
Article:
Watts, Adam, Hamoodi, Zaid, Hewitt, Catherine Elizabeth orcid.org/0000-0002-0415-3536 et al. (1 more author) (2022) Elbow arthroplasty replacement research methods, outcome domains and instruments in clinical outcome studies: a scoping review. The Bone and Joint journal. pp. 1148-1155. ISSN: 2049-4394

https://doi.org/10.1302/0301-620X.104B10.BJJ-2022-0570.R1

Elbow replacement research methods, outcome domains and instruments in clinical outcome studies: a scoping review

Journal:	*The Bone & Joint Journal*
Manuscript ID	BJJ-2022-0570.R1
Manuscript Type:	Review Article
Keywords:	Arthroplasty, Replacement, Elbow, Outcome, Methods, Funding

Title: Elbow replacement research methods, outcome domains and instruments in clinical outcome studies: a scoping review

Abstract

Aim

Prosthetic joint replacement of the elbow including total elbow replacement, hemireplacement, radial head replacement and radiocapitellar replacement, are rare procedures. This scoping review aims to map current research to inform the development of future research.

Materials and Methods

A scoping review was undertaken adhering to the Joanna Briggs Institute (JBI) guidelines using Medline, Embase, CENTRAL and trial registries limited to studies published between 1st January 1990 and 7th February 2021. Endnote software was used for screening and selection and was limited to randomised trials, non-randomised controlled trials, prospective and retrospective cohort studies, case-control studies, analytical cross-sectional studies and case series of ten patients or more reporting clinical outcomes of elbow replacement. The results are presented as frequency counts of types of studies reported, sample size, length of follow up, clinical outcome domains and instruments used, funding sources and a narrative review.

Results

362 studies met the inclusion criteria. The majority were of total elbow replacement (246, 68%), followed by radial head replacement (100, 28%), distal humerus hemireplacement (11, 3%) and radiocapitellar replacement (5, 1%). Most studies were retrospective (326, 90%) and most were observational (315, 87%).

The median study sample size for all implant types across all studies was 36 implants. The median length of follow up for all study types was 56 months. A total of 583 unique outcome descriptors were used that were categorised into 18 domains. A total of 105 outcome instruments were used to measure 39 outcomes.

Discussion

This review has found the majority of published research into elbow replacement consists of retrospective observational studies with small sample sizes and short follow up. A large number of outcome descriptors were used with a high number of different outcome instruments employed indicating a need to define a core outcome set for elbow replacement.

Key words: Arthroplasty, Replacement, Elbow, Outcome, Methods, Funding

Introduction

Prosthetic joint replacement (elbow replacement) of all or part of the elbow has been performed routinely for a number of indications since the cemented replacement design of Dee in the 1960's, including inflammatory arthropathy, osteoarthritis, acute trauma, trauma sequelae, instability and (rarely) tumour.(1) The term elbow replacement is often taken to mean total elbow replacement, that is replacement of the distal humerus and proximal ulna with or without the radial head, but also includes distal humerus replacement in isolation (distal humerus hemireplacement), replacement of the capitellum of the humerus and radial head (radiocapitellar replacement) and radial head replacement in isolation. The purpose of elbow replacement is to relieve pain, restore function and quality of life for the patient.

Clinical practice should be underpinned by robust scientific evidence, and randomised controlled trials are viewed as the gold standard method for assessing interventions. Undertaking evaluations of the effectiveness of elbow replacement techniques and devices is challenging as the intervention is relatively rare. The National Joint Registry Annual Report for England, Wales and Northern Ireland reported a total of 834 cases of elbow replacement in the year 2019 (prior to the Covid-19 outbreak) divided between acute trauma (455 cases) and elective indications (379 cases) across 172 units and 249 surgeons.(2) These low numbers mean that innovative approaches to the design and delivery of trials are required to ensure surgical practice is underpinned by high quality evidence.

To inform the development of future research assessing the effects of elbow replacement it is important to have an understanding of the research methods that have been employed. In addition, with uncertainty as to the most appropriate outcomes to use in evaluation of elbow replacement, work is required to determine the outcome domains that have been assessed and the outcome instruments used to support development of a core outcome set as outlined in the COMET handbook.(3) Further, it is important to map the traditional sources of funding for elbow replacement research in order to understand the limitations and opportunities available. This mapping is best undertaken by a scoping review of evidence sources to examine how research is undertaken in this field.(4)

A preliminary search of Pubmed conducted on 28th December 2020 for previous systematic or scoping reviews on elbow arthroplasty or replacement identified eight relevant articles.

One of the systematic reviews had been retracted leaving one scoping review and six systematic reviews.(5)(6)(7)(8)(9)(10)(11) Two studied the clinical outcomes of primary elbow replacement, two compared the clinical outcome of radial head replacement with osteosynthesis, one analysed the trends in indication for total elbow replacement and one was a review of revision of infected primary elbow replacement. The scoping review was also on the diagnosis and management of infected elbow replacement.(5) An additional internet search of Google Scholar conducted on 29th December 2020 identified a further seven systematic reviews, six of which reviewed the outcome of total elbow replacement and one reviewed the causes for failure of elbow replacement.(12)(13)(14)(15)(16)(17)(18) No systematic or scoping reviews have been identified that map the research methods, outcome domains and instruments, and funding sources used in elbow replacement research.

We therefore undertook a scoping review to identify and map the research methods, domains and outcome instruments used in elbow replacement research of clinical outcomes to inform future research in this field and to describe the sources of funding used for published elbow replacement research.

Review questions

This scoping review addressed the following research questions:

a) What research methods are used to study the clinical effectiveness of elbow replacement surgery?
b) What outcome domains are assessed and which instruments have been used to evaluate clinical outcomes of elbow replacement surgery?
c) What funding sources are identified in clinical outcome studies of elbow replacement?

Methods

The protocol was developed in accordance with the JBI guidelines(19) and is available online at Open Science Framework (https://osf.io/t6qyh/)

Eligibility criteria

Studies of adults with a diagnosis of inflammatory arthropathy, osteoarthrosis, post-trauma sequelae, and acute trauma undergoing primary elbow replacement were eligible for

inclusion. Reports of replacement for tumour or other rare indications were excluded. In-vitro studies and studies of surgical approaches, biomechanics, health economics and revision elbow replacement were excluded. Studies of populations with heterogeneous diagnoses were included as long as at least 90% of the participants had one of the eligible diagnoses.

The context for the scoping review was all primary elbow replacement studies published between 1st January 1990 and 7th February 2021 and any trials on international registries that met the inclusion criteria. The types of evidence included were randomised trials, non-randomised controlled trials, prospective and retrospective cohort studies, case-control studies, analytical cross-sectional studies and case series of ten patients or more published in the English language. Review articles, surveys, case reports and conference abstracts were excluded.

Search strategy

An initial limited search of Medline was undertaken to perform an analysis of text words in titles and abstracts and index terms to inform the full search strategy. A full search was conducted, with support from an information specialist on 7th February 2021of Medline, Embase, and CENTRAL using the terms "Elbow Prosthesis", "Arthroplasty, Replacement, Elbow", "Hemiarthroplasty", "Radial head arthroplasty or replacement" and "Radiocapitellar arthroplasty or replacement". This was adapted for the other databases. A search was conducted of the reference lists of reports selected for inclusion in the review to identify any additional studies. The reference lists of prior reviews in elbow replacement were also searched. The ISRCTN Registry and Clinicaltrials.gov websites were reviewed to identify any ongoing trials meeting the inclusion criteria. No search of grey literature was undertaken. The full search strategy for Medline is included in table 1.

Evidence selection

Endnote software Version X9; Clarivate Analytics, Philadelphia, PA, USA was used for management of the results of the search. Duplicates were excluded before initial screening based on title and abstract was undertaken by two reviewers (AW, ZH) with independent selection of evidence based on the pre-specified inclusion criteria. The full article of potentially relevant records were obtained and screened by two reviewers (AW, ZH) to

identify eligible studies. Where there was disagreement the two reviewers reviewed the manuscripts together to reach consensus.

Data extraction

Pilot testing of a customised excel data extraction tool was undertaken using 25 articles selected at random and screened by AW and ZH. A meeting was held to review the screening results to determine whether any changes needed to be made, with 75% agreement required before the data extraction tool was accepted. Full text screening of the remaining articles was conducted by AW including citation details (author/s, date, title, journal, volume, issue, pages), the country in which research has been undertaken, further details of the research methodology (RCT, non-randomised controlled trials, prospective and retrospective cohort studies, case-control studies, analytical cross-sectional studies and case series of ten patients or more), implant studied, population (diagnosis, age and sex), setting, sample size, length of follow up (minimum, maximum, mean/median), outcome assessed, instruments used to assess outcomes and funding sources for the research.

Analysis of the evidence

Data were tabulated and key study characteristics described. The planned analyses were frequency counts of types of studies reported, length of follow up, domains and outcome instruments used. Where possible, findings were stratified by diagnosis (inflammatory arthropathy, osteoarthrosis, post-trauma sequelae, and acute trauma) and type of elbow replacement (total elbow replacement, distal humerus hemireplacement, radial head replacement and radio-capitellar replacement). Outcomes were recorded verbatim from source and categorised into domains after extractions using the taxonomy described by Dodd et al.(20) For ease of reporting the most common outcomes for each domain were rationalised into a common term. For example, in the adverse events domain the outcomes "pain", "residual pain", "proximal forearm pain", "severe pain" and "post-operative pain" were recorded in the table as post-operative pain. The instruments were categorised according to the outcome that the source reported they were being used to assess. No assessment of the quality of the studies or reporting was undertaken, in keeping with guidelines for scoping reviews, as the review is not designed to inform clinical decision making.(21) A full list of included studies and outcomes is available from the corresponding author.

Results

The findings of the literature search are reported in a flow chart adhering to the PRISMA-ScR statement and PRISMA-S extension (Figure 1).(22)(23) From a total of 2,197 de-duplicated titles identified from the searches, 402 full text articles were reviewed, of which 40 were excluded for the reasons stated in Figure 1, leaving 362 studies for final inclusion in the scoping review.

Scope of included studies

Of the 362 studies published between 1st January 1990 and 7th February 2021 the subject of the study was total elbow replacement in 246(68%), radial head replacement in 100(28%), distal humerus hemireplacement in 11(3%) and radiocapitellar replacement in 5(1%). Over this time period there has been an overall increase in the number of publications per annum, although a decrease in the annual number of publications on total elbow replacement has been observed since 2015 (Figure 2). Studies were reported from 34 countries, with one international collaboration. The top ten locations for published English language elbow replacement studies by country are listed in table 2.

The majority of studies were conducted in a hospital setting (329, 91%) with few community-based studies (32, 9%). Most studies were retrospective (326, 91%) and most were observational (321, 89%). There were 23 administrative database studies, 21 of which were conducted in the USA and 8 national implant registry studies from Australia, Denmark (2 studies), Norway, Finland, Sweden and New Zealand. There were 6 prospective randomised controlled trials (RCT),(24)(25)(26)(27)(28)(29) one retrospective review of patients from a previous RCT(30) and three RCT protocols.(31)(32)(33) Two RCT sources described comparison of total elbow replacement to osteosynthesis of distal humerus fractures, one reporting study results at two years and one retrospective review of the same cohort at an average of 12.5 years.(25)(30) One source reports the outcome of total elbow arthroplasty with two different ulna components.(28) Three sources compare the outcome of radial head replacement to osteosynthesis for acute radial head fracture, and one compared radial head replacement to radial head excision.(24)(26)(29)(27) Two protocols described comparison of total elbow replacement to distal humerus hemireplacement for distal humerus fracture, and one protocol was for a study comparing distal humerus hemireplacement to osteosynthesis. (31)(33)(32) None of the RCTs compare elbow replacement to a non-surgical intervention.

Only one RCT had a stated source of funding which was from a commercial source.(25) In five RCTs it was stated that there was no funding or conflict of interest for the trial,(32)(24)(30)(27)(28) and for four it was not stated if there was any funding or conflict of interest.(31)(26)(33)(29) The median sample size by study design is given in table 3.

Properties of included studies

The median study sample size by implant type was 17(range 10 to 44) implants for distal humerus hemireplacement, 20(range 10 to 31) for radiocapitellar replacement, 32(range 11 to 528) for radial head replacement and 41(range 10 to 56,379) for total elbow replacement. The indication for surgery by procedure type is presented in table 4. Differences were found between procedure types in the mean percentage of female study participants and mean age of participants (Table 5).

The median of the mean length of follow up for all study types was 56 months(range 1 to 216 months). It was longest for registry studies with a median follow up of 96 months(range 67 to 126 months). The median follow-up in observational case series, which was the largest group, was 57 months(range 6 to 216 months). For randomised trials the median of the mean follow-up was 29 months(range 15 to 151 months). The median of the mean reported follow up for studies of total elbow replacement was 60 months(range 1 to 216 months), for radial head replacement 42 months(range 10 to 145 months), distal humerus hemireplacement 35 months(range 12 to 82 months) and radiocapitellar replacement 59 months(range 23 to 100 months).

Reported outcomes

A total of 583 unique outcome descriptors were used across 362 included studies and were categorised into 18 domains (Table 6). Many of these outcome descriptors reported the same outcome using different terms and in 76 cases the outcome instrument was reported without specification of what was being assessed. The largest group of outcomes are categorised in the adverse events domain (311, 53%) despite the fact that complications were not a pre-specified outcome in most studies. The physical function domain contains the second largest number of outcome descriptors (93, 16%). These can be grouped into four outcomes: function/disability, range of movement, strength and activities of daily living. Strength was often poorly defined but most commonly described an assessment of strength of elbow extension as a measure of triceps function. Radiographic appearance of the elbow was

assessed by 19 separate outcomes in the musculoskeletal domain including implant alignment, congruency, fixation, success, lengthening, head size, stem size, stem positioning, implant positioning, prosthetic sizing, quality of cementing technique, bone graft integration or incorporation, cortical fit, cement mantle, valgus tilting, congruence of the proximal radio-ulnar joint, cement technique, and joint congruity.

Outcome instruments

A total of 105 outcome instruments were used to measure 39 outcomes, of which 26 were clinical and 13 were radiographic. The average number of instruments used per outcome where an instrument was described was 5(range 1 to 26). The list of instruments used to assess each of the 39 outcomes is provided in table 7. For implant survival the listed instruments are methods of analysis but are included for completeness. Some instruments are included in more than one outcome category and may be listed for outcomes and domains that may seem inappropriate, but these are taken verbatim from the included studies.

Discussion

Randomised controlled trials (RCTs) are considered the gold-standard for evaluation of healthcare interventions but in orthopaedic surgery the number of RCTs undertaken is consistently low. A systematic review of orthopaedic literature found that only 20% of procedures had at least one low risk of bias RCT supporting the operative intervention when compared to non-operative treatment.(34) We did not identify any for elbow replacement. Many different reasons have been proposed for this and the cause is likely to be multifactorial.(35)(36) One of the challenges of performing a randomised trial in some areas of orthopaedics where the condition is rare is the feasibility of recruiting sufficient participants to address the research question.

