Population	Adults (≥ 18 years) with acute olecranon fractures (≤3 weeks from injury)
Intervention	Any surgical or nonsurgical treatment for olecranon fractures, including TBW and its variants, plate-and-screw fixation, intramedullary devices, transosseous sutures, immobilization, and early mobilization protocols
Comparison	Any comparison, including different surgical techniques, different non-surgical approaches, or surgical versus nonsurgical treatment
Outcomes	Functional outcomes, treatment-related complications, pain, ROM, patient satisfaction, radiographic outcomes, intraoperative parameters, and economic outcomes (see ►**Table 2**)

Abbreviations: PICO, population, intervention, comparison, and outcome; ROM, range of motion; TBW, tension band wiring.

Performance Score (MEPS) type IIA, are the most common.[3] These injuries are traditionally managed surgically, most often using the tension band wiring (TBW) technique. However, this method has been consistently associated with a high rate of complications, including implant prominence, soft tissue irritation, and the need for reoperation.[4] This complication profile has led to the investigation of alternative surgical fixation techniques, such as plate fixation, transosseous sutures, and intramedullary devices, as well as renewed interest in conservative management for fracture patterns previously considered clear indications for surgery.

In 2014, a Cochrane systematic review evaluating surgical interventions for olecranon fractures in adults highlighted the limited availability of high-quality evidence comparing different operative techniques and exclusively assessed surgical treatments.[5] Since then, an increasing number of randomized controlled trials (RCTs) have been published. These studies have compared different surgical techniques with one another, along with nonsurgical approaches, with a focus on functional outcomes, complication rates, and patient satisfaction across a range of fracture patterns and patient populations.[6,7]

Despite this growing body of literature, systematic reviews based exclusively on RCTs and directly comparing both conservative and surgical treatment strategies remain scarce. Many existing reviews include heterogeneous study designs or rely on narrative synthesis, limiting the certainty of evidence and its applicability to clinical decision-making.

Given the expanding evidence base and persistent lack of consensus on optimal management strategies, an updated and methodologically rigorous synthesis is warranted.

The objective of this systematic review is to identify, evaluate, and compare the effectiveness and safety of the main current treatment options for adult olecranon fractures, including conservative and surgical approaches, with emphasis on functional outcomes, treatment-related complications, pain, and patient satisfaction.

Methods

This protocol describes a systematic review and meta-analysis conducted in accordance with the Cochrane Handbook for Systematic Reviews of Interventions and reported following the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P).[8] The review is registered in the International Prospective Register of Systematic Reviews (PROSPERO- CRD42024520697).

Regarding eligibility criteria (►**Tables 1**–**2**), Only randomized controlled trials (RCTs) evaluating treatments for olecranon fractures in adults will be included. Eligible studies will involve patients aged 18 years or older, with acute olecranon fractures, defined as fractures occurring within 3 weeks of injury.

Any surgical or nonsurgical intervention will be considered. Surgical techniques may include, but are not limited to, TBW, plate fixation, intramedullary devices, and transosseous sutures. Nonsurgical approaches may include immobilization methods and early mobilization protocols. Comparisons may involve different surgical techniques, different nonsurgical approaches, or surgical versus nonsurgical treatments.

Studies will be excluded if they involve pediatric populations, nonrandomized designs, pathological fractures, revision surgeries, nonunion, animal or laboratory research, or of they are not available as full-text articles.

Outcomes will be classified as primary and secondary (►**Table 2**). Primary outcomes will include: (a) patient-reported function, assessed preferentially using the disabilities of the arm, shoulder, and hand (DASH) questionnaire or its shortened version (QuickDASH); when these are not available, the Mayo elbow performance score (MEPS) will be used as an alternative, with DASH/QuickDASH and MEPS analyzed as separate outcomes and not pooled together given their different constructs; (b) treatment-related complications, as detailed below; and (c) pain intensity, assessed using validated instruments such as the visual analogue scale (VAS) or numeric rating scale (NRS), as reported by each study.[9–11]

Treatment-related complications will include all adverse events described in the original trials, with particular attention to reoperations, infections (superficial or deep), implant-related complications (e.g., prominence, migration, or failure), and loss of fracture reduction. Reoperations will be analyzed as two distinct outcomes: symptomatic hardware removal, defined as elective implant removal due to prominence, pain, or soft tissue irritation in the absence of mechanical failure; and revision surgery for treatment failure, defined as any unplanned reoperation due to loss of reduction, fixation failure, deep infection, or nonunion.

