National Institute for Health and Care Excellence

Draft for Consultation

Joint replacement (primary): hip, knee and shoulder

[O] Evidence review for hemiarthroplasty proximal humeral fracture

NICE guideline

Intervention evidence review

October 2019

Draft for Consultation

This evidence review was developed by the National Guideline Centre, hosted by the Royal College of Physicians

Disclaimer

The recommendations in this guideline represent the view of NICE, arrived at after careful consideration of the evidence available. When exercising their judgement, professionals are expected to take this guideline fully into account, alongside the individual needs, preferences and values of their patients or service users. The recommendations in this guideline are not mandatory and the guideline does not override the responsibility of healthcare professionals to make decisions appropriate to the circumstances of the individual patient, in consultation with the patient and, where appropriate, their carer or guardian.

Local commissioners and providers have a responsibility to enable the guideline to be applied when individual health professionals and their patients or service users wish to use it. They should do so in the context of local and national priorities for funding and developing services, and in light of their duties to have due regard to the need to eliminate unlawful discrimination, to advance equality of opportunity and to reduce health inequalities. Nothing in this guideline should be interpreted in a way that would be inconsistent with compliance with those duties.

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1 Reverse total shoulder replacement versus humeral hemiarthroplasty versus conventional shoulder replacement

1.1 Review question: In adults having primary elective shoulder replacement for pain and functional loss after a previous proximal humeral fracture (not acute trauma), what is the clinical and cost effectiveness of reverse total shoulder arthroplasty versus humeral hemiarthroplasty versus conventional total shoulder arthroplasty?

1.2 Introduction

The number of people having shoulder replacement surgery is increasing year on year with 6,526 detailed in the national joint registry in 2017.[32] The majority of these are elective procedures. There have been recent changes and variations in practice about which type of shoulder replacement might offer the best outcomes for different patient groups.

For people with post traumatic shoulder pathology following a proximal humeral fracture, there is no consensus on which procedure has the best outcomes amongst these patients. National Joint Registry data indicates that an increasing number of people are being treated with a reverse total shoulder replacements as opposed to a humeral hemiarthroplasty or conventional total shoulder replacement.[32] This review question was included to evaluate the published evidence on the different types of shoulder replacements in relation to patients following previous proximal humeral fractures (not acute trauma) as there is currently no consensus amongst shoulder surgeons in the UK.

1.3 PICO table

For full details see the review protocol in appendix A.

Table 1: PICO characteristics of review question

Population	People who have pain and functional loss after a previous proximal humeral fracture and are indicated for shoulder arthroplasty.
Interventions	• Reverse total shoulder arthroplasty • Conventional total shoulder arthroplasty • Shoulder humeral hemiarthroplasty
Comparison	Comparison of interventions
Outcomes	**Critical** • Mortality: life expectancy (dichotomous) • Mortality: 30 day (dichotomous) • Quality of life at 6 weeks or earlier, later than 6 weeks up to 1 year, at least 2 years (continuous) • Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier, later than 6 weeks up to 1 year, at least 2 years (continuous)

	• Revision of joint replacement (time to event) • Reoperation Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier, later than 6 weeks up to 1 year, at least 2 years (dichotomous) **Important** • Component failure (dichotomous) • Dislocations within 1 year, after 1 year (dichotomous) • Return to activity/sports (time to event) • Deep surgical site Infection (dichotomous) • Superficial surgical site infection (dichotomous) • Length of stay (continuous) • Major adverse events (including nerve injury, MI, VTE)
Study design	Randomised controlled trials If no well-conducted RCTs are available, then observational studies with multivariate analysis will be investigated.

1.4 Clinical evidence

1.4.1 Included studies

A search was conducted for randomised trials and observational studies comparing the effectiveness of 3 types of shoulder arthroplasty for people who have had a previous proximal humeral fracture.

No relevant clinical studies were identified.

See also the study selection flow chart in appendix C.

1.4.2 Excluded studies

See the excluded studies list in appendix I.

1.5 Economic evidence

1.5.1 Included studies

No relevant heath economic studies were identified.