The European Union defines rare diseases as those with a prevalence of less than 50 per 100,000 population for the purposes of orphan drugs, where normal economic models prevent research and development.(37) Elbow replacement is a “rare” procedure with an annual incidence estimated from Scottish data as 1.4 per 100,000 population and the same economic and scientific challenges apply, with low investment in research and barriers to conventional frequentist approaches to investigate clinical outcomes due to the feasibility of randomised controlled trials (RCTs). (38)

This scoping review has found that the literature on elbow replacement consists largely of unfunded retrospective observation studies with small sample sizes. It is interesting to note that the number of studies on total elbow replacement has declined in recent years. The cause of this is unknown, but it may be due to the contracting usage resulting from improved medical management of inflammatory joint disease. Only 9 prospective randomised controlled trials were identified, three of which are protocols of ongoing trials rather than reports of trial results. The sample size of these RCTs ranges from 20 to a maximum of 60 participants. Only one randomised trial had a stated source of funding, and that funding was from a commercial body. This review has not identified any RCTs comparing joint replacement to non-operative treatment in the elbow. It is beyond the scope of this review to determine the causes for the quality of the evidence but there remain many questions regarding elbow replacement that require robust unbiased scientific investigation. Researchers designing future RCTs in elbow arthroplasty will need to explore solutions for investigation of rare diseases with multi-centre and possibly international collaborations to ensure sufficient statistical power and exploration of alternative trial designs. The moral hazard of enrolment of patients into underpowered trials could be avoided through a planned meta-analysis of duplicate studies.(39) However, this would require co-ordination and establishment of a musculoskeletal rare intervention trials registry and a mechanism to ensure data sharing and individual patient data (IPD) meta-analysis.(40)(41) Alternative trial designs have been explored for investigation of rare diseases including crossover designs, N-of-1 trials and adaptive designs, but most are not suitable for surgical research due to the irreversible nature of surgical interventions and the time period required to determine the outcome of the intervention.(42)(43) Bayesian analysis methods, however, could be used to exploit all available data to strengthen the findings from smaller RCTs.(44) Appropriate funding will be required to ensure the successful delivery of these more complicated investigations and qualitative research may be needed to understand the barriers and facilitators within the elbow replacement community that may be affecting research practice.

Alternative approaches to tackling the paucity of information may mean pooling data from multiple sources. The combination of data for meta-analysis is hindered, however, by the diversity of outcome domains and instruments used to measure outcomes. The 583 individual descriptors identified in this scoping review for clinical outcomes of elbow arthroplasty can be rationalised to 41 outcomes over 18 domains using the taxonomy adopted by the COMET

initiative, however this is still a large number of domains and it is unclear which of these might be considered most important by patients, carers and treating clinicians.(20) An average of five instruments have been used for the 39 outcomes where an outcome instrument has been described. This review has not sought to analyse the psychometric properties of the instruments used but rather to map the domains, outcomes and instruments without an assessment of quality or validity. Once core outcomes have been defined it will be necessary to undertake an assessment of relevant instruments to determine if any meet the criteria of truth, discrimination and feasibility.(45)

This review has highlighted a clear need to define the core outcome domains for elbow replacement research that can then lead to the development of a set of core outcome instruments.

References

1. Dee R. Elbow replacement with the R. Dee prosthesis. Acta Orthop Belg. 1975 Aug;41(4):477–83.

2. Ben-Shlomo Y, Blom A, Boulton C, Brittain R, Clark E, Dawson-Bowling S, et al. The National Joint Registry 18th Annual Report 2021 [Internet]. London: National Joint Registry; 2021 [cited 2022 Mar 22]. (National Joint Registry Annual Reports). Available from: http://www.ncbi.nlm.nih.gov/books/NBK576858/

3. Williamson PR, Altman DG, Bagley H, Barnes KL, Blazeby JM, Brookes ST, et al. The COMET Handbook: version 1.0. Trials. 2017 Jun;18(S3):280.

4. Munn Z, Peters MDJ, Stern C, Tufanaru C, McArthur A, Aromataris E. Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. BMC Med Res Methodol. 2018 Dec;18(1):143.

5. Watts A, Duckworth A, Trail I, Rees J, Thomas M, Rangan A. Scoping review: Diagnosis and management of periprosthetic joint infection in elbow arthroplasty. Shoulder Elb. 2019 Aug;11(4):282–91.

6. Wang JH, Ma HH, Chou TFA, Tsai SW, Chen CF, Wu PK, et al. Outcomes following total elbow arthroplasty for rheumatoid arthritis versus post-traumatic conditions: a systematic review and meta-analysis. Bone Jt J. 2019 Dec;101-B(12):1489–97.

7. Kholinne E, Altamimi LA, Aldayel A, AlSabti R, Kim H, Park D, et al. Primary Linked Total Elbow Arthroplasty for Acute Distal Humerus Fracture Management: A Systematic Review of Clinical Outcome. Clin Orthop Surg. 2020;12(4):503.

8. Macken AA, Prkic A, Kodde IF, Lans J, Chen NC, Eygendaal D. Global trends in indications for total elbow arthroplasty: a systematic review of national registries. EFORT Open Rev. 2020 Apr;5(4):215–20.

9. Chen H, Shao Y, Li S. Replacement or repair of terrible triad of the elbow: A systematic review and meta-analysis. Medicine (Baltimore). 2019 Feb;98(6):e13054.

10. Kunutsor SK, Beswick AD, Whitehouse MR, Blom AW. One- and two-stage surgical revision of infected elbow prostheses following total joint replacement: a systematic review. BMC Musculoskelet Disord. 2019 Dec;20(1):467.

11. Kyriacou S, Gupta Y, Bains HK, Singh HP. Radial head replacement versus reconstruction for the treatment of the terrible triad injury of the elbow: a systematic review and meta-analysis. Arch Orthop Trauma Surg. 2019 Apr;139(4):507–17.

12. Samdanis V, Manoharan G, Jordan RW, Watts AC, Jenkins P, Kulkarni R, et al. Indications and outcome in total elbow arthroplasty: A systematic review. Shoulder Elb. 2020 Oct;12(5):353–61.

13. van der Lugt JCT, Rozing PM. Systematic review of primary total elbow prostheses used for the rheumatoid elbow. Clin Rheumatol [Internet]. 2004 Aug [cited 2021 Jan 6];23(4). Available from: http://link.springer.com/10.1007/s10067-004-0884-9

14. Chou TFA, Ma HH, Wang JH, Tsai SW, Chen CF, Wu PK, et al. Total elbow arthroplasty in patients with rheumatoid arthritis: a systematic review and meta-analysis. Bone Jt J. 2020 Aug;102-B(8):967–80.

15. Githens M, Yao J, Sox AHS, Bishop J. Open Reduction and Internal Fixation Versus Total Elbow Arthroplasty for the Treatment of Geriatric Distal Humerus Fractures: A Systematic Review and Meta-Analysis. J Orthop Trauma. 2014 Aug;28(8):481–8.

16. Prkic A, Welsink C, The B, van den Bekerom MPJ, Eygendaal D. Why does total elbow arthroplasty fail today? A systematic review of recent literature. Arch Orthop Trauma Surg. 2017 Jun;137(6):761–9.

17. Little CP, Graham AJ, Carr AJ. Total elbow arthroplasty: a systematic review of the literature in the English language until the end of 2003. J Bone Joint Surg Br. 2005 Apr;87(4):437–44.

18. Welsink CL, Lambers KTA, van Deurzen DFP, Eygendaal D, van den Bekerom MPJ. Total Elbow Arthroplasty: A Systematic Review. JBJS Rev. 2017 Jul;5(7):e4–e4.

19. Peters M, Godfrey C, McInerney P, Munn Z, Trico A, Khalil H. Chapter 11: Scoping Reviews. In: Aromataris E, Munn Z, editors. JBI Manual for Evidence Synthesis [Internet]. JBI; 2020 [cited 2020 Dec 7]. Available from: https://wiki.jbi.global/display/MANUAL/Chapter+11%3A+Scoping+reviews

20. Dodd S, Clarke M, Becker L, Mavergames C, Fish R, Williamson PR. A taxonomy has been developed for outcomes in medical research to help improve knowledge discovery. J Clin Epidemiol. 2018 Apr;96:84–92.

21. Peters MDJ, Marnie C, Tricco AC, Pollock D, Munn Z, Alexander L, et al. Updated methodological guidance for the conduct of scoping reviews. JBI Evid Synth. 2020 Oct;18(10):2119–26.

22. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. Ann Intern Med. 2018 Oct 2;169(7):467.

23. PRISMA-S Group, Rethlefsen ML, Kirtley S, Waffenschmidt S, Ayala AP, Moher D, et al. PRISMA-S: an extension to the PRISMA Statement for Reporting Literature Searches in Systematic Reviews. Syst Rev. 2021 Dec;10(1):39.

24. Chen X, Wang S cheng, Cao L hu, Yang G qing, Li M, Su J can. Comparison between radial head replacement and open reduction and internal fixation in clinical treatment of unstable, multi-fragmented radial head fractures. Int Orthop. 2011 Jul;35(7):1071–6.

25. McKee MD, Veillette CJH, Hall JA, Schemitsch EH, Wild LM, McCormack R, et al. A multicenter, prospective, randomized, controlled trial of open reduction—internal fixation versus total elbow arthroplasty for displaced intra-articular distal humeral fractures in elderly patients. J Shoulder Elbow Surg. 2009 Jan;18(1):3–12.

26. Ruan HJ, Fan CY, Liu JJ, Zeng BF. A comparative study of internal fixation and prosthesis replacement for radial head fractures of Mason type III. Int Orthop. 2009 Feb;33(1):249–53.

27. Singh AK, Jidge A, Ramteke U, Venkateswaran N, Rokade H, Mulje SM, et al. Functional Outcome of Elbow Kinematics in Radial Head Excision Versus Radial Head Replacement: A Comparative Study. Open Access Maced J Med Sci. 2019 May 15;7(9):1505–8.

28. Tanaka N, Sakahashi H, Ishii S, Kudo H. Comparison of two types of ulnar component in type-5 Kudo total elbow arthroplasty in patients with rheumatoid arthritis: a long-term follow-up. J Bone Joint Surg Br. 2006 Mar;88(3):341–4.

29. Yan M, Ni J, Song D, Ding M, Liu T, Huang J. Radial head replacement or repair for the terrible triad of the elbow: which procedure is better? ANZ J Surg. 2015 Sep;85(9):644–8.

30. Dehghan N, Furey M, Schemitsch L, Ristevski B, Goetz T, Schemitsch EH, et al. Long-term outcomes of total elbow arthroplasty for distal humeral fracture: results from a prior randomized clinical trial. J Shoulder Elbow Surg. 2019 Nov;28(11):2198–204.

31. Adolfsson L. Elbow Hemiarthroplasty Versus Total Elbow Arthroplasty for Irreparable Distal Humeral Fractures [Internet]. 2011. Available from: https://ClinicalTrials.gov/show/NCT03596736.

32. Al-Hamdani A, Rasmussen JV, Holtz K, Olsen BS. Elbow hemiarthroplasty versus open reduction and internal fixation for AO/OTA type 13 C2 and C3 fractures of distal humerus in patients aged 50 years or above: a randomized controlled trial. Trials. 2020 Dec;21(1):497.

33. Smith C. Hemiarthroplasty Or Total Elbow Arthroplasty in the Elderly [Internet]. 2020. Available from: https://clinicaltrials.gov/show/NCT04646798.

34. Lim HC, Adie S, Naylor JM, Harris IA. Randomised Trial Support for Orthopaedic Surgical Procedures. Elsalanty M, editor. PLoS ONE. 2014 Jun 13;9(6):e96745.

35. Solomon MJ, McLeod RS. Should we be performing more randomized controlled trials evaluating surgical operations? Surgery. 1995 Sep;118(3):459–67.

36. McCulloch P. Randomised trials in surgery: problems and possible solutions. BMJ. 2002 Jun 15;324(7351):1448–51.

37. Orphan Drug Act (1983) [Internet]. 1983. Available from: https://www.govinfo.gov/content/pkg/STATUTE-96/pdf/STATUTE-96-Pg2049.pdf

38. Jenkins PJ, Watts AC, Norwood T, Duckworth AD, Rymaszewski LA, McEachan JE. Total elbow replacement: outcome of 1,146 arthroplasties from the Scottish Arthroplasty Project. Acta Orthop. 2013;84(2):119–23.

39. Halpern SD. The Continuing Unethical Conduct of Underpowered Clinical Trials. JAMA. 2002 Jul 17;288(3):358.

40. Medley N, Cuthbert A, Crew R, Stewart L, Smith CT, Alfirevic Z. Developing a topic-based repository of clinical trial individual patient data: experiences and lessons learned from a pilot project. Syst Rev. 2021 Dec;10(1):162.

41. Rydzewska LHM, Stewart LA, Tierney JF. Sharing individual participant data: through a systematic reviewer lens. Trials. 2022 Dec;23(1):167.

42. Cornu C, Kassai B, Fisch R, Chiron C, Alberti C, Guerrini R, et al. Experimental designs for small randomised clinical trials: an algorithm for choice. Orphanet J Rare Dis. 2013;8(1):48.

43. Gupta S, Faughnan ME, Tomlinson GA, Bayoumi AM. A framework for applying unfamiliar trial designs in studies of rare diseases. J Clin Epidemiol. 2011 Oct;64(10):1085–94.

44. Tan SB. Strategy for randomised clinical trials in rare cancers. BMJ. 2003 Jul 3;327(7405):47–9.

45. Boers M, Kirwan JR, Wells G, Beaton D, Gossec L, d'Agostino MA, et al. Developing Core Outcome Measurement Sets for Clinical Trials: OMERACT Filter 2.0. J Clin Epidemiol. 2014 Jul;67(7):745–53.

Legends

Table 1: Medline search string.

Table 2: The 10 countries with the highest number of recorded publications on elbow replacement (frequency, % of total).

Table 3: Sample size of studies by study type.

Table 4: Primary diagnosis at the time of surgery by type of procedure.

Table 5: Sex and Age of patients included in studies by type of procedure.

Table 6: Reported outcomes categorised by domain.

Table 7: Outcome instruments used in included studies (no assessment of psychometric properties has been conducted). *(ASES – American Shoulder and Elbow Score; DASH – Disabilities of the Arm Shoulder and Hand; HSS – Hospital for Special Surgery; JOA – Japanese Orthopaedic Association; PREE – Patient Rated Elbow Evaluation; SANE – Single Assessment Numeric Evaluation; VAS – visual analogue score; RAND-36 – early version of SF-36; MMSE – Mini-Mental State Evaluation)*

Figure 1. PRISMA flow chart

Figure 2. Histogram of the number of publications per year categorised by type of procedure.

Table 1.

Terms for Medline search.

Search Conducted 7th February 2021

Ovid MEDLINE(R) ALL <1946 to February 04, 2021>

1	Elbow Prosthesis/ or Arthroplasty, Replacement, Elbow/	485
2	(elbow* adj3 (arthroplast* or replacement* or hemiarthroplast* or hemireplacement*)).tw.	1217
3	((radial head or capitell*) adj3 (arthroplast* or replacement* or hemiarthroplast* or hemireplacement*)).tw.	453
4	1 or 2 or 3	1721
5	((interposition or osteocapsular or arthroscop*) adj arthroplasty).tw.	430
6	4 not 5	1671
7	exp animals/ not humans.sh.	4787332
8	6 not 7	1653
9	limit 8 to yr="1990 -Current"	1480

Table 2.