Table 2 Summary of outcomes, preferred measurement instruments, and classification

Classification	Outcome	Preferred instrument	Time points
Primary	Patient-reported function	DASH or QuickDASH; MEPS if DASH unavailable	Short-, medium-, and long-term
Primary	Treatment-related complications	As reported; disaggregated into symptomatic hardware removal and revision surgery for treatment failure	All available
Primary	Pain intensity	VAS (0–10) or NRS; as reported	Short-, medium-, and long-term
Secondary	Elbow ROM	Goniometry (degrees)—flexion, extension, pronation, supination	Short-, medium-, and long-term
Secondary	Patient satisfaction	As reported, including esthetic satisfaction	Long-term
Secondary	Radiographic outcomes	Fracture union, maintenance of reduction, alignment,	All available
Secondary	Operative time	Minutes	Intraoperative
Secondary	Estimated blood loss	Milliliters (mL)	Intraoperative
Secondary	Economic outcomes	Direct and indirect costs; cost-effectiveness data	When reported

Abbreviations: DASH, disabilities of the arm, shoulder, and hand; MEPS, minimum energy performance standards; NRS, numeric rating scale; ROM, range of motion; VAS, visual analogue scale.

A composite outcome of any reoperation will also be reported. When primary studies report a single composite of complications without disaggregation, data should be classified according to the most explicit description available, and this limitation must be acknowledged in the synthesis.

For all dichotomous outcomes, the unit of analysis will be the participant rather than the number of events. When a participant experiences more than one event of the same outcome, they will be counted once for that outcome.

Secondary outcomes will include elbow range of motion (ROM), patient satisfaction, radiographic outcomes, intraoperative parameters, and economic outcomes, when available. Elbow ROM will be assessed through objective measurements of flexion, extension, pronation, and supination. Patient satisfaction will be captured using self-reported questionnaires, including esthetic satisfaction when reported. Radiographic outcomes will include fracture union, maintenance of reduction and alignment. Intraoperative outcomes will include surgical time and estimated blood loss. Economic outcomes will encompass any reported data related to direct or indirect costs of treatment, or cost-effectiveness analyses.

Outcomes will be collected at all follow-up time points reported in the included studies. Data will be grouped according to follow-up duration and analyzed as short ($<$ 3 months), medium (3 to 12 months), and long-term outcomes ($>$ 12 months). When more than one time point is reported within the same interval, the measurement closest to the end of that interval will be selected for analysis. Outcomes from different intervals will be analyzed separately and will not be combined within a single meta-analysis.

A comprehensive and systematic search will be conducted to identify all relevant RCTs. This search was developed in consultation with an experienced librarian to ensure optimal sensitivity and specificity. The systematic search was initially conducted on 21 June 2025 across the following electronic databases and trial registries: PubMed/MEDLINE, Excerpta Medica dataBASE (EMBASE), Cochrane Central Register of Controlled Trials (CENTRAL), SciELO (Scientific Electronic Library Online), and Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS) via Biblioteca Virtual em Saúde (BVS). An updated search using the identical strategy will be performed before submission of the final review; its cut-off date will be reported, and all newly identified studies will undergo the same procedures described in this protocol.

To minimize publication bias, sources of gray literature and clinical trial registries will also be consulted. These will include ClinicalTrials.gov, the World Health Organization's (WHO) International Clinical Trials Registry Platform (ICTRP), and Google Scholar (screening the first 200 results sorted by relevance).[12]

The search strategy will combine controlled vocabulary terms (medical subject headings [MeSH] for PubMed and Emtree for EMBASE) with free-text keywords. Validated methodological filters recommended by the Cochrane Handbook will be applied to identify RCTs.

Complete search strategies for each database are provided in Appendix 1.

Study selection will be performed independently by two reviewers using the Covidence (Veritas Health Innovation) software. The selection process will be conducted in two stages. In the first stage, titles and abstracts will be screened and classified as eligible, not eligible, or unclear. Studies classified as eligible or unclear will undergo full-text assessment in the second stage.