1.5.2 Excluded studies

One health economic study that was relevant to this question was excluded due to assessment of limited applicability [34]. The study is listed in appendix I, with reasons for exclusion given.

See also the health economic study selection flow chart in appendix G.

1.5.3 Unit costs

Relevant unit costs are provided below to aid consideration of cost effectiveness. All three procedures map the same healthcare resource group (HRG HB61) suggesting similar resource use. However, there may be some difference in implant cost as illustrated in Table 2.

Table 2: Unit costs for different shoulder implants

Type of shoulder procedure	Implant cost (£)
Reverse total shoulder arthroplasty	£2,996
Conventional total shoulder arthroplasty	£2,307
Hemiarthroplasty	£1,013

Source: Implant costs are taken from a private provider supplied by a committee member. The magnitude of difference may differ for other providers.

1.6 Evidence statements

1.6.1 Clinical evidence statements

No relevant published evidence was identified.

1.6.2 Health economic evidence statements

No relevant economic evaluations were identified.

1.7 The committee's discussion of the evidence

1.7.1 Interpreting the evidence

1.7.1.1 The outcomes that matter most

The critical outcomes were mortality, quality of life, patient reported outcomes (PROMs), revision of joint replacement and reoperation.

The important outcomes were component failure, dislocations, return to activity or sports, deep surgical site infection, superficial surgical site infection, length of stay and major adverse events.

PROMs and quality of life are critical outcome measurements, as they are a true representation of a person's subjective experience of joint replacement, which differentiates them from harder objective outcomes and end points such as revision surgery. It was discussed how it is easier to revise a hemiarthroplasty than a conventional total shoulder arthroplasty (TSA) or reverse shoulder arthroplasty (RSA). Therefore, not all people in need of a TSA revision have the surgery because it is complex with more associated risks. This would be highlighted through the subjective outcomes rather than the objective outcomes. Revision is a critical outcome as it is a significant operation and the lengthier the period of time before one is in need of a revision, the better it is in terms of the initial replacement. The return to activity or sports is important, some people in need of shoulder replacement surgery are more physically active and a return to sporting activity is very important to them. Length of stay is important in terms of economics and reflects the desire of people to leave hospital earlier.

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1.7.1.2 The quality of the evidence

No clinical studies were found for this review question.

1.7.1.3 Benefits and harms

No clinical studies were found for this review question. Most of the excluded studies found concentrated on acute treatment of proximal humeral fractures. NJR data would have been considered if it was adjusted for confounding factors.The committee spoke about the population for this question. Proximal humeral fractures are a fracture of top end of the arm bone where the ball of the shoulder joint breaks into 2, 3 or 4 pierces. It is left to heal and farther down the line, mostly within 12 to 18 months, the person realises the non-operative treatment has not worked. People in this situation experience a lot of pain with limited movement. The treatment options are then are either a hemiarthroplasty, which is replacing the broken and badly healed ball with a new ball, a conventional TSA, which replaces the broken ball and the shoulder socket or an RSA, which can still be done when the healed fracture is very bad and the rotator cuff tendons are torn. Hemiarthroplasty and conventional TSAs are not commonly done as the rotator cuff tendons still need to be working and in the correct place while this is not required for RSAs There is therefore an argument that a move straight to an RSA makes sense in people whose bones and rotator cuff are damaged by trauma and fractures. As long as the person's deltoid muscle is in working order, the results of the RSA are expected to be good. This has led to a trend towards RSA over the past decade, and it is now probably the first line treatment in this population for most surgeons in the NHS. However, in people who have a lesser fracture and whose rotator cuff is still intact, a hemiarthroplasty or conventional TSA can still be considered a reasonable option because there still remains a future option to revise it to an RSA.

No clinical studies were found for this review question, and the committee could not agree on a consensus recommendation on the type of surgery for this population. So a research recommendation was made to answer the clinical question posed in this guideline.

1.7.2 Cost effectiveness and resource use

There was no published cost effectiveness studies found. The implant costs for reverse TSA and conventional TSA may be more than for hemiarthroplasty given that their prosthesis consists of 2 parts. However, implant costs are variable depending on the manufacturer. Overall procedure costs and resource use are likely to be similar, as indicated by all 3 procedures mapping to the same Health Resource Group (HRG HN52) code.