Country	Number	%
USA	91	25%
UK	52	14%
France	25	7%
Japan	19	5%
Italy	18	5%
Netherlands	18	5%
Canada	16	4%
Germany	16	4%
Sweden	12	3%
Finland	11	3%

Table 3

	Mean	Median	Min	Max
Observational studies	67	32	10	1441
Randomised trial	38	40	20	60
Admin database	7819	1625	176	56379
Registry study	692	584	126	1457

Table 4

	RA	OA	Post Trauma	Acute Trauma	Other
Total elbow replacement	61%	5%	16%	18%	2%
Distal humerus hemireplacement	0%	0%	15%	85%	0%
Radial head replacement	<1%	<1%	12%	87%	<1%
Radiocapitellar replacement	11%	58%	27%	1%	3%

Table 5

	Mean % female	Mean of minimum age in years (range)	Mean of maximum age in years (range)	Mean of mean age in years (range)
Total elbow replacement	76	36 (5-75)	81 (40-97)	61 (28-85)
Distal humerus hemireplacement	85	47 (16-62)	81 (63-90)	67 (45-79)
Radiocapitellar replacement	51	31 (25-40)	74 (69-82)	55 (53-61)
Radial head replacement	46	23 (14-62)	75 (50-93)	49 (31-67)

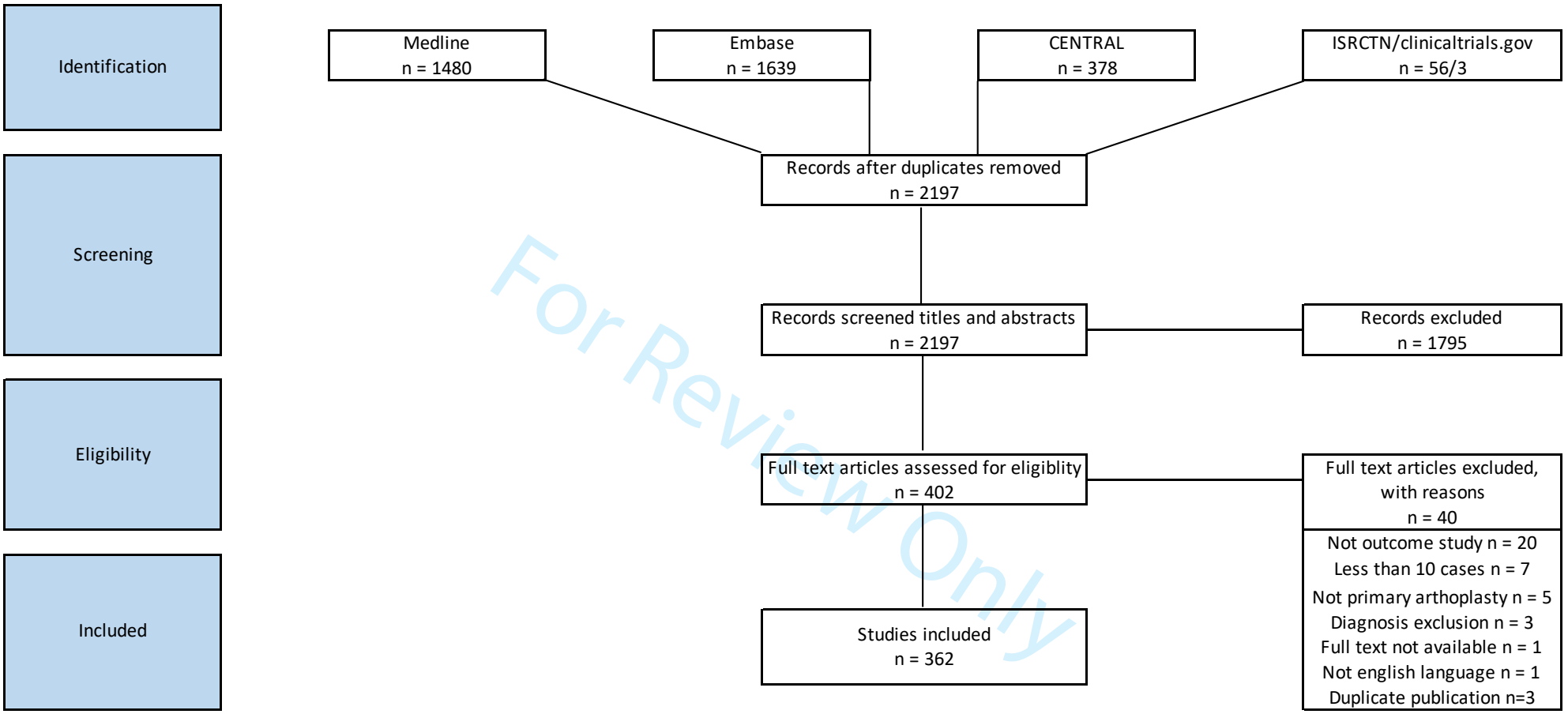
Table 6

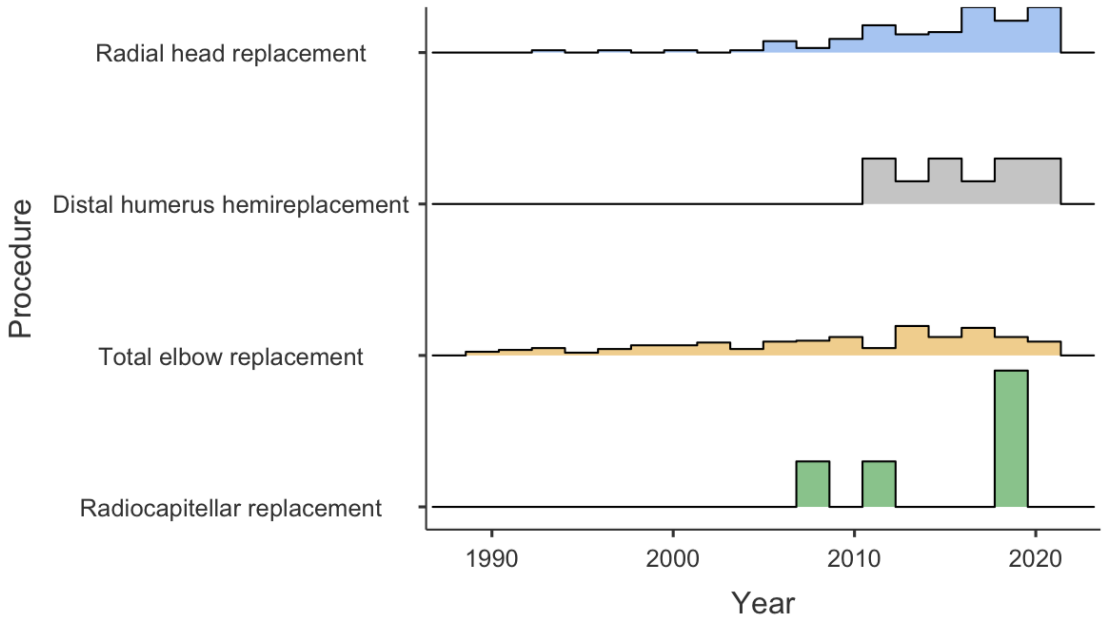
Domain	Outcome	
Adverse events (311)	Post-operative pain Radiographic complications Infection Triceps weakness Neurological Effusion/Synovitis	Implant related Wound problems Stiffness Bone problems Transfusion Medical complications
Physical function (93)	Function/disability Range of movement	Strength Activities of daily living
MSK connective tissue (37)	Radiographic appearance Elbow stability	
Need for further intervention (34)	Re-operation Implant revision/survival	
Nervous system (30)	Pain Neurological status	
Delivery of care (15)	Satisfaction	
Social function (13)	Sport participation Social-psychological status	
Hospital resources (11)	Length of stay Re-admission	Return to operating room Length of surgery
Role function (8)	Return to work	
Perceived health (7)	General health	
Economic resource (7)	Hospital costs Non-routine discharge costs	
Mortality /Survival (6)	Mortality	
Psychiatric (3)	Mental health	
Quality of life (2)	Quality of life	
Emotional well-being (2)	Well-being Role emotional	
Cognitive function (1)	Cognitive status	
Personal circumstances (1)	Patient autonomy	
Societal carer burden (1)	Non-homebound discharge	

Table 7

Outcome	Instrument
Activities of daily living	Liverpool elbow score, Mayo elbow performance index, Mayo elbow performance score, UCLA Activity score, Wrightington score
Cognitive status	MMSE
Complications	Voloshin
Cost utility analysis	QALY
Deformity	Ewald scoring system, JOA score
Function	Andrews score, ASES score, Broberg Morrey score, DASH score, Elbex score, Elbow functional assessment, Ewald score, Inglis score, JOA score, Khatri score, likert scale, Liverpool elbow score, Mayo elbow performance index, Mayo elbow performance score, numerical rating scale, Oxford score, PREE, QuickDASH, SANE, SECEC, Souter, Stanford health assessment questionnaire, VAS
Global Health	EQ5D
Grip strength	ASES, Broberg Morrey, Dynamometer, NK hand evaluation system
Implant Survival	Dobbs, Kaplan-Meier, Life table, Murray
Joint position sense	Propriometer
Locomotion	Linkoping
Mental health	SF-12 Mental
Pain	ASES, Broberg Morrey, DASH, Elbow functional assessment, Ewald score, Inglis score, JOA score, Khatri score, likert scale, Mayo elbow performance score, Modified Andrews score, numeric rating scale, Oxford elbow score, Liverpool elbow score, Pain intensity scle, PREE, VAS
Patient Autonomy	Katz
Physical health	SF-12 physical
Quality of life	RAND-36, SF-36
Radial Nerve Palsy	Hirachi, Electrophysiology
Range of motion	ASES, Broberg Morrey, Cassebaum, Elbow functional assessment, Ewald score, HSS score, JOA score, Inglis score, Khatri score, likert, Liverpool elbow socre, Mayo elbow performance index, Mayo elbow performance score, Modified Andrews, NK hand evaluation system, Propriometer
Return to Work	binary
Satisfaction	ASES, binary, Jungbluth, likert scale, numerical rating scale, SANE, VAS
Sport participation	Allain, Liverpool elbow score
Stability	ASES, Broberg Morrey, Elbow functional assessment, JOA score, likert, Mayo elbow performance index, Mayo elbow performance score, Modified Andrews score
Strength	ASES, Broberg Morrey, HSS score, Isobex, Kindeyn Dynamometer, Lido workset, Mayo elbow performance index, Mayo elbow performance score, MRC scale, likert, Liverpool elbow score
Success of treatment	VAS
Tenderness	ASES
Ulnar nerve function	Electophysiology, Liverpool elbow score, McGowan grade
Radiographic alignment	Figgie, H index, O'Driscoll, RSA analysis, Storen's line, U index, Wrightington
Radiographic bushing wear	Gill, Llamas, Lee, Mayo, Ramsey, Schneeberger
Radiographic capitellum erosion	Broberg Morrey, likert scale, Llamas
Radiographic heterotopic ossification	binary, Brooker, Hastings and Graham, Ilahi, likert
Radiographic loosening	Berschback, binary, Cil, Gill and Morrey, Goldberg, Grewal, Harris, King, likert scale, Madsen, Mayo, Morrey and Adams, Popovic, Schneeberger, Wagener, Wrightington
Radiographic lucency	binary, Fehringer, Gruen, Kodde, Kudo and Iwano, Morrey, Souter, Tanaka, Wrightington
Radiographic medial collateral ligament healing	Ultrasound
Radiographic osteoarthrosis	binary, Broberg Morrey, Kellgren Lawrence, Knirk and Jupiter, Lindenhovius, likert scale
Radiographic overstuffing	Rowland, Van Riet
Radiographic quality cement technique	Schneeberger
Radiographic radial head prominence	Doornberg
Radiographic synovitis	Forster
Radiographic ulna wear	Smith and Hughes

Flow Diagram Scoping Review Literature Search




Radial head replacement
Distal humerus hemireplacement
Total elbow replacement
Radiocapitellar replacement
Procedure
1990
2000
2010
2020
Year

1. Abdulla IN, Molony DC, Symes M, Cass B. Radial head replacement with pyrocarbon prosthesis: early clinical results. ANZ J Surg. 2015;85(5):368-72.
2. Afifi A, Lymona AM, Galal S. Radial Head Fixation vs Replacement in Terrible Triad: Preliminary Results of a Prospective Cohort Study with Patient Reported Outcome. Indian j. 2020;54(Suppl 2):254-9.
3. Al-Burdeni S, Abuodeh Y, Ibrahim T, Ahmed G. Open reduction and internal fixation versus radial head arthroplasty in the treatment of adult closed comminuted radial head fractures (modified Mason type III and IV). Int Orthop. 2015;39(8):1659-64.
4. Al-Hamdani A, Rasmussen JV, Holtz K, Olsen BS. Elbow hemiarthroplasty versus open reduction and internal fixation for AO/OTA type 13 C2 and C3 fractures of distal humerus in patients aged 50 years or above: a randomized controlled trial. Trials. 2020;21(1):497.
5. Al-Hamdani A, Rasmussen JV, Sorensen AKB, Ovesen J, Holtz K, Brorson S, et al. Good outcome after elbow hemiarthroplasty in active patients with an acute intra-articular distal humeral fracture. J Shoulder Elbow Surg. 2019;28(5):925-30.
6. Al-Kussary I, Al-Akkad M, Khallaf F. Prosthetic replacement of radial head in the surgical management of fracture dislocation of the elbow. Do we really need to repair the MCL or to use the hinged external fixator or cross pins? Kuwait Medical Journal. 2015;47(1):10-6.
7. Albert BM, Lee A, McLendon TW, Devereaux RS, Odum CC, Foulkes GD. Is Total Elbow Arthroplasty Safe as an Outpatient Procedure? J Surg Orthop Adv. 2017;26(1):25-8.
8. Aldridge JM, 3rd, Lightdale NR, Mallon WJ, Coonrad RW. Total elbow arthroplasty with the Coonrad/Coonrad-Morrey prosthesis. A 10- to 31-year survival analysis. J Bone Joint Surg Br. 2006;88(4):509-14.
9. Ali A, Shahane S, Stanley D. Total elbow arthroplasty for distal humeral fractures: indications, surgical approach, technical tips, and outcome. J Shoulder Elbow Surg. 2010;19(2 Suppl):53-8.
10. Alizadehkhaiyat O, Al Mandhari A, Sinopidis C, Wood A, Frostick S. Total elbow arthroplasty: a prospective clinical outcome study of Discovery Elbow System with a 4-year mean follow-up. J Shoulder Elbow Surg. 2015;24(1):52-9.
11. Allavena C, Delclaux S, Bonnevialle N, Rongieres M, Bonnevialle P, Mansat P. Outcomes of bipolar radial head prosthesis to treat complex radial head fractures in 22 patients with a mean follow-up of 50 months. Orthop Traumatol Surg Res. 2014;100(7):703-9.
12. Allieu Y, Meyer zu Reckendorf G, Daude O. Long-term results of unconstrained Roper-Tuke total elbow arthroplasty in patients with rheumatoid arthritis. J Shoulder Elbow Surg. 1998;7(6):560-4.
13. Allieu Y, Winter M, Pequignot JP, De Mourgues P. Radial head replacement with a pyrocarbon head prosthesis: Preliminary results of a multicentric prospective study. European Journal of Orthopaedic Surgery and Traumatology. 2006;16(1):1-9.
14. Amirfeyz R, Blewitt N. Mid-term outcome of GSB-III total elbow arthroplasty in patients with rheumatoid arthritis and patients with post-traumatic arthritis. Arch Orthop Trauma Surg. 2009;129(11):1505-10.
15. Angst F, Goldhahn J, Drerup S, Kolling C, Aeschlimann A, Simmen BR, et al. Responsiveness of five outcome measurement instruments in total elbow arthroplasty. Arthritis Care Res (Hoboken). 2012;64(11):1749-55.
16. Angst F, John M, Pap G, Mannion AF, Herren DB, Flury M, et al. Comprehensive assessment of clinical outcome and quality of life after total elbow