During full-text review, eligibility will be independently assessed, and specific reasons for exclusion will be documented. Disagreements at any stage of the selection process will be resolved by discussion or, when necessary, by consultation with a third reviewer. The selection process and reasons for exclusion will be reported in accordance with PRISMA 2020 guidelines.[13]

When essential data are missing or unclear, the corresponding authors should be contacted for clarification.

Data extraction will be performed independently by two reviewers using a standardized and piloted data extraction form implemented within Covidence software .

Prior to full data extraction, the form will be piloted on a sample of included studies, and any necessary refinements will be made. Discrepancies identified during the data extraction process will be resolved by discussion between the two reviewers, with adjudication by a third reviewer when consensus cannot be reached.

All extracted data will be securely stored within the software platform. Following completion of data extraction and resolution of discrepancies, the final dataset will be exported for statistical analysis.

Data items will be extracted to characterize the included studies, participants, interventions, outcomes, and methodological quality. Extracted study characteristics will include authorship, year of publication, journal, country, clinical setting, study design, duration of follow-up, funding sources, and declared conflicts of interest.

Participant-related data will include eligibility criteria, number of participants randomized and analyzed in each group, baseline demographic characteristics, relevant comorbidities, fracture characteristics and classification systems, and losses to follow-up with reasons for attrition. Intervention-related data will include descriptions of each study arm, comparator interventions, cointerventions, and qualifications of personnel (when reported).

Outcome data will include all predefined primary and secondary factors. For all outcomes, sample sizes, measures of central tendency, event counts, and effect estimates with 95% confidence intervals (CI) will be extracted, at all reported time points.

Information to support risk of bias assessment using the Risk of Bias 2 (RoB 2, Cochrane Collaboration) will also be extracted. A detailed list of all extracted data items is provided in Appendix 2.

Results from comparable studies will be quantitatively synthesized when participants, interventions, comparators, and outcomes are sufficiently similar; otherwise, narrative synthesis will be used.

Given the diversity of treatment modalities identified in the literature, eligible interventions will be grouped into four prespecified categories based on the underlying treatment principle: nonoperative management, including immobilization and early mobilization protocols; TBW and its technical variants; plate-and-screw fixation; and alternative fixation devices.

Direct pairwise meta-analyses will be performed for two prespecified primary comparisons: operative versus nonoperative management, and TBW versus plate fixation. Additional pairwise comparisons will be conducted when at least two studies provide compatible outcome data for the same intervention.

A network meta-analysis was considered but is not planned, given the expected limited number of trials per comparison and the potential clinical heterogeneity in fracture patterns and implant techniques, which may violate the transitivity assumption required for indirect comparisons.

For multi-arm trials, arms within the same intervention category will be combined, following the Cochrane Handbook's recommendations to avoid double-counting of participants.

Meta-analyses will be conducted using a random-effects model, acknowledging the expected clinical and methodological heterogeneity among studies. For dichotomous outcomes, treatment effects will be expressed as risk ratios with corresponding 95% CIs. For continuous outcomes, results will be reported as mean differences when outcomes are measured using the same scale, or as standardized mean differences when different measurement scales are used. When outcomes are reported as medians and ranges or interquartile ranges (IQR), data will be converted to means and standard deviations (SDs) using validated methods.[14] Methodological decisions regarding data handling and statistical approaches will follow the recommendations of the Cochrane Handbook for Systematic Reviews of Interventions.

All analyses will be performed using Review Manager (RevMan Web, Cochrane Collaboration), version 10.4.0.

The risk of bias of included studies will be independently assessed by two reviewers using RoB 2.[15] This assessment will be performed for all primary outcomes. The risk of bias for secondary outcomes will be assessed using representative outcomes within each domain, prioritizing those that are most consistently reported across studies. The evaluation will consider bias arising from randomization process, deviations from intended interventions, missing data, measurement scales, and selection of the reported result.

Each domain will be judged as having a low or high risk of bias, or some concerns. Disagreements between reviewers will be resolved by discussion, and, if necessary, by consultation with a third reviewer.