No recommendation was made due to the lack of clinical evidence. Therefore practice is likely to remain variable for this population. There are roughly 5,500 primary elective shoulder operations annually, and a small proportion of these will be people with a previous proximal humeral fracture. As current practice will not change for the small population size, and there is similarity in costs between the interventions considered, there will not be any resource impact.

References

1. Alentorn-Geli E, Samitier G, Torrens C, Wright TW. Reverse shoulder arthroplasty. Part 2: Systematic review of reoperations, revisions, problems, and complications. International Journal of Shoulder Surgery. 2015; 9(2):60-7

2. Anakwenze OA, Zoller S, Ahmad CS, Levine WN. Reverse shoulder arthroplasty for acute proximal humerus fractures: A systematic review. Journal of Shoulder and Elbow Surgery. 2014; 23(4):e73-80

3. Antuna SA, Sperling JW, Sanchez-Sotelo J, Cofield RH. Shoulder arthroplasty for proximal humeral malunions: Long-term results. Journal of Shoulder and Elbow Surgery. 2002; 11(2):122-9

4. Baudi P, Campochiaro G, Serafini F, Gazzotti G, Matino G, Rovesta C et al. Hemiarthroplasty versus reverse shoulder arthroplasty: Comparative study of functional and radiological outcomes in the treatment of acute proximal humerus fracture. Musculoskeletal Surgery. 2014; 98(Suppl 1):19-25

5. Boileau P, Trojani C, Walch G, Krishnan SG, Romeo A, Sinnerton R. Shoulder arthroplasty for the treatment of the sequelae of fractures of the proximal humerus. Journal of Shoulder and Elbow Surgery. 2001; 10(4):299-308

6. Bonnevialle N, Tournier C, Clavert P, Ohl X, Sirveaux F, Saragaglia D et al. Hemiarthroplasty versus reverse shoulder arthroplasty in 4-part displaced fractures of the proximal humerus: Multicenter retrospective study. Orthopaedics & Traumatology, Surgery & Research. 2016; 102(5):569-73

7. Boons HW, Goosen JH, Van Grinsven S, Van Susante JL, Van Loon CJ. Hemiarthroplasty for humeral four-part fractures for patients 65 years and older a randomized controlled trial. Clinical Orthopaedics and Related Research. 2012; 470:3483-3491

8. Boyer E, Menu G, Loisel F, Saadnia R, Uhring J, Adam A et al. Cementless and locked prosthesis for the treatment of 3-part and 4-part proximal humerus fractures: Prospective clinical evaluation of hemi- and reverse arthroplasty. European Journal of Orthopaedic Surgery & Traumatology. 2017; 27(3):301-308

9. Boyle MJ, Youn SM, Frampton CM, Ball CM. Functional outcomes of reverse shoulder arthroplasty compared with hemiarthroplasty for acute proximal humeral fractures. Journal of Shoulder and Elbow Surgery. 2013; 22(1):32-7

10. Brorson S, Rasmussen JV, Olsen BS, Frich LH, Jensen SL, Hrobjartsson A. Reverse shoulder arthroplasty in acute fractures of the proximal humerus: A systematic review. International Journal of Shoulder Surgery. 2013; 7(2):70-8

11. Cabarcas BC, Gowd AK, Liu JN, Cvetanovich GL, Erickson BJ, Romeo AA et al. Establishing maximum medical improvement following reverse total shoulder arthroplasty for rotator cuff deficiency. Journal of Shoulder and Elbow Surgery. 2018; 27(9):1721-1731

12. Chalmers PN, Slikker W, 3rd, Mall NA, Gupta AK, Rahman Z, Enriquez D et al. Reverse total shoulder arthroplasty for acute proximal humeral fracture: comparison to open reduction-internal fixation and hemiarthroplasty. Journal of Shoulder and Elbow Surgery. 2014; 23(2):197-204