arthroplasty. Arthritis Rheum. 2005;53(1):73-82.
17. Antoni M, Ginot G, Mereb T, Clement X, Eichler D, Kempf JF, et al. Post-traumatic elbow osteoarthritis after radial head arthroplasty: Prevalence and risk factors. Orthop Traumatol Surg Res. 2021:102814.
18. Antuna SA, Laakso RB, Barrera JL, Espiga X, Ferreres A. Linked total elbow arthroplasty as treatment of distal humerus fractures. Acta Orthop Belg. 2012;78(4):465-72.
19. Argintar E, Berry M, Narvy SJ, Kramer J, Omid R, Itamura JM. Hemiarthroplasty for the treatment of distal humerus fractures: short-term clinical results. Orthopedics. 2012;35(12):1042-5.
20. Ashmore AM, Gozzard C, Blewitt N. Use of the Liverpool Elbow Score as a postal questionnaire for the assessment of outcome after total elbow arthroplasty. J Shoulder Elbow Surg. 2007;16(3 Suppl):S55-8.
21. Ashwood N, Bain GI, Unni R. Management of Mason type-III radial head fractures with a titanium prosthesis, ligament repair, and early mobilization. J Bone Joint Surg Am. 2004;86(2):274-80.
22. Baek CS, Kim BS, Kim DH, Cho CH. Short- to mid-term outcomes of radial head replacement for complex radial head fractures. Clinics in Shoulder & Elbow. 2020;23(4):183-9.
23. Baghdadi YM, Jacobson JA, Duquin TR, Larson DR, Morrey BF, Sanchez-Sotelo J. The outcome of total elbow arthroplasty in juvenile idiopathic arthritis (juvenile rheumatoid arthritis) patients. J Shoulder Elbow Surg. 2014;23(9):1374-80.
24. Baghdadi YMK, Veillette CJH, Malone AA, Morrey BF, Sanchez-Sotelo J. Total elbow arthroplasty in obese patients. Journal of Bone and Joint Surgery - American Volume. 2014;96(9):e70.1-e.7.
25. Bai XS, Petscavage-Thomas JM, Ha AS. Total elbow arthroplasty: a radiographic outcome study. Skeletal Radiol. 2016;45(6):789-94.
26. Baik JS, Lee SH, Kang HT, Song TH, Kim JW. Comparison of open reduction and internal fixation with total elbow arthroplasty for intra-articular distal humeral fractures in older age: a retrospective study. Clinics in Shoulder & Elbow. 2020;23(2):94-9.
27. Baksi D, Pal AK, Baksi DP. Sloppy Hinge Prosthetic Replacement in Old Healed Side Swipe Injuries of Elbow - Long term Results. Indian j. 2018;52(2):177-83.
28. Baksi DP, Pal AK, Baksi D. Prosthetic replacement of elbow for intercondylar fractures (recent or ununited) of humerus in the elderly. Int Orthop. 2011;35(8):1171-7.
29. Barco R, Streubel PN, Morrey BF, Sanchez-Sotelo J. Total Elbow Arthroplasty for Distal Humeral Fractures: A Ten-Year-Minimum Follow-up Study. J Bone Joint Surg Am. 2017;99(18):1524-31.
30. Barlow JD, Morrey BF, O'Driscoll SW, Steinmann SP, Sanchez-Sotelo J. Activities after total elbow arthroplasty. J Shoulder Elbow Surg. 2013;22(6):787-91.
31. Barthel PY, Mansat P, Sirveaux F, Dap F, Mole D, Dautel G. Is total elbow arthroplasty indicated in the treatment of traumatic sequelae? 19 cases of Coonrad-Morrey(R) reviewed at a mean follow-up of 5.2 years. Orthop Traumatol Surg Res. 2014;100(1):113-8.
32. Bassi RS, Simmons D, Ali F, Nuttall D, Birch A, Trail IA, et al. Early results of the Acclaim elbow replacement. J Bone Joint Surg Br. 2007;89(4):486-9.
33. Benegas E, Malavolta EA, Gracitelli ME, de Sousa AT, Miyazaki AN, Fregoneze M, et al. Results from Bi-Contact(R) Total Elbow Arthroplasty: Multicenter

Study. Rev. 2011;46(5):565-71.
34. Berschback JC, Lynch TS, Kalainov DM, Wysocki RW, Merk BR, Cohen MS. Clinical and radiographic comparisons of two different radial head implant designs. J Shoulder Elbow Surg. 2013;22(8):1108-20.
35. Bigsby E, Kemp M, Siddiqui N, Blewitt N. The long-term outcome of the Gschwend-Scheier-Bahler III elbow replacement. J Shoulder Elbow Surg. 2016;25(3):362-8.
36. Biomet Z. Clinical Outcomes Study of the Nexel Total Elbow. https://ClinicalTrials.gov/show/NCT02469662; 2015.
37. Blewitt N, Pooley J. Elbow lengthening after total prosthetic arthroplasty: Observations and clinical implications. J Shoulder Elbow Surg. 1994;3(4):200-6.
38. Borton ZM, Prasad G, Konstantopoulos G, Morgan ML, Cresswell T, Espag MP, et al. Mid-long term survivorship of the cemented, semi-constrained "Discovery" total elbow arthroplasty. J Shoulder Elbow Surg. 2021;21:21.
39. Bowman SH, Barfield WR, Slone HS, Shealy GJ, Walton ZJ. The clinical implications of heterotopic ossification in patients treated with radial head replacement for trauma: A case series and review of the literature. Journal of Orthopaedics. 2016;13(4):272-7.
40. Brady O, Quinlan W. The Guildford elbow. J Hand Surg [Br]. 1993;18(3):389-93.
41. Brinkman JM, De Vos MJ, Eygendaal D. Failure mechanisms in uncemented Kudo type 5 elbow prosthesis in patients with rheumatoid arthritis: 7 of 49 Ulnar components revised because of loosening after 2-10 years. Acta Orthop. 2007;78(2):263-70.
42. Brinkman JM, Rahusen FT, de Vos MJ, Eygendaal D. Treatment of sequelae of radial head fractures with a bipolar radial head prosthesis: good outcome after 1-4 years follow-up in 11 patients. Acta Orthop. 2005;76(6):867-72.
43. Burkhart KJ, Mattyasovszky SG, Runkel M, Schwarz C, Kuchle R, Hessmann MH, et al. Mid- to long-term results after bipolar radial head arthroplasty. J Shoulder Elbow Surg. 2010;19(7):965-72.
44. Burkhart KJ, Nijs S, Mattyasovszky SG, Wouters R, Gruszka D, Nowak TE, et al. Distal humerus hemiarthroplasty of the elbow for comminuted distal humeral fractures in the elderly patient. J Trauma. 2011;71(3):635-42.
45. Burnett R, Fyfe IS. Souter-Strathclyde arthroplasty of the rheumatoid elbow. 23 cases followed for 3 years. Acta Orthop Scand. 1991;62(1):52-4.
46. Canovas F, Ledoux D, Bonnel F. Total elbow arthroplasty in rheumatoid arthritis: 20 GSBIII prostheses followed 2-5 years. Acta Orthop Scand. 1999;70(6):564-8.
47. Carbonell-Escobar R, Vaquero-Picado A, Barco R, Antuna S. Neurologic complications after surgical management of complex elbow trauma requiring radial head replacement. J Shoulder Elbow Surg. 2020;29(6):1282-8.
48. Carita E, Donadelli A, Cugola L, Perazzini P. Radial head prosthesis: results overview. Musculoskelet Surg. 2017;101(Suppl 2):197-204.
49. Celli A. A new posterior triceps approach for total elbow arthroplasty in patients with osteoarthritis secondary to fracture: preliminary clinical experience. J Shoulder Elbow Surg. 2016;25(8):e223-31.
50. Celli A, Arash A, Adams RA, Morrey BF. Triceps insufficiency following total elbow arthroplasty. J Bone Joint Surg Am. 2005;87(9):1957-64.
51. Celli A, Bonucci P. The anconeus-triceps lateral flap approach for total elbow arthroplasty in rheumatoid arthritis. Musculoskelet Surg. 2016;100(Suppl 1):73-83.

52. Celli A, Modena F, Celli L. The acute bipolar radial head replacement for isolated unreconstructable fractures of the radial head. Musculoskelet Surg. 2010;94 Suppl 1:S3-9.
53. Celli A, Morrey BF. Total elbow arthroplasty in patients forty years of age or less. J Bone Joint Surg Am. 2009;91(6):1414-8.
54. Cesar M, Roussanne Y, Bonnel F, Canovas F. GSB III total elbow replacement in rheumatoid arthritis. J Bone Joint Surg Br. 2007;89(3):330-4.
55. Chalidis B, Dimitriou C, Papadopoulos P, Petsatodis G, Giannoudis PV. Total elbow arthroplasty for the treatment of insufficient distal humeral fractures. A retrospective clinical study and review of the literature. Injury. 2009;40(6):582-90.
56. Chapman CB, Su BW, Sinicropi SM, Bruno R, Strauch RJ, Rosenwasser MP. Vitallium radial head prosthesis for acute and chronic elbow fractures and fracture-dislocations involving the radial head. J Shoulder Elbow Surg. 2006;15(4):463-73.
57. Chen AC, Chou YC, Weng CJ, Cheng CY. Long-term outcomes of modular metal prosthesis replacement in patients with irreparable radial head fractures. Journal of Orthopaedic Surgery. 2018;13(1):134.
58. Chen AC, Weng CJ, Chiu CH, Chang SS, Cheng CY, Chan YS. Retrospective cohort study on radial head arthroplasty comparing long-term outcomes between valgus type injury and fracture dislocation. BMC Musculoskelet Disord. 2020;21(1):763.
59. Chen D, Luo L, Liu J, Li S. The outcome comparison of arthroplasty and ORIF for mason type iii radial head fractures. Int J Clin Exp Med. 2018;11(8):8282-8.
60. Chen X, Wang SC, Cao LH, Yang GQ, Li M, Su JC. Comparison between radial head replacement and open reduction and internal fixation in clinical treatment of unstable, multi-fragmented radial head fractures. Int Orthop. 2011;35(7):1071-6.
61. Cheung EV, O'Driscoll SW. Total elbow prosthesis loosening caused by ulnar component pistoning. J Bone Joint Surg Am. 2007;89(6):1269-74.
62. Chien HY, Chen AC, Huang JW, Cheng CY, Hsu KY. Short- to medium-term outcomes of radial head replacement arthroplasty in posttraumatic unstable elbows: 20 to 70 months follow-up. Chang Gung Med J. 2010;33(6):668-78.
63. Chiu KY, Luk KDK, Pun WK. Souter-Strathclyde elbow replacement for severe rheumatoid arthritis. Journal of Orthopaedic Rheumatology. 1996;9(4):194-9.
64. Cil A, Veillette CJ, Sanchez-Sotelo J, Morrey BF. Linked elbow replacement: a salvage procedure for distal humeral nonunion. J Bone Joint Surg Am. 2008;90(9):1939-50.
65. Cinats D, Bois AJ, Hildebrand KA. Clinical outcomes and complications following primary total elbow arthroplasty using the Latitude prosthesis. Shoulder Elbow. 2019;11(5):359-71.
66. Claessen F, Bexkens R, Kodde IF, Doornberg JN, Bekerom M, Eygendaal D. Radiographic Predictors for Short-term Functional Outcome after Radial Head Arthroplasty in Patients with Persistent Symptoms after Treatment for Radial Head. Arch. 2020;8(1):27-32.
67. Cobb TK, Morrey BF. Total elbow arthroplasty as primary treatment for distal humeral fractures in elderly patients. J Bone Joint Surg Am. 1997;79(6):826-32.
68. Connor PM, Morrey BF. Total elbow arthroplasty in patients who have juvenile rheumatoid arthritis. J Bone Joint Surg Am. 1998;80(5):678-88.
69. Cook C, Hawkins R, Aldridge JM, 3rd, Tolan S, Krupp R, Bolognesi M. Comparison of perioperative complications in patients with and without rheumatoid arthritis who receive total elbow replacement. J Shoulder Elbow Surg. 2009;18(1):21-6.

70. Corradi M, Frattini M, Panno B, Tocco S, Pogliacomi F. Linked semi-constrained total elbow prosthesis in chronic arthritis: results of 18 cases. Musculoskelet Surg. 2010;94 Suppl 1:S11-23.
71. Cottias P, Leclerc P, Zaoui A, Abouchaaya AM, Khallouk R, Anract P. Digastric olecranon osteotomy a new approach to the elbow: retrospective study of 24 Coonrad-Morrey^R total elbow arthroplasty at 30-month follow-up. Eur. 2020;30(3):485-91.
72. Cristofaro CD, Carter TH, Wickramasinghe NR, McQueen MM, White TO, Duckworth AD. High Risk of Further Surgery After Radial Head Replacement for Unstable Fractures: Longer-term Outcomes at a Minimum Follow-up of 8 Years. Clin Orthop. 2019;477(11):2531-40.
73. Crook TB, Bissell IJ, Barham GS, Hargreaves DG. Upper limb function improvement following total elbow arthroplasty in patients with rheumatoid arthritis. European Journal of Orthopaedic Surgery and Traumatology. 2008;18(4):307-10.
74. Cross MB, Cicalese E, Nam D, McArthur BA, Lipman JD, Figgie MP. Results of custom-fit, noncemented, semiconstrained total elbow arthroplasty for inflammatory arthritis at an average of eighteen years of follow-up. J Shoulder Elbow Surg. 2014;23(9):1368-73.
75. Cutler HS, Collett G, Farahani F, Ahn J, Nakonezny P, Koehler D, et al. Thirty-day readmissions and reoperations after total elbow arthroplasty: a national database study. J Shoulder Elbow Surg. 2021;30(2):e41-e9.
76. Dachs RP, Fleming MA, Chivers DA, Carrara HR, Du Plessis JP, Vrettos BC, et al. Total elbow arthroplasty: outcomes after triceps-detaching and triceps-sparing approaches. J Shoulder Elbow Surg. 2015;24(3):339-47.
77. Dachs RP, Vrettos BC, Chivers DA, Du Plessis JP, Roche SJ. Outcomes After Ulnar Nerve In Situ Release During Total Elbow Arthroplasty. Journal of Hand Surgery - American Volume. 2015;40(9):1832-7.
78. Dainton JN, Hutchins PM. A medium-term follow-up study of 44 Souter-Strathclyde elbow arthroplasties carried out for rheumatoid arthritis. J Shoulder Elbow Surg. 2002;11(5):486-92.
79. Dalemans A, De Smet L, Degreef I. Long-term outcome of elbow resurfacing. J Shoulder Elbow Surg. 2013;22(11):1455-60.
80. Dehghan N, Furey M, Schemitsch L, Ristevski B, Goetz T, Schemitsch EH, et al. Long-term outcomes of total elbow arthroplasty for distal humeral fracture: results from a prior randomized clinical trial. J Shoulder Elbow Surg. 2019;28(11):2198-204.
81. Dennis DA, Clayton ML, Ferlic DC, Stringer EA, Bramlett KW. Capitello-Condylar total elbow arthroplasty for rheumatoid arthritis. J Arthroplasty. 1990;5 Suppl:S83-8.
82. deVos MJ, Verdonschot N, Luites JW, Anderson PG, Eygendaal D. Stable fixation of the IBP humeral component implanted without cement in total elbow replacement: a radiostereometric analysis study of 16 elbows at two-year follow-up. Bone Joint J. 2014;96-B(2):229-36.
83. Dhar S, Beddow FH. The modified Liverpool total elbow prosthesis. J Hand Surg [Br]. 1994;19(2):224-8.
84. Doornberg JN, Parisien R, van Duijn PJ, Ring D. Radial head arthroplasty with a modular metal spacer to treat acute traumatic elbow instability. J Bone Joint Surg Am. 2007;89(5):1075-80.
85. Dotzis A, Cochu G, Mabit C, Charissoux JL, Arnaud JP. Comminuted fractures of the radial head treated by the Judet floating radial head prosthesis. J Bone Joint Surg Br. 2006;88(6):760-4.