Statistical heterogeneity among the included studies will be evaluated by visually inspecting the forest plots and statistically assessed using the Chi-squared test for heterogeneity, along with the I^2 statistic.[16,17] The Chi-squared test's p-value will be considered significant at $p < 0.10$. Heterogeneity will be categorized based on I^2 values (0–40%: not important; 30–60%: moderate; 50–90%: substantial; 75–100%: considerable), interpreted as general guidance alongside the magnitude of effect estimates and clinical characteristics of included studies.

Reporting biases will be assessed in accordance with the PRISMA-P 2015[8] statement and the Cochrane Handbook for Systematic Reviews of Interventions.[17] The comprehensive search strategy, including gray literature sources and clinical trial registries (ClinicalTrials.gov, WHO-ICTRP, and Google

Scholar), is designed to minimize the risk of publication bias by identifying unpublished or ongoing studies.

For meta-analyses including a sufficient number of studies (generally ten or more), potential publication bias will be explored by visual inspection of funnel plots. When asymmetry is suggested, statistical methods such as Egger's regression[18] test or Begg's rank correlation test[19] will be used to formally assess the likelihood of small-study effects. Selective outcome reporting within individual studies will be evaluated as part of the RoB 2 assessment, specifically within the domain addressing bias in the selection of the reported result.

Sensitivity analyses will be performed to assess the robustness of the estimated treatment effects for key outcomes. These analyses will also explore the impact of including studies judged to be at high risk of bias or presenting some concerns in critical domains of the RoB 2 assessment, as well as the influence of studies with missing or imputed outcome data.

Predefined subgroup analyses will be performed when the data permit, according to the type of intervention and participant characteristics. Additional subgroup analyses will be conducted according to fracture classification, particularly comparing Mayo fractures type IIA versus IIB (or equivalent classifications as reported), with unstable or complex fracture patterns analyzed separately when data permit, as well as patients' age group ($\leq$65 and $>$65 years) and sex.

Analyses will follow the intention-to-treat principle. When outcome data are missing, study authors will be contacted. If it cannot be retrieved, the impact of missing data will be explored through sensitivity analyses, including best-case and worst-case scenarios where appropriate.

The certainty of the evidence for each outcome will be assessed using the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) approach.[20] Evidence will be classified as high, moderate, low, or very low certainty.[17] The GRADEpro (McMaster University and Evidence Prime) software will be used to generate Summary of Findings tables for the main outcomes.

Ethical approval and patient informed consent are not required for this systematic review, as it will rely exclusively on data extracted from accessible, published literature. The findings of this systematic review will be disseminated through publication in a peer-reviewed scientific journal and presented at relevant national and international scientific conferences.

Data Availability

Data will be available upon request to the corresponding author.

Authors' Contributions

DAC: conceptualization; writing – original draft. MJT, JCB, JSF: conceptualization, methodology. MJT: writing – review and editing.

Financial Support

The authors declare that they received financial support from the Universidade Federal de São Paulo (UNIFESP) to conduct the present study.

Conflict of Interest

The authors declare no conflicts of interest.

References

1 Duckworth AD, Clement ND, Aitken SA, Court-Brown CM, McQueen MM. The epidemiology of fractures of the proximal ulna. Injury 2012;43(03):343–346. Doi: 10.1016/j.injury.2011.10.017

2 Brüggemann A, Mukka S, Wolf O. Epidemiology, classification and treatment of olecranon fractures in adults: an observational study on 2462 fractures from the Swedish Fracture Register. Eur J Trauma Emerg Surg 2022;48(03):2255–2263. Doi: 10.1007/s00068-021-01765-2

3 Cantore M, Candela V, Sessa P, Giannicola G, Gumina S. Epidemiology of isolated olecranon fractures: a detailed survey on a large sample of patients in a suburban area. JSES Int 2022;6(02):309–314. Doi: 10.1016/j.jseint.2021.11.015

4 Parkes J, Limb R, Quadri ST, et al. Complications and mortality associated with olecranon fractures in the elderly: a retrospective cohort comparison from a large level one trauma centre. Shoulder Elbow 2022;14(02):200–210. Doi: 10.1177/1758573221994860

5 Matar HE, Ali AA, Buckley S, Garlick NI, Atkinson HD. Surgical interventions for treating fractures of the olecranon in adults. Cochrane Database Syst Rev 2014;2014(11):CD010144. Doi: 10.1002/14651858.CD010144.pub2

6 Duckworth AD, Clement ND, McEachan JE, White TO, Court-Brown CM, McQueen MM. Prospective randomised trial of non-operative *versus* operative management of olecranon fractures in the elderly. Bone Joint J 2017;99-B(07):964–972. Doi: 10.1302/0301-620X.99B7.BJJ-2016-1112.R2

7 Duckworth AD, Clement ND, White TO, Court-Brown CM, McQueen MM. Plate Versus Tension-Band Wire Fixation for Olecranon Fractures: A Prospective Randomized Trial. J Bone Joint Surg Am 2017;99(15):1261–1273. Doi: 10.2106/JBJS.16.00773

8 Moher D, Shamseer L, Clarke M, et al; PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. Syst Rev 2015;4(01):1. Doi: 10.1186/2046-4053-4-1

9 Morrey BF. Functional Evaluation of the Elbow. In: Morrey BF, Sanchez-Sotelo J, Morrey ME, (eds.). The Elbow and its Disorders. 5th ed. Philadelphia, PA: Elsevier; 2018:66–74. Doi: 10.1016/B978-0-323-34169-1.00005-X

10 Dawson J, Doll H, Boller I, et al. The development and validation of a patient-reported questionnaire to assess outcomes of elbow surgery. J Bone Joint Surg Br 2008;90(04):466–473. Doi: 10.1302/0301-620X.90B4.20290

11 Hudak PL, Amadio PC, Bombardier CThe Upper Extremity Collaborative Group (UECG) Development of an upper extremity outcome measure: the DASH (disabilities of the arm, shoulder and hand) [corrected]. Am J Ind Med 1996;29(06):602–60810.1002/(SICI)1097-0274(199606)29:6<602::AID-AJIM4>3.0.CO;2-L Erratum in: Am J Ind Med 1996;30(3):372 Doi: 10.1002/ajim.4700280321

12 Haddaway NR, Collins AM, Coughlin D, Kirk S. The Role of Google Scholar in Evidence Reviews and Its Applicability to Grey Literature Searching. PLoS One 2015;10(09):e0138237. Doi: 10.1371/journal.pone.0138237

13 Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. Doi: 10.1136/bmj.n71

14 Wan X, Wang W, Liu J, Tong T. Estimating the sample mean and standard deviation from the sample size, median, range and/or interquartile range. BMC Med Res Methodol 2014;14(01):135. Doi: 10.1186/1471-2288-14-135
15 Sterne JAC, Savović J, Page MJ, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. BMJ 2019;366:l4898. Doi: 10.1136/bmj.l4898
16 Higgins JPT, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. BMJ 2003;327(7414):557–560. Doi: 10.1136/bmj.327.7414.557
17 Higgins J, Thomas J, Chandler J, et al. (eds.). Cochrane Handbook for Systematic Reviews of Interventions version 6.5 (updated August 2024). Cochrane; 2024. Accessed September 17, 2026 from https://www.cochrane.org/handbook
18 Egger M, Smith GD, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. BMJ 1997;315(7109): 629–634. Doi: 10.1136/bmj.315.7109.629
19 Begg CB, Mazumdar M. Operating characteristics of a rank correlation test for publication bias. Biometrics 1994;50(04): 1088–1101. Doi: 10.2307/2533446
20 Schünemann H, Brożek J, Guyatt G, Oxman A (eds). GRADE handbook for grading quality of evidence and strength of recommendations. Updated October 2013. The GRADE Working Group; 2013. Accessed September 17, 2026 from https://www.guidelinedevelopment.org/handbook

Appendix 1 Search Strategies

This appendix details the search strategies employed across all electronic databases to identify relevant RCTs for this systematic review. The strategies were developed in consultation with an experienced librarian, combining controlled vocabulary terms with free-text keywords and applying validated methodological filters. The initial search was conducted on June 21, 2025, across all listed databases. An updated search will be performed prior to submission of the final review manuscript, with the cut-off date corresponding to the date of execution.

PubMed/MEDLINE Search Strategy

The following search strategy was utilized for PubMed/MEDLINE, combining Medical Subject Headings (MeSH) terms with free-text keywords, and applying specific filters to identify RCTs.