86. Duckworth AD, Wickramasinghe NR, Clement ND, Court-Brown CM, McQueen MM. Radial head replacement for acute complex fractures: what are the rate and risks factors for revision or removal? Clin Orthop. 2014;472(7):2136-43.
87. Ducrot G, Ehlinger M, Adam P, Di Marco A, Clavert P, Bonnomet F. Complex fractures of the distal humerus in the elderly: is primary total elbow arthroplasty a valid treatment alternative? A series of 20 cases. Orthop Traumatol Surg Res. 2013;99(1):10-20.
88. Duncan SF, Sperling JW, Morrey BF. Prevalence of pulmonary embolism after total elbow arthroplasty. J Bone Joint Surg Am. 2007;89(7):1452-3.
89. Duncan SF, Sperling JW, Morrey BF. Incidence and risk factors for blood transfusion in total elbow arthroplasty. J Shoulder Elbow Surg. 2008;17(6):961-2.
90. Dunn JC, Kusnezov NA, Koehler LR, Eisenstein ED, Kilcoyne KG, Orr JD, et al. Radial Head Arthroplasty in the Active Duty Military Service Member With Minimum 2-Year Follow-Up. Journal of Hand Surgery - American Volume. 2017;42(8):660.e1-.e7.
91. El Sallakh S. Radial head replacement for radial head fractures. J Orthop Trauma. 2013;27(6):e137-40.
92. Espag MP, Back DL, Clark DI, Lunn PG. Early results of the Souter-Strathclyde unlinked total elbow arthroplasty in patients with osteoarthritis. J Bone Joint Surg Br. 2003;85(3):351-3.
93. Ewald FC, Simmons ED, Jr., Sullivan JA, Thomas WH, Scott RD, Poss R, et al. Capitellocondylar total elbow replacement in rheumatoid arthritis. Long-term results. J Bone Joint Surg Am. 1993;75(4):498-507.
94. Fehringer EV, Burns EM, Knierim A, Sun J, Apker KA, Berg RE. Radiolucencies surrounding a smooth-stemmed radial head component may not correlate with forearm pain or poor elbow function. J Shoulder Elbow Surg. 2009;18(2):275-8.
95. Fevang BT, Lie SA, Havelin LI, Skredderstuen A, Furnes O. Results after 562 total elbow replacements: a report from the Norwegian Arthroplasty Register. J Shoulder Elbow Surg. 2009;18(3):449-56.
96. Flinkkila T, Kaisto T, Sirnio K, Hyvonen P, Leppilahti J. Short- to mid-term results of metallic press-fit radial head arthroplasty in unstable injuries of the elbow. J Bone Joint Surg Br. 2012;94(6):805-10.
97. Frankle MA, Herscovici D, Jr., DiPasquale TG, Vasey MB, Sanders RW. A comparison of open reduction and internal fixation and primary total elbow arthroplasty in the treatment of intraarticular distal humerus fractures in women older than age 65. J Orthop Trauma. 2003;17(7):473-80.
98. Frostick SP, Elsheikh AA, Mohammed AA, Wood A. Results of cementless total elbow arthroplasty using the Discovery elbow system at a mean follow-up of 61.8 months. J Shoulder Elbow Surg. 2017;26(8):1348-54.
99. Furman AA, Sherman AE, Plantz MA, Marra G, Saltzman MD. Differences in 30-day outcomes between inpatient and outpatient total elbow arthroplasty (TEA). J Shoulder Elbow Surg. 2020;29(12):2640-5.
100. Gallucci GL, Larrondo Calderon W, Boretto JG, Castellaro Lantermo JA, Teran J, de Carli P. Total elbow arthroplasty for the treatment of distal humeral fractures. Revista Espanola de Cirugia Ortopedica y Traumatologia. 2016;60(3):167-74.
101. Gambirasio R, Riand N, Stern R, Hoffmeyer P. Total elbow replacement for complex fractures of the distal humerus. An option for the elderly patient. J Bone Joint Surg Br. 2001;83(7):974-8.

102. Garcia JA, Mykula R, Stanley D. Complex fractures of the distal humerus in the elderly. The role of total elbow replacement as primary treatment. J Bone Joint Surg Br. 2002;84(6):812-6.
103. Gauci MO, Winter M, Dumontier C, Bronsard N, Allieu Y. Clinical and radiologic outcomes of pyrocarbon radial head prosthesis: midterm results. J Shoulder Elbow Surg. 2016;25(1):98-104.
104. Gay DM, Lyman S, Do H, Hotchkiss RN, Marx RG, Daluiski A. Indications and reoperation rates for total elbow arthroplasty: an analysis of trends in New York State. J Bone Joint Surg Am. 2012;94(2):110-7.
105. Giannicola G, Angeloni R, Mantovani A, Rebuzzi E, Merolla G, Greco A, et al. Open debridement and radiocapitellar replacement in primary and post-traumatic arthritis of the elbow: a multicenter study. J Shoulder Elbow Surg. 2012;21(4):456-63.
106. Giannicola G, Bullitta G, Sacchetti FM, Scacchi M, Polimanti D, Citoni G, et al. Change in quality of life and cost/utility analysis in open stage-related surgical treatment of elbow stiffness. Orthopedics. 2013;36(7):e923-30.
107. Giannicola G, Calella P, Bigazzi P, Mantovani A, Spinello P, Cinotti G. Midterm results of radiocapitellar arthroplasty of the elbow: a multicentre prospective study on two different implants. Bone Joint J. 2019;101-B(11):1362-9.
108. Giannicola G, Scacchi M, Polimanti D, Cinotti G. Discovery elbow system: 2- to 5-year results in distal humerus fractures and posttraumatic conditions: a prospective study on 24 patients. Journal of Hand Surgery - American Volume. 2014;39(9):1746-56.
109. Gill DR, Morrey BF. The Coonrad-Morrey total elbow arthroplasty in patients who have rheumatoid arthritis. A ten to fifteen-year follow-up study. J Bone Joint Surg Am. 1998;80(9):1327-35.
110. Goodman AD, Johnson JP, Kleiner JE, Gil JA, Daniels AH. The expanding use of total elbow arthroplasty for distal humerus fractures: a retrospective database analysis of 56,379 inpatients from 2002-2014. Phys Sportsmed. 2018;46(4):492-8.
111. Goyal N, Bohl DD, Ong KL, Lau E, Nicholson GP, Wysocki RW. Reoperation Risk After Total Elbow Arthroplasty Versus Open Reduction Internal Fixation for Distal Humerus Fractures in Elderly Patients. J Orthop Trauma. 2020;34(9):503-9.
112. Gramlich Y, Krausch E, Stein T, Schmidt-Horlohe K, Hoffmann R, Klug A. Mid-term clinical outcome comparison of long-stemmed monopolar osseointegrated and short-stemmed bipolar radial head prostheses. Arch Orthop Trauma Surg. 2020;27:27.
113. Gramlich Y, Krausch EL, Klug A, Buckup J, Schmidt-Horlohe K, Hoffmann R. Complications after radial head arthroplasty: a comparison between short-stemmed bipolar and monopolar long-stemmed osteointegrative rigidly fixed prostheses. Int Orthop. 2019;43(8):1917-25.
114. Grewal R, MacDermid JC, Faber KJ, Drosdowech DS, King GJ. Comminuted radial head fractures treated with a modular metallic radial head arthroplasty. Study of outcomes. J Bone Joint Surg Am. 2006;88(10):2192-200.
115. Griffin JW, Werner BC, Gwathmey FW, Chhabra AB. Obesity is associated with increased postoperative complications after total elbow arthroplasty. J Shoulder Elbow Surg. 2015;24(10):1594-601.
116. Gschwend N, Scheier NH, Baehler AR. Long-term results of the GSB III elbow arthroplasty. J Bone Joint Surg Br. 1999;81(6):1005-12.
117. Gschwend N, Simmen BR, Matejovsky Z. Late complications in elbow arthroplasty. J Shoulder Elbow Surg. 1996;5(2 Pt 1):86-96.

118. Ha AS, Petscavage JM, Chew FS. Radial head arthroplasty: a radiologic outcome study. AJR Am J Roentgenol. 2012;199(5):1078-82.
119. Hanninen P, Niinimaki T, Flinkkila T, Niinimaki J, Ohtonen P, Yli-Luukko S, et al. Discovery Elbow System: clinical and radiological results after 2- to 10-year follow-up. Eur. 2017;27(7):901-7.
120. Hari Krishnan B, Gupta TP. Bipolar radial head arthroplasty for management of radial head fractures. Journal of Arthroscopy and Joint Surgery. 2019;6(1):48-52.
121. Harrington IJ, Sekyi-Otu A, Barrington TW, Evans DC, Tuli V. The functional outcome with metallic radial head implants in the treatment of unstable elbow fractures: a long-term review. J Trauma. 2001;50(1):46-52.
122. Hastings H, 2nd, Lee DH, Pietrzak WS. A prospective multicenter clinical study of the Discovery elbow. J Shoulder Elbow Surg. 2014;23(5):e95-e107.
123. Heijink A, Kodde IF, Mulder PGH, Van Dijk CN, Eygendaal D. Cemented bipolar radial head arthroplasty: midterm follow-up results. J Shoulder Elbow Surg. 2016;25(11):1829-38.
124. Hildebrand KA, Patterson SD, Regan WD, MacDermid JC, King GJ. Functional outcome of semiconstrained total elbow arthroplasty. J Bone Joint Surg Am. 2000;82(10):1379-86.
125. Hodgson SP, Parkinson RW, Noble J. Capitellocondylar total elbow replacement for rheumatoid arthritis. J R Coll Surg Edinb. 1991;36(2):133-5.
126. Ibrahim EF, Rashid A, Thomas M. Linked semiconstrained and unlinked total elbow replacement in juvenile idiopathic arthritis: a case comparison series with mean 11.7-year follow-up. J Shoulder Elbow Surg. 2017;26(2):305-13.
127. Ikavalko M, Belt EA, Kautiainen H, Lehto MU. Souter arthroplasty for elbows with severe destruction. Clin Orthop. 2004(421):126-33.
128. Ikavalko M, Belt EA, Kautiainen H, Lehto MUK. Revisions for aseptic loosening in Souter-Strathclyde elbow arthroplasty: Incidence of revisions of different components used in 522 consecutive cases. Acta Orthop Scand. 2002;73(3):257-63.
129. Ikavalko M, Lehto MU. Fractured rheumatoid elbow: treatment with Souter elbow arthroplasty--a clinical and radiologic midterm follow-up study. J Shoulder Elbow Surg. 2001;10(3):256-9.
130. Ikavalko M, Lehto MU, Repo A, Kautiainen H, Hamalainen M. The Souter-Strathclyde elbow arthroplasty. A clinical and radiological study of 525 consecutive cases. J Bone Joint Surg Br. 2002;84(1):77-82.
131. Ikavalko M, Tiihonen R, Skytta ET, Belt EA. Long-term survival of the Souter-Strathclyde total elbow replacement in patients with rheumatoid arthritis. J Bone Joint Surg Br. 2010;92(5):656-60.
132. Inglis AE, Inglis AE, Jr., Figgie MM, Asnis L. Total elbow arthroplasty for flail and unstable elbows. J Shoulder Elbow Surg. 1997;6(1):29-36.
133. Ishii K, Mochida Y, Harigane K, Mitsugi N, Taki N, Mitsuhashi S, et al. Clinical and radiological results of GSB III total elbow arthroplasty in patients with rheumatoid arthritis. Mod Rheumatol. 2012;22(2):223-7.
134. Jenkins PJ, Watts AC, Norwood T, Duckworth AD, Rymaszewski LA, McEachan JE. Total elbow replacement: outcome of 1,146 arthroplasties from the Scottish Arthroplasty Project. Acta Orthop. 2013;84(2):119-23.
135. Jensen CH, Jacobsen S, Ratchke M, Sonne-Holm S. The GSB III elbow prosthesis in rheumatoid arthritis: a 2- to 9-year follow-up. Acta Orthop. 2006;77(1):143-8.
136. Jeon IH, Morrey BF, Anakwenze OA, Tran NV. Incidence and implications of early postoperative wound complications after total elbow arthroplasty. J Shoulder

Elbow Surg. 2011;20(6):857-65.
137. Jeon IH, Morrey BF, Sanchez-Sotelo J. Ulnar component surface finish influenced the outcome of primary Coonrad-Morrey total elbow arthroplasty. J Shoulder Elbow Surg. 2012;21(9):1229-35.
138. Jimenez-Martin A, Contreras-Joya M, Navarro-Martinez S, Najarro-Cid FJ, Santos-Yubero FJ, Perez-Hidalgo S. Clinical results of radial arthroplasty in Hotchkiss' terrible triad, a case series of 47. Revista Espanola de Cirugia Ortopedica y Traumatologia. 2020;64(2):83-91.
139. Jonsson B, Larsson SE. Elbow arthroplasty in rheumatoid arthritis. Function after 1-2 years in 20 cases. Acta Orthop Scand. 1990;61(4):344-7.
140. Jost B, Adams RA, Morrey BF. Management of acute distal humeral fractures in patients with rheumatoid arthritis. A case series. J Bone Joint Surg Am. 2008;90(10):2197-205.
141. Judet T, Garreau de Loubresse C, Piriou P, Charnley G. A floating prosthesis for radial-head fractures. J Bone Joint Surg Br. 1996;78(2):244-9.
142. Jung M, Groetzner-Schmidt C, Porschke F, Grutzner PA, Guehring T, Schnetzke M. Low return-to-sports rate after elbow injury and treatment with radial head arthroplasty. J Shoulder Elbow Surg. 2019;28(8):1441-8.
143. Jung M, Groetzner-Schmidt C, Porschke F, Grutzner PA, Guehring T, Schnetzke M. Monteggia-like lesions in adults treated with radial head arthroplasty-mid-term follow-up of 27 cases. Journal of Orthopaedic Surgery. 2020;15(1):5.
144. Kachooei AR, Claessen FM, Chase SM, Verheij KK, van Dijk CN, Ring D. Factors associated with removal of a radial head prosthesis placed for acute trauma. Injury. 2016;47(6):1253-7.
145. Kachooei AR, Heesakkers NAM, Heijink A, The B, Eygendaal D. Radiocapitellar prosthetic arthroplasty: short-term to midterm results of 19 elbows. J Shoulder Elbow Surg. 2018;27(4):726-32.
146. Kamineni S, Morrey BF. Distal humeral fractures treated with noncustom total elbow replacement. J Bone Joint Surg Am. 2004;86(5):940-7.
147. Karanjia ND, Stiles PJ. The Guildford elbow. Int Orthop. 1990;14(3):315-9.
148. Kasten MD, Skinner HB. Total elbow arthroplasty. An 18-year experience. Clin Orthop. 1993(290):177-88.
149. Katthagen JC, Jensen G, Lill H, Voigt C. Monobloc radial head prostheses in complex elbow injuries: results after primary and secondary implantation. Int Orthop. 2013;37(4):631-9.
150. Kaur MN, MacDermid JC, Grewal R, Stratford P, King G. Acute postoperative pain is a predictor of chronic functional impairment 2 years after radial head arthroplasty. Critical Reviews in Physical and Rehabilitation Medicine. 2015;27(2-4):159-70.
151. Kelly EW, Coghlan J, Bell S. Five- to thirteen-year follow-up of the GSB III total elbow arthroplasty. J Shoulder Elbow Surg. 2004;13(4):434-40.
152. Khatri M, Stirrat AN. Souter-Strathclyde total elbow arthroplasty in rheumatoid arthritis: medium-term results. J Bone Joint Surg Br. 2005;87(7):950-4.
153. Kiechle M, Thannheimer A, Friederichs J, Buhren V, Hungerer S, Von Ruden C. Long-term Outcomes after Primary Radial Head Resection Arthroplasty vs. Acute radial head resection vs. Secondary prosthetic removal in comminuted radial head fractures. Archives of Bone and Joint Surgery. 2019;7(2):112-7.
154. Kiran M, Jariwala A, Wigderowitz C. Medium term outcomes of primary and revision Coonrad-Morrey total elbow replacement. Indian j. 2015;49(2):233-8.
155. Kleinlugtenbelt IV, Bakx PA, Huij J. Instrumented Bone Preserving elbow