#	Search Term
1	"Olecranon Fracture" [Mesh] OR (Fracture, Olecranon) OR (Fractures of the Olecranon Process) OR (Olecranon Process Fractures) OR (Fracture, Olecranon Process) OR (Olecranon Process Fracture) OR (Olecranon Fractures)
2	"Surgical Procedures, Operative" [Mesh] OR (Operative Surgical Procedure*) OR (Surgical Procedure, Operative) OR (Procedure*, Operative Surgical) OR (Operative Procedure*) OR (Procedure*, Operative) OR (Surgery, Ghost) OR (Ghost Surgery) OR Surgery OR "Conservative Treatment" [Mesh] OR (Conservative Treatments) OR (Treatment*, Conservative) OR (Conservative Management*) OR (Management*, Conservative) OR (Conservative Therap*) OR (Therap*, Conservative)
3	((randomized controlled trial [pt] OR controlled clinical trial [pt] OR randomized controlled trials [mh] OR random allocation [mh] OR double-blind method [mh] OR single-blind method [mh] OR clinical trial [pt] OR clinical trials [mh] OR ("clinical trial" [tw])) OR ((singl* [tw] OR doubl* [tw] OR trebl* [tw] OR tripl* [tw]) AND (mask* [tw] OR blind* [tw])) OR (placebos [mh] OR placebo* [tw] OR random* [tw] OR research design [mh:noexp] OR (comparative study) OR (evaluation studies) OR (follow-up studies) OR (prospective studies) OR control* [tw] OR prospectiv* [tw] OR volunteer* [tw])) NOT (animals [mh] NOT humans [mh])
4	#1 AND #2 AND #3

Cochrane Library Search Strategy (CENTRAL)

The following search strategy was employed in the Cochrane Library (CENTRAL), combining free-text terms to identify relevant trials.

#	Search Term
1	(Olecranon Fracture) OR (Fracture, Olecranon) OR (Fractures of the Olecranon Process) OR (Olecranon Process Fractures) OR (Fracture, Olecranon Process) OR (Olecranon Process Fracture) OR (Olecranon Fractures)
2	(Surgical Procedures, Operative) OR (Operative Surgical Procedure*) OR (Surgical Procedure, Operative) OR (Procedure*, Operative Surgical) OR (Operative Procedure*) OR (Procedure*, Operative) OR (Surgery, Ghost) OR (Ghost Surgery) OR (Conservative Treatment) OR (Conservative Treatments) OR (Treatment*, Conservative) OR (Conservative Management*) OR (Management*, Conservative) OR (Conservative Therap*) OR (Therap*, Conservative)
3	#1 AND #2

EMBASE Search Strategy

The search strategy for EMBASE combined Emtree terms with free-text keywords, incorporating specific filters for randomized controlled trials and de-duplication from Medline.

#	Search Term
1	'olecranon fracture'/exp OR 'fracture of the olecranon' OR 'fracture, olecranon' OR 'olecranon fracture' OR 'olecranon process fracture'
2	'surgery'/exp OR (diagnosis, surgical) OR (diagnostic techniques, surgical) OR operation OR (operation care) OR (operative intervention) OR (operative repair) OR (operative restoration) OR (operative surgical procedure) OR (operative treatment) OR (research surgery) OR resection OR (specialties, surgical) OR (surgery, operative) OR (surgical care) OR (surgical correction) OR (surgical exposure) OR (surgical intervention) OR (surgical management) OR (surgical operation) OR (surgical practice) OR (surgical procedures, operative) OR (surgical repair) OR (surgical research) OR (surgical restoration) OR (surgical servisse) OR (surgical specialty) OR (surgical specialty) OR (surgical therapy) OR (surgical treatment) OR 'conservative treatment'/exp OR (conservative management) OR (conservative therapy) OR (nonoperative treatment) OR (nonsurgical treatment) OR (organ sparing treatment) OR (organ sparing treatments) OR (treatment, conservative)
3	#1 AND #2
4	#3 AND [embase]/lim NOT ([embase]/lim AND [medline]/lim)
5	#3 AND ([embase]/lim NOT ([embase]/lim AND [medline]/lim) OR ([medline]/lim NOT ([embase]/lim AND [medline]/lim) NOT ([embase classic]/lim AND [medline]/lim))) AND ([controlled clinical trial]/lim OR [randomized controlled trial]/lim)

SciELO and LILACS Search Strategy – via BVS

The search strategy for SciELO and LILACS, accessed through the Virtual Health Library (BVS, 'Biblioteca Virtual em Saúde' in Portuguese), utilized a combination of Medical Subject Headings (MH) and free-text terms in Portuguese, Spanish, and English.