prosthesis in rheumatoid arthritis: 2-8 year follow-up. J Shoulder Elbow Surg. 2010;19(6):923-8.
156. Klug A, Gramlich Y, Buckup J, Schweigkofler U, Hoffmann R, Schmidt-Horlohe K. Trends in total elbow arthroplasty: a nationwide analysis in Germany from 2005 to 2014. Int Orthop. 2018;42(4):883-9.
157. Kodama A, Mizuseki T, Adachi N. Kudo type-5 total elbow arthroplasty for patients with rheumatoid arthritis: a minimum ten-year follow-up study. Bone Joint J. 2017;99-B(6):818-23.
158. Kodde IF, Heijink A, Kaas L, Mulder PG, van Dijk CN, Eygendaal D. Press-fit bipolar radial head arthroplasty, midterm results. J Shoulder Elbow Surg. 2016;25(8):1235-42.
159. Kodde IF, van Riet RP, Eygendaal D. Semiconstrained total elbow arthroplasty for posttraumatic arthritis or deformities of the elbow: a prospective study. Journal of Hand Surgery - American Volume. 2013;38(7):1377-82.
160. Kondo N, Arai K, Fujisawa J, Murai T, Netsu T, Endo N, et al. Clinical outcome of Niigata-Senami-Kyocera modular unconstrained total elbow arthroplasty for destructive elbow in patients with rheumatoid arthritis. J Shoulder Elbow Surg. 2019;28(5):915-24.
161. Kraay MJ, Figgie MP, Inglis AE, Wolfe SW, Ranawat CS. Primary semiconstrained total elbow arthroplasty. Survival analysis of 113 consecutive cases. J Bone Joint Surg Br. 1994;76(4):636-40.
162. Krenek L, Farng E, Zingmond D, SooHoo NF. Complication and revision rates following total elbow arthroplasty. Journal of Hand Surgery - American Volume. 2011;36(1):68-73.
163. Krukhaug Y, Hallan G, Dybvik E, Lie SA, Furnes ON. A survivorship study of 838 total elbow replacements: a report from the Norwegian Arthroplasty Register 1994-2016. J Shoulder Elbow Surg. 2018;27(2):260-9.
164. Kudo H, Iwano K. Total elbow arthroplasty with a non-constrained surface-replacement prosthesis in patients who have rheumatoid arthritis. A long-term follow-up study. J Bone Joint Surg Am. 1990;72(3):355-62.
165. Kudo H, Iwano K, Nishino J. Cementless or hybrid total elbow arthroplasty with titanium-alloy implants. A study of interim clinical results and specific complications. J Arthroplasty. 1994;9(3):269-78.
166. Kudo H, Iwano K, Nishino J. Total elbow arthroplasty with use of a nonconstrained humeral component inserted without cement in patients who have rheumatoid arthritis. J Bone Joint Surg Am. 1999;81(9):1268-80.
167. Kumar S, Mahanta S. Primary total elbow arthroplasty. Indian j. 2013;47(6):608-14.
168. Kusnezov N, Eisenstein E, Dunn JC, Fares A, Mitchell J, Kilcoyne K, et al. Operative Management of Unstable Radial Head Fractures in a Young Active Population. Hand. 2018;13(4):473-80.
169. Laflamme M, Grenier-Gauthier PP, Leclerc A, Antoniades S, Bedard AM. Retrospective cohort study on radial head replacements comparing results between smooth and porous stem designs. J Shoulder Elbow Surg. 2017;26(8):1316-24.
170. Lamas C, Castellanos J, Proubasta I, Dominguez E. Comminuted radial head fractures treated with pyrocarbon prosthetic replacement. Hand. 2011;6(1):27-33.
171. Lami D, Chivot M, Caubere A, Galland A, Argenson JN. First-line management of distal humerus fracture by total elbow arthroplasty in geriatric traumatology: Results in a 21-patient series at a minimum 2years' follow-up. Orthop Traumatol Surg Res. 2017;103(6):891-7.

172. Landor I, Vavrik P, Jahoda D, Guttler K, Sosna A. Total elbow replacement with the Souter-Strathclyde prosthesis in rheumatoid arthritis. Long-term follow-up. J Bone Joint Surg Br. 2006;88(11):1460-3.
173. LaPorte DM, Murphy MS, Moore JR. Distal humerus nonunion after failed internal fixation: reconstruction with total elbow arthroplasty. Am J Orthop. 2008;37(10):531-4.
174. Large R, Tambe A, Cresswell T, Espag M, Clark DI. Medium-term clinical results of a linked total elbow replacement system. Bone Joint J. 2014;96-B(10):1359-65.
175. Laumonerie P, Reina N, Ancelin D, Delclaux S, Tibbo ME, Bonnevialle N, et al. Mid-term outcomes of 77 modular radial head prostheses. Bone Joint J. 2017;99-B(9):1197-203.
176. Laumonerie P, Reina N, Gutierrez C, Delclaux S, Tibbo ME, Bonnevialle N, et al. Tight-fitting radial head prosthesis: does stem size help prevent painful loosening? Int Orthop. 2018;42(1):161-7.
177. Laun R, Tanner S, Grassmann JP, Schneppendahl J, Wild M, Hakimi M, et al. Primary cemented bipolar radial head prostheses for acute elbow injuries with comminuted radial head fractures: mid-term results of 37 patients. Musculoskelet Surg. 2019;103(1):91-7.
178. Laun R, Wild M, Hakimi M. One-year results of cemented bipolar radial head prostheses for comminuted radial head fractures. GMS, Interdiscip. 2015;4:Doc12.
179. Leigh WB, Ball CM. Radial head reconstruction versus replacement in the treatment of terrible triad injuries of the elbow. J Shoulder Elbow Surg. 2012;21(10):1336-41.
180. Lenoir H, Micallef JP, Djerbi I, Waitzenegger T, Lazerges C, Chammas M, et al. Total elbow arthroplasty: Influence of implant positioning on functional outcomes. Orthop Traumatol Surg Res. 2015;101(6):721-7.
181. Levy JC, Formaini NT, Kurowicki J. Outcomes and radiographic findings of anatomic press-fit radial head arthroplasty. J Shoulder Elbow Surg. 2016;25(5):802-9.
182. Little CP, Graham AJ, Karatzas G, Woods DA, Carr AJ. Outcomes of total elbow arthroplasty for rheumatoid arthritis: comparative study of three implants. J Bone Joint Surg Am. 2005;87(11):2439-48.
183. Liu R, Liu P, Shu H, Gong J, Sun Q, Wu J, et al. Comparison of primary radial head replacement and ORIF (open reduction and internal fixation) in Mason type III fractures: a retrospective evaluation in 72 elderly patients. Med Sci Monit. 2015;21:90-3.
184. Ljung P, Jonsson K, Rydholm U. Short-term complications of the lateral approach for non-constrained elbow replacement. Follow-up of 50 rheumatoid elbows. J Bone Joint Surg Br. 1995;77(6):937-42.
185. Lo CY, Lee KB, Wong CK, Chang YP. Semi-constrained total elbow arthroplasty in Chinese rheumatoid patients. Hand Surg. 2003;8(2):187-92.
186. Lobo-Escolar L, Abellan-Miralles C, Escola-Benet A. Outcomes of press-fit radial head arthroplasty following complex radial head fractures. Orthop Traumatol Surg Res. 2020:102645.
187. Logli AL, Shannon SF, Boe CC, Morrey ME, O'Driscoll SW, Sanchez-Sotelo J. Total Elbow Arthroplasty for Distal Humerus Fractures Provided Similar Outcomes When Performed as a Primary Procedure or After Failed Internal Fixation. J Orthop Trauma. 2020;34(2):95-101.
188. Lopiz Y, Gonzalez A, Garcia-Fernandez C, Garcia-Coiradas J, Marco F.

Comminuted fractures of the radial head: resection or prosthesis? Injury. 2016;47 Suppl 3:S29-S34.
189. Lott A, Broder K, Goch A, Konda SR, Egol KA. Results after radial head arthroplasty in unstable fractures. J Shoulder Elbow Surg. 2018;27(2):270-5.
190. Lovy AJ, Keswani A, Dowdell J, Koehler S, Kim J, Hausman MR. Outcomes, complications, utilization trends, and risk factors for primary and revision total elbow replacement. J Shoulder Elbow Surg. 2016;25(6):1020-6.
191. Lovy AJ, Keswani A, Koehler SM, Kim J, Hausman M. Short-Term Complications of Distal Humerus Fractures in Elderly Patients: Open Reduction Internal Fixation Versus Total Elbow Arthroplasty. Geriatr. 2016;7(1):39-44.
192. Lubiatowski P, Olczak I, Lisiewicz E, Breborowicz M, Dlugosz J, Redman M, et al. Clinical and functional evaluation of patients after total elbow arthroplasty. Pol Orthop Traumatol. 2013;78:53-8.
193. Lubiatowski P, Olczak I, Lisiewicz E, Ogrodowicz P, Breborowicz M, Romanowski L. Elbow joint position sense after total elbow arthroplasty. J Shoulder Elbow Surg. 2014;23(5):693-700.
194. Lyall HA, Cohen B, Clatworthy M, Constant CR. Results of the Souter-Strathclyde total elbow arthroplasty in patients with rheumatoid arthritis. A preliminary report. J Arthroplasty. 1994;9(3):279-84.
195. Machado S, Almeida Pinto I, Pinto R, Ribeiro de Oliveira P. Establishing the Role of Unlinked Total Elbow Arthroplasty in Low Demand Patients: A Long-Term Follow-up Study. Acta Med Port. 2016;29(6):367-72.
196. Maghen Y, Leo AJ, Hsu JW, Hausman MR. Is a silastic radial head still a reasonable option? Clin Orthop. 2011;469(4):1061-70.
197. Maheshwari R, Vaziri S, Helm RH. Total elbow replacement with the Coonrad-Morrey prosthesis: our medium to long-term results. Ann R Coll Surg Engl. 2012;94(3):189-92.
198. Malone AA, Taylor AJ, Fyfe IS. Successful outcome of the Souter-Strathclyde elbow arthroplasty. J Shoulder Elbow Surg. 2004;13(5):548-54.
199. Mansat P, Bonnevialle N, Rongieres M, Mansat M, Bonnevialle P. Experience with the Coonrad-Morrey total elbow arthroplasty: 78 consecutive total elbow arthroplasties reviewed with an average 5 years of follow-up. J Shoulder Elbow Surg. 2013;22(11):1461-8.
200. Mansat P, Bonnevialle N, Rongieres M, Mansat M, Bonnevialle P, French Society for Shoulder and Elbow S. Results with a minimum of 10 years follow-up of the Coonrad/Morrey total elbow arthroplasty. Orthop Traumatol Surg Res. 2013;99(6 Suppl):S337-43.
201. Mansat P, Morrey BF. Semiconstrained total elbow arthroplasty for ankylosed and stiff elbows. J Bone Joint Surg Am. 2000;82(9):1260-8.
202. Mansat P, Nouaille Degorce H, Bonnevialle N, Demezon H, Fabre T, Sofcot. Total elbow arthroplasty for acute distal humeral fractures in patients over 65 years old - results of a multicenter study in 87 patients. Orthop Traumatol Surg Res. 2013;99(7):779-84.
203. Marcheix PS, Cuenca C, Vergnenegre G, Mabit C, Hardy J, Charissoux JL. Factors influencing the mid-term radiological and functional outcomes of 41 post-fracture bipolar radial head arthroplasty cases at a mean follow-up of 87 months. Orthop Traumatol Surg Res. 2021:102818.
204. Marinello PG, Peers S, Styron J, Pervaiz K, Evans PJ. Triceps fascial tongue exposure for total elbow arthroplasty: surgical technique and case series. Tech. 2015;19(2):60-3.

205. Marsh JP, Grewal R, Faber KJ, Drosdowech DS, Athwal GS, King GJ. Radial Head Fractures Treated with Modular Metallic Radial Head Replacement: Outcomes at a Mean Follow-up of Eight Years. J Bone Joint Surg Am. 2016;98(7):527-35.
206. Martin Fuentes AM, Ramos Pascua LR, Cecilia Lopez D. Correlation between radiographic findings and clinical failure in monopolar radial head replacement. Arch Orthop Trauma Surg. 2020;140(1):51-8.
207. McKee MD, Pugh DM, Richards RR, Pedersen E, Jones C, Schemitsch EH. Effect of humeral condylar resection on strength and functional outcome after semiconstrained total elbow arthroplasty. J Bone Joint Surg Am. 2003;85(5):802-7.
208. McKee MD, Veillette CJ, Hall JA, Schemitsch EH, Wild LM, McCormack R, et al. A multicenter, prospective, randomized, controlled trial of open reduction--internal fixation versus total elbow arthroplasty for displaced intra-articular distal humeral fractures in elderly patients. Journal of shoulder and elbow surgery. 2009;18(1):3â12.
209. Medvedev G, Wang C, Amdur R, Neviaser R, Neviaser A. Operative Distal Humerus Fractures in Older Patients: Predictors for Early Complications Based on a National Database. Hss J. 2017;13(3):212-6.
210. Mehta SS, Watts AC, Talwalkar SC, Birch A, Nuttall D, Trail IA. Early results of Latitude primary total elbow replacement with a minimum follow-up of 2 years. J Shoulder Elbow Surg. 2017;26(10):1867-72.
211. Meijering D, Boerboom AL, Breukelman F, Eygendaal D, Bulstra SK, Stevens M. Long-term results of the iBP elbow prosthesis: beware of destructive metallosis! BMC Musculoskelet Disord. 2019;20(1):415.
212. Mikel AB, Javier AB, Fausto LM, Angel PM, Irene LT, Carlos AG. A retrospective comparative cohort study of radial head arthroplasty versus resection in complex elbow dislocations. Injury. 2020;51 Suppl 1:S89-S93.
213. Minami M, Kondo M, Nishio Y, Suzuki K, Kato S, Kawamura S, et al. Postoperative Infection Related with the Total Elbow Arthroplasty (Kudo's Prosthesis) in Rheumatoid Arthritis. J Hand Surg Asian Pac Vol. 2018;23(1):58-65.
214. Moghaddam A, Raven TF, Dremel E, Studier-Fischer S, Grutzner PA, Biglari B. Outcome of Radial Head Arthroplasty in Comminuted Radial Head Fractures: Short and Midterm Results. Trauma mon. 2016;21(1):e20201.
215. Mori T, Kudo H, Iwano K, Juji T. Kudo type-5 total elbow arthroplasty in mutilating rheumatoid arthritis: a 5- to 11-year follow-up. J Bone Joint Surg Br. 2006;88(7):920-4.
216. Morrey BF, Adams RA. Semiconstrained elbow replacement for distal humeral nonunion. J Bone Joint Surg Br. 1995;77(1):67-72.
217. Morrey BF, Adams RA, Bryan RS. Total replacement for post-traumatic arthritis of the elbow. J Bone Joint Surg Br. 1991;73(4):607-12.
218. Mou Z, Chen M, Xiong Y, Fan Z, Wang A, Wang Z. Comminuted radial head fractures treated by the Acumed anatomic radial head system. Int J Clin Exp Med. 2015;8(4):6327-33.
219. Muhm M, de Castro R, Winkler H. Radial head arthroplasty with an uncemented modular metallic radial head prosthesis: short- and mid-term results. European Journal of Trauma & Emergency Surgery. 2011;37(1):85-95.
220. Mukka S, Berg G, Hassany HR, Koye AK, Sjoden G, Sayed-Noor AS. Semiconstrained total elbow arthroplasty for rheumatoid arthritis patients: clinical and radiological results of 1-8 years follow-up. Arch Orthop Trauma Surg. 2015;135(5):595-600.
221. Mukka S, Sjoholm P, Perisynakis N, Wahlstrom P, Rahme H, Kadum B. Radial head arthroplasty for radial head fractures: a clinical and radiological comparison of