#	Search Term
1	MH:"Fratura do Olécrano" OR (Olecranon Fracture) OR (Fratura do Olecrânio) OR (Fratura do Processo Olecraniano) OR (Fratura do Processo do Olécrano) OR (Fraturas do Olecrânio) OR (Fraturas do Olécrano) OR (Fraturas do Processo Olecraniano) OR (Fraturas do Processo do Olécrano) OR MH:C26.088.134.500.750$ OR MH:C26.088.268.807.500$ OR MH:C26.404.020.250$ OR MH:C26.404.937.773$
2	MH:"Procedimentos Cirúrgicos Operatórios" OR (Procedimentos Cirúrgicos Operatórios) OR (Procedimientos Quirúrgicos Operativos) OR (Surgical Procedures, Operative) OR (Intervenção Cirúrgica) OR (Intervenções Cirúrgicas) OR (Operação Cirúrgica) OR (Operações Cirúrgicas) OR (Procedimento Cirúrgico) OR (Procedimento Cirúrgico Operatório) OR (Procedimentos Cirúrgicos) OR MH:E04$ OR MH:VS3.003.001.006.002$ OR MH:"Tratamento Conservador" OR (Tratamento Conservador) OR (Tratamiento Conservador) OR (Conservative Treatment) OR (Conduta Conservadora) OR (Terapia Conservadora) OR (Monitoramento Conservador) OR MH:E02.197$
3	#1 AND #2

Gray Literature and Clinical Trial Registries Search

ClinicalTrials.gov and the World Health Organization International Clinical Trials Registry Platform (WHO ICTRP) were searched using the free-text terms "olecranon fracture" AND "adults". OpenGrey was searched using "olecranon fracture".

Appendix 2 Data Extraction Items

Data items: The following data items will be extracted from included studies:

- **Study Identification and Characteristics:**
  - Study title and primary authors;
  - Publication year and journal;
  - Country and clinical setting;
  - Study design;
  - Duration of the study, including recruitment period and follow-up length;
  - Funding sources and declared conflicts of interest.
- **Participant Characteristics:**
  - Inclusion and exclusion criteria of the study;
  - Total number of participants randomized and analyzed per group;
  - Baseline demographics (mean age, age range, sex distribution, relevant comorbidities);
  - Specific details of the olecranon fractures, including diagnostic criteria and classification systems utilized;
  - Losses to follow-up and reasons for attrition.
- **Intervention Details:**
  - Detailed description of the interventions for each studied arm;
  - Comparison group details;
  - Duration and frequency of the intervention;
  - Details of cointerventions or concomitant treatments;
  - Qualifications of personnel administering the interventions, if reported.
- **Outcome Data:**
  - Primary:
    - Functional assessment scores (e.g., MEPS, DASH, Oxford elbow score);
    - Adverse events;
    - Pain intensity (e.g., VAS, NRS).
  - Secondary:
    - Range of motion (ROM) of the elbow (flexion, extension, pronation, supination);
    - Patient satisfaction (including esthetic results, if assessed);
    - Radiographic outcomes;
    - Intraoperative metrics (e.g., operation time, estimated blood loss);
    - Economic outcomes (e.g., cost-effectiveness, direct/indirect costs);
    - For all outcomes, relevant statistics will be extracted, including sample sizes, means, SDs, medians, IQRs, counts of events, and measures of effect (e.g., mean differences, risk ratios) with their respective confidence intervals and *p*-values, at all reported time points. Outcome data will be captured with time points as reported by the included studies. Additional outcome details (e.g., measurement scales, units, directionality, and actual reported values) will be extracted to ensure comparability and robust synthesis. Secondary outcomes (e.g., ROM, patient satisfaction, radiographic healing, and economic evaluations) will be included as reported on a case-by-case basis.
- **Methodological details for risk of bias assessment:** Information required for assessing bias in each domain of the RoB 2 tool (randomization process, allocation concealment, blinding, handling of missing data, selective reporting).