monopolar and bipolar radial head arthroplasty at a mean follow-up of 6 years. European Journal of Trauma & Emergency Surgery. 2020;46(3):565-72.
222. Muthukumar Balaji S, Rajesh Kumar T, Devadoss S, Devadoss A. Baksi's sloppy hinged prosthesis in rheumatoid arthritis of elbow: A midterm follow-up study. Journal of Arthroscopy and Joint Surgery. 2016;3(2):71-4.
223. Na KT, Song SW, Lee YM, Choi JH. Modified triceps fascial tongue approach for primary total elbow arthroplasty. J Shoulder Elbow Surg. 2018;27(5):887-93.
224. Naqui SZ, Rajpura A, Nuttall D, Prasad P, Trail IA. Early results of the Acclaim total elbow replacement in patients with primary osteoarthritis. J Bone Joint Surg Br. 2010;92(5):668-71.
225. Nct. Elbow Hemiarthroplasty Versus Total Elbow Arthroplasty for Irreparable Distal Humeral Fractures. https://clinicaltrialsgov/show/NCT03596736. 2018.
226. Nct. Hemiarthroplasty Or Total Elbow Arthroplasty in the Elderly. https://clinicaltrialsgov/show/NCT04646798. 2020.
227. Nestorson J, Ekholm C, Etzner M, Adolfsson L. Hemiarthroplasty for irreparable distal humeral fractures: medium-term follow-up of 42 patients. Bone Joint J. 2015;97-B(10):1377-84.
228. Nestorson J, Josefsson PO, Adolfsson L. A radial head prosthesis appears to be unnecessary in Mason-IV fracture dislocation. Acta Orthop. 2017;88(3):315-9.
229. Nestorson J, Rahme H, Adolfsson L. Arthroplasty as primary treatment for distal humeral fractures produces reliable results with regards to revisions and adverse events: a registry-based study. J Shoulder Elbow Surg. 2019;28(4):e104-e10.
230. Nishida K, Hashizume K, Nakahara R, Ozawa M, Harada R, Machida T, et al. Short-term results of the PROSNAP linked elbow prosthesis with a snap-in structure and modular flange for the reconstruction of severely damaged rheumatoid elbows. J Shoulder Elbow Surg. 2014;23(6):837-42.
231. Nishida K, Hashizume K, Nasu Y, Kishimoto M, Ozaki T, Inoue H. A 5-22-year follow-up study of stemmed alumina ceramic total elbow arthroplasties with cement fixation for patients with rheumatoid arthritis. J Orthop Sci. 2014;19(1):55-63.
232. Nishida K, Hashizume K, Nasu Y, Ozawa M, Fujiwara K, Inoue H, et al. Mid-term results of alumina ceramic unlinked total elbow arthroplasty with cement fixation for patients with rheumatoid arthritis. Bone Joint J. 2018;100-B(8):1066-73.
233. Nishida K, Hashizume K, Ozawa M, Takeshita A, Kaneda D, Nakahara R, et al. Results of Total Elbow Arthroplasty with Cementless Implantation of an Alumina Ceramic Elbow Prosthesis for Patients with Rheumatoid Arthritis. Acta Med Okayama. 2017;71(1):41-7.
234. Nosenzo A, Galavotti C, Menozzi M, Garzia A, Pogliacomi F, Calderazzi F. Acute radial head replacement with bipolar prostheses: midterm results. Eur. 2020;31:31.
235. O'Driscoll SW, Herald JA. Forearm pain associated with loose radial head prostheses. J Shoulder Elbow Surg. 2012;21(1):92-7.
236. Ogino H, Ito H, Furu M, Ishikawa M, Yoshitomi H, Matsuda S. Outcome of shortened extra-small ulnar component in linked total elbow arthroplasty for patients with rheumatoid arthritis. Mod Rheumatol. 2015;25(6):849-53.
237. Ogino H, Ito H, Furu M, Ishikawa M, Yoshitomi H, Matsuda S. Limited extension after linked total elbow arthroplasty in patients with rheumatoid arthritis. Mod Rheumatol. 2016;26(3):347-51.
238. Oizumi N, Suenaga N, Yoshioka C, Yamane S. Triceps-sparing ulnar approach for total elbow arthroplasty. Bone Joint J. 2015;97-B(8):1096-101.

239. Ovesen J, Olsen BS, Johannsen HV, Sojbjerg JO. Capitellocondylar total elbow replacement in late-stage rheumatoid arthritis. J Shoulder Elbow Surg. 2005;14(4):414-20.
240. Park JG, Cho NS, Song JH, Lee DS, Rhee YG. Clinical Outcomes of Semiconstrained Total Elbow Arthroplasty in Patients Who Were Forty Years of Age or Younger. J Bone Joint Surg Am. 2015;97(21):1781-91.
241. Park SE, Kim JY, Cho SW, Rhee SK, Kwon SY. Complications and revision rate compared by type of total elbow arthroplasty. J Shoulder Elbow Surg. 2013;22(8):1121-7.
242. Pasternack JB, Mahmood B, Martins AS, Choueka J. The transition of total elbow arthroplasty into the outpatient theater. JSES Int. 2020;4(1):44-8.
243. Patil N, Cheung EV, Mow CS. High revision rate after total elbow arthroplasty with a linked semiconstrained device. Orthopedics. 2009;32(5):321.
244. Perretta D, van Leeuwen WF, Dyer G, Ring D, Chen N. Risk factors for reoperation after total elbow arthroplasty. J Shoulder Elbow Surg. 2017;26(5):824-9.
245. Phadnis J, Banerjee S, Watts AC, Little N, Hearnden A, Patel VR. Elbow hemiarthroplasty using a "triceps-on" approach for the management of acute distal humeral fractures. J Shoulder Elbow Surg. 2015;24(8):1178-86.
246. Pham TT, Delclaux S, Huguet S, Wargny M, Bonnevialle N, Mansat P. Coonrad-Morrey total elbow arthroplasty for patients with rheumatoid arthritis: 54 prostheses reviewed at 7 years' average follow-up (maximum, 16 years). J Shoulder Elbow Surg. 2018;27(3):398-403.
247. Plaschke HC, Thillemann TM, Brorson S, Olsen BS. Implant survival after total elbow arthroplasty: a retrospective study of 324 procedures performed from 1980 to 2008. J Shoulder Elbow Surg. 2014;23(6):829-36.
248. Plaschke HC, Thillemann TM, Brorson S, Olsen BS. Outcome after total elbow arthroplasty: a retrospective study of 167 procedures performed from 1981 to 2008. J Shoulder Elbow Surg. 2015;24(12):1982-90.
249. Pogliacomi F, Aliani D, Cavaciocchi M, Corradi M, Ceccarelli F, Rotini R. Total elbow arthroplasty in distal humeral nonunion: clinical and radiographic evaluation after a minimum follow-up of three years. J Shoulder Elbow Surg. 2015;24(12):1998-2007.
250. Pogliacomi F, Galavotti C, Cavaciocchi M, Corradi M, Rotini R, Ceccarelli F. Total elbow arthroplasty following traumas: mid-term results. Acta Biomed Ateneo Parmense. 2014;84(3):212-8.
251. Pogliacomi F, Schiavi P, Defilippo M, Corradi M, Vaienti E, Ceccarelli F, et al. Total elbow arthroplasty following complex fractures of the distal humerus: results in patients over 65 years of age. Acta Biomed Ateneo Parmense. 2016;87(2):148-55.
252. Pogliacomi F, Schiavi P, Pedrazzini A, Nosenzo A, Tocco S, Ceccarelli F. Modified Mason type III and IV radial head fractures: results of different surgical treatments. Acta Biomed Ateneo Parmense. 2015;86(3):242-50.
253. Pooley J. Unicompartmental elbow replacement: Development of a lateral replacement elbow (LRE) arthroplasty. Techniques in Shoulder and Elbow Surgery. 2007;8(4):204-12.
254. Pooley J, Salvador Carreno J. Total elbow joint replacement for fractures in the elderly--Functional and radiological outcomes. Injury. 2015;46 Suppl 5:S37-42.
255. Pope D, Scaife SL, Tzeng TH, Vasdev S, Saleh KJ. Impact of diabetes on early postoperative outcomes after total elbow arthroplasty. J Shoulder Elbow Surg. 2015;24(3):348-52.
256. Potter D, Claydon P, Stanley D. Total elbow replacement using the Kudo

prosthesis. Clinical and radiological review with five- to seven-year follow-up. J Bone Joint Surg Br. 2003;85(3):354-7.
257. Prasad N, Ali A, Stanley D. Total elbow arthroplasty for non-rheumatoid patients with a fracture of the distal humerus: a minimum ten-year follow-up. Bone Joint J. 2016;98-B(3):381-6.
258. Prasad N, Dent C. Outcome of total elbow replacement for distal humeral fractures in the elderly: a comparison of primary surgery and surgery after failed internal fixation or conservative treatment. J Bone Joint Surg Br. 2008;90(3):343-8.
259. Prasad N, Dent C. Outcome of total elbow replacement for rheumatoid arthritis: single surgeon's series with Souter-Strathclyde and Coonrad-Morrey prosthesis. J Shoulder Elbow Surg. 2010;19(3):376-83.
260. Prki CA, Viveen J, The B, Koenraadt KLM, Eygendaal D. Early Mobilization and Functional Discharge Criteria Affecting Length of Stay after Total Elbow Arthroplasty. Acta Chir Orthop Traumatol Cech. 2020;87(3):197-202.
261. Puskas GJ, Morrey BF, Sanchez-Sotelo J. Aseptic loosening rate of the humeral stem in the Coonrad-Morrey total elbow arthroplasty. Does size matter? J Shoulder Elbow Surg. 2014;23(1):76-81.
262. Qureshi F, Draviaraj KP, Stanley D. The Kudo 5 total elbow replacement in the treatment of the rheumatoid elbow: results at a minimum of ten years. J Bone Joint Surg Br. 2010;92(10):1416-21.
263. Rahme H. The Kudo elbow prosthesis in rheumatoid arthritis: a consecutive series of 26 elbow replacements in 24 patients followed prospectively for a mean of 5 years. Acta Orthop Scand. 2002;73(3):251-6.
264. Rahme H, Mattsson P, Larsson S. Stable fixation of the ulnar component in the Kudo elbow prosthesis: A radiostereometric (RSA) study of 13 prostheses with 2-year follow-up. Acta Orthop. 2005;76(1):104-8.
265. Ramsey ML, Adams RA, Morrey BF. Instability of the elbow treated with semiconstrained total elbow arthroplasty. J Bone Joint Surg Am. 1999;81(1):38-47.
266. Rauhaniemi J, Tiusanen H, Kyro A. Kudo total elbow arthroplasty in rheumatoid arthritis. Clinical and radiological results. J Hand Surg [Br]. 2006;31(2):162-7.
267. Raven TF, Banken L, Schmidmaier G, Studier-Fischer S, Biglari B, Moghaddam A. Evaluation of two different types of radial head prosthesis in practical use. Using either Evolve R or MoPyC^R radial head prosthesis in the treatment of comminuted radial head fractures. Orthop Rev (Pavia). 2020;12(1):8386.
268. Reinhard R, van der Hoeven M, de Vos MJ, Eygendaal D. Total elbow arthroplasty with the Kudo prosthesis. Int Orthop. 2003;27(6):370-2.
269. Reinhardt D, Toby EB, Brubacher J. Reoperation Rates and Costs of Radial Head Arthroplasty Versus Open Reduction and Internal Fixation of Radial Head and Neck Fractures: A Retrospective Database Study. Hand. 2021;16(1):115-22.
270. Ricon FJ, Lajara F, Fuentes A, Aguilar ML, Boix A, Lozano JA. Pyrocarbon arthroplasty in acute unreconstructable radial head fractures: mid-term to long term results. Journal of Orthopaedics & Traumatology. 2018;19(1):13.
271. Ricon FJ, Sanchez P, Lajara F, Galan A, Lozano JA, Guerado E. Result of a pyrocarbon prosthesis after comminuted and unreconstructable radial head fractures. J Shoulder Elbow Surg. 2012;21(1):82-91.
272. Risung F. The Norway elbow replacement. Design, technique and results after nine years. J Bone Joint Surg Br. 1997;79(3):394-402.
273. Robinson PM, MacInnes SJ, Stanley D, Ali AA. Heterotopic ossification

following total elbow arthroplasty: a comparison of the incidence following elective and trauma surgery. Bone Joint J. 2018;100-B(6):767-71.
274. Rotini R, Marinelli A, Guerra E, Bettelli G, Cavaciocchi M. Radial head replacement with unipolar and bipolar SBi system: a clinical and radiographic analysis after a 2-year mean follow-up. Musculoskelet Surg. 2012;96 Suppl 1:S69-79.
275. Rotini R, Ricciarelli M, Guerra E, Marinelli A, Celli A. Elbow hemiarthroplasty in distal humeral fractures: Indication, surgical technique and results. Injury. 2020;10:10.
276. Rozing P. Souter-Strathclyde total elbow arthroplasty. J Bone Joint Surg Br. 2000;82(8):1129-34.
277. Ruan HJ, Fan CY, Liu JJ, Zeng BF. A comparative study of internal fixation and prosthesis replacement for radial head fractures of Mason type III. Int Orthop. 2009;33(1):249-53.
278. Ruth JT, Wilde AH. Capitellocondylar total elbow replacement. A long-term follow-up study. J Bone Joint Surg Am. 1992;74(1):95-100.
279. Ryu J, Saito S, Honda T, Oikawa H, Sakamoto A. A new total elbow arthroplasty for rheumatoid arthritis. Japanese Journal of Rheumatology. 1998;8(4):411-28.
280. Ryu SM, Park SG, Kim JH, Yang HS, Na HD, Seo JS. Treatment of Modified Mason Type III or IV Radial Head Fracture: Open Reduction and Internal Fixation versus Arthroplasty. Indian j. 2018;52(6):590-5.
281. Samijo SK, Van den Berg ME, Verburg AD, Tonino AJ. Souter-Strathclyde total elbow arthroplasty: medium-term results. Acta Orthop Belg. 2003;69(6):501-6.
282. Sanchez-Sotelo J, Baghdadi YM, Morrey BF. Primary Linked Semiconstrained Total Elbow Arthroplasty for Rheumatoid Arthritis: A Single-Institution Experience with 461 Elbows Over Three Decades. J Bone Joint Surg Am. 2016;98(20):1741-8.
283. Sanchez-Sotelo J, Sperling JW, Morrey BF. Ninety-day mortality after total elbow arthroplasty. J Bone Joint Surg Am. 2007;89(7):1449-51.
284. Sarris IK, Kyrkos MJ, Galanis NN, Papavasiliou KA, Sayegh FE, Kapetanos GA. Radial head replacement with the MoPyC pyrocarbon prosthesis. J Shoulder Elbow Surg. 2012;21(9):1222-8.
285. Schemitsch EH, Ewald FC, Thornhill TS. Results of total elbow arthroplasty after excision of the radial head and synovectomy in patients who had rheumatoid arthritis. J Bone Joint Surg Am. 1996;78(10):1541-7.
286. Schiavi P, Pogliacomi F, Garzia A, Valenti P, Ceccarelli F, Calderazzi F. Survival and outcome of total elbow arthroplasty for distal humeral fracture at long-term follow-up. Acta Biomedica. 2020;91(Supplement 14):1-9.
287. Schneeberger AG, Adams R, Morrey BF. Semiconstrained total elbow replacement for the treatment of post-traumatic osteoarthrosis. J Bone Joint Surg Am. 1997;79(8):1211-22.
288. Schneeberger AG, Hertel R, Gerber C. Total elbow replacement with the GSB III prosthesis. J Shoulder Elbow Surg. 2000;9(2):135-9.
289. Schneeberger AG, Meyer DC, Yian EH. Coonrad-Morrey total elbow replacement for primary and revision surgery: a 2- to 7.5-year follow-up study. J Shoulder Elbow Surg. 2007;16(3 Suppl):S47-54.
290. Schnetzke M, Aytac S, Deuss M, Studier-Fischer S, Swartman B, Muenzberg M, et al. Radial head prosthesis in complex elbow dislocations: effect of oversizing and comparison with ORIF. Int Orthop. 2014;38(11):2295-301.
291. Schnetzke M, Jung MK, Groetzner-Schmidt C, Tross AK, Porschke F,

Grutzner PA, et al. Long-term Outcome and Survival Rate of Monopolar Radial Head Replacement. J Shoulder Elbow Surg. 2021;20:20.
292. Schoch B, Wong J, Abboud J, Lazarus M, Getz C, Ramsey M. Results of Total Elbow Arthroplasty in Patients Less Than 50 Years Old. Journal of Hand Surgery - American Volume. 2017;42(10):797-802.
293. Schoch BS, Werthel JD, Sanchez-Sotelo J, Morrey BF, Morrey M. Total elbow arthroplasty for primary osteoarthritis. J Shoulder Elbow Surg. 2017;26(8):1355-9.
294. Schoni M, Drerup S, Angst F, Kyburz D, Simmen BR, Goldhahn J. Long-term survival of GSB III elbow prostheses and risk factors for revisions. Arch Orthop Trauma Surg. 2013;133(10):1415-24.
295. Schultzel M, Scheidt K, Klein CC, Narvy SJ, Lee BK, Itamura JM. Hemiarthroplasty for the treatment of distal humeral fractures: midterm clinical results. J Shoulder Elbow Surg. 2017;26(3):389-93.
296. Sershon RA, Luchetti TJ, Cohen MS, Wysocki RW. Radial head replacement with a bipolar system: an average 10-year follow-up. J Shoulder Elbow Surg. 2018;27(2):e38-e44.
297. Shah BM, Trail IA, Nuttall D, Stanley JK. The effect of epidemiologic and intraoperative factors on survival of the standard Souter-Strathclyde total elbow arthroplasty. J Arthroplasty. 2000;15(8):994-8.
298. Shi LL, Zurakowski D, Jones DG, Koris MJ, Thornhill TS. Semiconstrained primary and revision total elbow arthroplasty with use of the Coonrad-Morrey prosthesis. J Bone Joint Surg Am. 2007;89(7):1467-75.
299. Shore BJ, Mozzon JB, MacDermid JC, Faber KJ, King GJ. Chronic posttraumatic elbow disorders treated with metallic radial head arthroplasty. J Bone Joint Surg Am. 2008;90(2):271-80.
300. Siala M, Laumonerie P, Hedjoudje A, Delclaux S, Bonnevialle N, Mansat P. Outcomes of semiconstrained total elbow arthroplasty performed for arthritis in patients under 55 years old. J Shoulder Elbow Surg. 2020;29(4):859-66.
301. Singh AK, Jidge A, Ramteke U, Venkateswaran N, Rokade H, Mulje SM, et al. Functional Outcome of Elbow Kinematics in Radial Head Excision Versus Radial Head Replacement: A Comparative Study. Open Access Maced J Med Sci. 2019;7(9):1505-8.
302. Singh JA, Cleveland JD. Medicaid Payer Status, Higher Comorbidity, and Low Income Are Associated With Poorer Outcomes After Total Elbow Arthroplasty. J. 2020;11:11.
303. Singh JA, Ramachandran R. Are there racial disparities in utilization and outcomes after total elbow arthroplasty? Rheumatol Int. 2015;35(9):1479-87.
304. Singh JA, Ramachandran R. Sex differences in characteristics, utilization, and outcomes of patient undergoing total elbow arthroplasty: a study of the US nationwide inpatient sample. Clin Rheumatol. 2016;35(3):723-31.
305. Sinha S, Sarkar S, Singh A, Saraf SK, Rastogi A, Singh T. Radial Head Arthroplasty, Excision and Osteosynthesis in Complex Elbow Fracture-Dislocations in Young Adults: What is Preferred? Indian j. 2020;54(Suppl 2):260-9.
306. Sjoden G, Blomgren G. The Souter-Strathclyde elbow replacement in rheumatoid arthritis. 13 patients followed for 5 (1-9) years. Acta Orthop Scand. 1992;63(3):315-7.
307. Sjoden GO, Lundberg A, Blomgren GA. Late results of the Souter-Strathclyde total elbow prosthesis in rheumatoid arthritis. 6/19 implants loose after 5 years. Acta Orthop Scand. 1995;66(5):391-4.
308. Skytta ET, Eskelinen A, Paavolainen P, Ikavalko M, Remes V. Total elbow

arthroplasty in rheumatoid arthritis: a population-based study from the Finnish Arthroplasty Register. Acta Orthop. 2009;80(4):472-7.
309. Skytta ET, Remes V, Nietosvaara Y, Tallroth K, Paimela L, Ylinen P. Similar results with 21 Kudo and 21 Souter-Strathclyde total elbow arthroplasties in patients with rheumatoid arthritis. Arch Orthop Trauma Surg. 2008;128(10):1201-8.
310. Smith GC, Hughes JS. Unreconstructable acute distal humeral fractures and their sequelae treated with distal humeral hemiarthroplasty: a two-year to eleven-year follow-up. J Shoulder Elbow Surg. 2013;22(12):1710-23.
311. Somerson JS, Matsen FA, 3rd. Timely recognition of total elbow and radial head arthroplasty adverse events: an analysis of reports to the US Food and Drug Administration. J Shoulder Elbow Surg. 2019;28(3):510-9.
312. Sorensen BW, Brorson S, Olsen BS. Primary total elbow arthroplasty in complex fractures of the distal humerus. World j. 2014;5(3):368-72.
313. Spinner RJ, Morgenlander JC, Nunley JA. Ulnar nerve function following total elbow arthroplasty: a prospective study comparing preoperative and postoperative clinical and electrophysiologic evaluation in patients with rheumatoid arthritis. Journal of Hand Surgery - American Volume. 2000;25(2):360-4.
314. Stoffelen DV, Holdsworth BJ. Excision or Silastic replacement for comminuted radial head fractures. A long-term follow-up. Acta Orthop Belg. 1994;60(4):402-7.
315. Stone MA, Singh P, Rosario SL, Omid R. Outpatient total elbow arthroplasty: 90-day outcomes. J Shoulder Elbow Surg. 2018;27(7):1311-6.
316. Strelzow JA, Athwal GS, MacDermid JC, Grewal R, Faber KJ, Drosdowech D, et al. Effect of Concomitant Elbow Injuries on the Outcomes of Radial Head Arthroplasty: A Cohort Comparison. J Orthop Trauma. 2017;31(10):e327-e33.
317. Strelzow JA, Frank T, Athwal GS, Faber KJ, King GJW. Results of Linked Convertible Total Elbow Arthroplasty for the Management of Distal Humeral Fractures in the Elderly. J Hand Surg [Am]. 2021;07:07.
318. Strelzow JA, Frank T, Chan K, Athwal GS, Faber KJ, King GJW. Management of rheumatoid arthritis of the elbow with a convertible total elbow arthroplasty. J Shoulder Elbow Surg. 2019;28(11):2205-14.
319. Studer A, Athwal GS, MacDermid JC, Faber KJ, King GJ. The lateral para-olecranon approach for total elbow arthroplasty. Journal of Hand Surgery - American Volume. 2013;38(11):2219-26.e3.
320. Swanson AB, de Groot Swanson G, Masada K, Makino M, Pires PR, Gannon DM, et al. Constrained total elbow arthroplasty. J Arthroplasty. 1991;6(3):203-12.
321. Szyluk K, Widuchowski W, Jasinski A, Koczy B, Widuchowski J. Comparison of short- to medium-term results of Coonrad-Morrey elbow replacement in patients with rheumatoid arthritis versus patients after elbow injuries. Med Sci Monit. 2013;19:18-27.
322. Tachihara A, Nakamura H, Yoshioka T, Miyamoto Y, Morishita M, Koyama T, et al. Postoperative results and complications of total elbow arthroplasty in patients with rheumatoid arthritis: three types of nonconstrained arthroplasty. Mod Rheumatol. 2008;18(5):465-71.
323. Talwalkar SC, Givissis PK, Trail IA, Nuttall D, Stanley JK. Survivorship of the Souter-Strathclyde elbow replacement in the young inflammatory arthritis elbow. J Bone Joint Surg Br. 2005;87(7):946-9.
324. Tanaka N, Kudo H, Iwano K, Sakahashi H, Sato E, Ishii S. Kudo total elbow arthroplasty in patients with rheumatoid arthritis: a long-term follow-up study. J Bone Joint Surg Am. 2001;83(10):1506-13.
325. Tanaka N, Sakahashi H, Ishii S, Kudo H. Comparison of two types of ulnar

component in type-5 Kudo total elbow arthroplasty in patients with rheumatoid arthritis: a long-term follow-up. J Bone Joint Surg Br. 2006;88(3):341-4.
326. Tarallo L, Mugnai R, Rocchi M, Capra F, Catani F. Mason type III radial head fractures treated by anatomic radial head arthroplasty: Is this a safe treatment option? Orthop Traumatol Surg Res. 2017;103(2):183-9.
327. Thillemann TM, Olsen BS, Johannsen HV, Sojbjerg JO. Long-term results with the Kudo type 3 total elbow arthroplasty. J Shoulder Elbow Surg. 2006;15(4):495-9.
328. Throckmorton T, Zarkadas P, Sanchez-Sotelo J, Morrey B. Failure patterns after linked semiconstrained total elbow arthroplasty for posttraumatic arthritis. J Bone Joint Surg Am. 2010;92(6):1432-41.
329. Tiusanen RE, Tiusanen HT, Saltychev M, Sarantsin PM. Discovery R elbow system arthroplasty: results of 10-year follow-up. Eur. 2021;09:09.
330. Toor AS, Jiang JJ, Shi LL, Koh JL. Comparison of perioperative complications after total elbow arthroplasty in patients with and without diabetes. J Shoulder Elbow Surg. 2014;23(11):1599-606.
331. Toulemonde J, Ancelin D, Azoulay V, Bonnevialle N, Rongieres M, Mansat P. Complications and revisions after semi-constrained total elbow arthroplasty: a mono-centre analysis of one hundred cases. Int Orthop. 2016;40(1):73-80.
332. Trail IA, Nuttall D, Stanley JK. Survivorship and radiological analysis of the standard Souter-Strathclyde total elbow arthroplasty. J Bone Joint Surg Br. 1999;81(1):80-4.
333. Trail IA, Nuttall D, Stanley JK. Comparison of survivorship between standard and long-stem Souter-Strathclyde total elbow arthroplasty. Journal of Shoulder and Elbow Surgery. 2002;11(4):373-6.
334. Ucpunar H, Camurcu Y, Altay R, Duman S, Cobden A, Sofu H. Monoblock polyethylene radial head prosthesis for the treatment of unreconstructable acute radial head fractures with a minimum 1-year follow-up: A retrospective case series. Current Orthopaedic Practice. 2020;31(2):120-5.
335. Valstar ER, Garling EH, Rozing PM. Micromotion of the Souter-Strathclyde total elbow prosthesis in patients with rheumatoid arthritis 21 elbows followed for 2 years. Acta Orthop Scand. 2002;73(3):264-72.
336. van der Lugt JC, Geskus RB, Rozing PM. Influence of previous open synovectomy on the outcome of Souter-Strathclyde total elbow prosthesis. Rheumatology (Oxford). 2004;43(10):1240-5.
337. van der Lugt JC, Geskus RB, Rozing PM. Limited influence of prosthetic position on aseptic loosening of elbow replacements: 125 elbows followed for an average period of 5.6 years. Acta Orthop. 2005;76(5):654-61.
338. Van Hoecke E, Van De Vijver A, Van Glabbeek F, Gielen J. Long term results after bipolar radial head arthroplasty. Acta Orthop Belg. 2016;82(2):382-8.
339. van Riet RP, Morrey BF, O'Driscoll SW. The Pritchard ERS total elbow prosthesis: lessons to be learned from failure. J Shoulder Elbow Surg. 2009;18(5):791-5.
340. Verstreken F, De Smet L, Westhovens R, Fabry G. Results of the Kudo elbow prosthesis in patients with rheumatoid arthritis: a preliminary report. Clin Rheumatol. 1998;17(4):325-8.
341. Vishwanathan K, Alizadehkhaiyat O, Kemp GJ, Frostick SP. Responsiveness of the Liverpool Elbow Score in elbow arthroplasty. J Shoulder Elbow Surg. 2013;22(3):312-7.
342. Vishwanathan K, Alizadehkhaiyat O, Kemp GJ, Frostick SP. Minimal clinically important difference of Liverpool Elbow Score in elbow arthroplasty. JSES Open

Access. 2017;1(3):144-8.
343. Viswanath AI, Frampton CM, Poon PC. A review of the New Zealand National Joint Registry to compare the outcomes of Coonrad-Morrey and Latitude total elbow arthroplasty. J Shoulder Elbow Surg. 2020;29(4):838-44.
344. Viveen J, van den Bekerom MPJ, Doornberg JN, Hatton A, Page R, Koenraadt KLM, et al. Use and outcome of 1,220 primary total elbow arthroplasties from the Australian Orthopaedic Association National Joint Arthroplasty Replacement Registry 2008-2018. Acta Orthop. 2019;90(6):511-6.
345. Wagener ML, de Vos MJ, Hannink G, van der Pluijm M, Verdonschot N, Eygendaal D. Mid-term clinical results of a modern convertible total elbow arthroplasty. Bone Joint J. 2015;97-B(5):681-8.
346. Wapler C, Fontaine C, Mesnil P, Chantelot C. Medial collateral ligament healing after posttraumatic radial head arthroplasty: A retrospective study of 33 cases with a mean follow-up of 73 months. Hand Surg Rehabil. 2016;35(1):44-50.
347. Watkins CEL, Elson DW, Harrison JWK, Pooley J. Long-term results of the lateral resurfacing elbow arthroplasty. Bone Joint J. 2018;100-B(3):338-45.
348. Watters TS, Garrigues GE, Ring D, Ruch DS. Fixation versus replacement of radial head in terrible triad: is there a difference in elbow stability and prognosis? Clin Orthop. 2014;472(7):2128-35.
349. Werner BC, Rawles RB, Jobe JT, Chhabra AB, Freilich AM. Obesity is associated with increased postoperative complications after operative management of distal humerus fractures. J Shoulder Elbow Surg. 2015;24(10):1602-6.
350. Werthel JD, Schoch B, Adams J, Steinmann S. Outcomes After Hemiarthroplasty of the Elbow for the Management of Posttraumatic Arthritis: Minimum 2-Year Follow-up. J Am Acad Orthop Surg. 2019;27(19):727-35.
351. Whaley A, Morrey BF, Adams R. Total elbow arthroplasty after previous resection of the radial head and synovectomy. J Bone Joint Surg Br. 2005;87(1):47-53.
352. Willems K, De Smet L. The Kudo total elbow arthroplasty in patients with rheumatoid arthritis. J Shoulder Elbow Surg. 2004;13(5):542-7.
353. Williams H, Madhusudhan T, Sinha A. Mid-term outcome of total elbow replacement for rheumatoid arthritis. Journal of Orthopaedic Surgery. 2016;24(2):262-4.
354. Winter M, Chuinard C, Cikes A, Pelegri C, Bronsard N, de Peretti F. Surgical management of elbow dislocation associated with non-reparable fractures of the radial head. Chir Main. 2009;28(3):158-67.
355. Woods DA, Williams JR, Gendi NS, Mowat AG, Burge PD, Carr AJ. Surgery for rheumatoid arthritis of the elbow: a comparison of radial-head excision and synovectomy with total elbow replacement. J Shoulder Elbow Surg. 1999;8(4):291-5.
356. Wright TW, Wong AM, Jaffe R. Functional outcome comparison of semiconstrained and unconstrained total elbow arthroplasties. J Shoulder Elbow Surg. 2000;9(6):524-31.
357. Wu PH, Shen L, Chee YH. Screw fixation versus arthroplasty versus plate fixation for 3-part radial head fractures. Journal of Orthopaedic Surgery. 2016;24(1):57-61.
358. Yan M, Ni J, Song D, Ding M, Liu T, Huang J. Radial head replacement or repair for the terrible triad of the elbow: which procedure is better? ANZ J Surg. 2015;85(9):644-8.
359. Yanni ON, Fearn CB, Gallannaugh SC, Joshi R. The Roper-Tuke total elbow arthroplasty. 4- to 10-year results of an unconstrained prosthesis. J Bone Joint Surg

Br. 2000;82(5):705-10.
360. Yu SY, Yan HD, Ruan HJ, Wang W, Fan CY. Comparative study of radial head resection and prosthetic replacement in surgical release of stiff elbows. Int Orthop. 2015;39(1):73-9.
361. Zhou H, Orvets ND, Merlin G, Shaw J, Dines JS, Price MD, et al. Total Elbow Arthroplasty in the United States: Evaluation of Cost, Patient Demographics, and Complication Rates. Orthop Rev (Pavia). 2016;8(1):6113.
362. Zunkiewicz MR, Clemente JS, Miller MC, Baratz ME, Wysocki RW, Cohen MS. Radial head replacement with a bipolar system: a minimum 2-year follow-up. J Shoulder Elbow Surg. 2012;21(1):98-104.