ISBN

13. Chen L, Xing F, Xiang Z. Effectiveness and safety of interventions for treating adults with displaced proximal humeral fracture: A network meta-analysis and systematic review. PloS One. 2016; 11(11):e0166801

14. Cuff DJ, Pupello DR. Comparison of hemiarthroplasty and reverse shoulder arthroplasty for the treatment of proximal humeral fractures in elderly patients. Journal of Bone and Joint Surgery (American Volume). 2013; 95(22):2050-5

15. Cvetanovich GL, Chalmers PN, Verma NN, Nicholson GP, Romeo AA. Open reduction internal fixation has fewer short-term complications than shoulder arthroplasty for proximal humeral fractures. Journal of Shoulder and Elbow Surgery. 2016; 25(4):624-631.e3

16. den Hartog D, de Haan J, Schep NW, Tuinebreijer WE. Primary shoulder arthroplasty versus conservative treatment for comminuted proximal humeral fractures: A systematic literature review. Open Orthopaedics Journal. 2010; 4:87-92

17. Du S, Ye J, Chen H, Li X, Lin Q. Interventions for Treating 3- or 4-part proximal humeral fractures in elderly patient: A network meta-analysis of randomized controlled trials. International Journal of Surgery. 2017; 48:240-246

18. Farng E, Zingmond D, Krenek L, Soohoo NF. Factors predicting complication rates after primary shoulder arthroplasty. Journal of Shoulder and Elbow Surgery. 2011; 20(4):557-63

19. Ferrel JR, Trinh TQ, Fischer RA. Reverse total shoulder arthroplasty versus hemiarthroplasty for proximal humeral fractures: A systematic review. Journal of Orthopaedic Trauma. 2015; 29(1):60-8

20. Fialka C, Stampfl P, Arbes S, Reuter P, Oberleitner G, Vecsei V. Primary hemiarthroplasty in four-part fractures of the proximal humerus: Randomized trial of two different implant systems. Journal of Shoulder and Elbow Surgery. 2008; 17(2):210-5

21. Gallinet D, Clappaz P, Garbuio P, Tropet Y, Obert L. Three or four parts complex proximal humerus fractures: Hemiarthroplasty versus reverse prosthesis: A comparative study of 40 cases. Orthopaedics & Traumatology, Surgery & Research. 2009; 95(1):48-55

22. Gallinet D, Ohl X, Decroocq L, Dib C, Valenti P, Boileau P et al. Is reverse total shoulder arthroplasty more effective than hemiarthroplasty for treating displaced proximal humerus fractures in older adults? A systematic review and meta-analysis. Orthopaedics & Traumatology, Surgery & Research. 2018; 104(6):759-766

23. Garrigues GE, Johnston PS, Pepe MD, Tucker BS, Ramsey ML, Austin LS. Hemiarthroplasty versus reverse total shoulder arthroplasty for acute proximal humerus fractures in elderly patients. Orthopedics. 2012; 35(5):e703-8

24. Gulotta LV. Reverse shoulder arthroplasty provided better functional outcomes than hemiarthroplasty for acute proximal humeral fractures. Journal of Bone and Joint Surgery (American Volume). 2015; 97(10):861

25. Handoll H, Brorson S. Interventions for treating proximal humeral fractures in adults. Cochrane Database of Systematic Reviews 2015, Issue 11. Art. No.: CD000434. DOI: 10.1002/14651858.CD000434.pub4.

26. Holton J, Yousri T, Arealis G, Levy O. The role of reverse shoulder arthroplasty in management of proximal humerus fractures with fracture sequelae: A systematic review of the literature. Orthopedic Reviews. 2017; 9(1):6977

27. Launonen AP, Lepola V, Flinkkila T, Laitinen M, Paavola M, Malmivaara A. Treatment of proximal humerus fractures in the elderly: A systemic review of 409 patients. Acta Orthopaedica. 2015; 86(3):280-5

28. Lopiz Y, Garcia-Coiradas J, Serrano-Mateo L, Garcia-Fernandez C, Marco F. Reverse shoulder arthroplasty for acute proximal humeral fractures in the geriatric patient: Results, health-related quality of life and complication rates. International Orthopaedics. 2016; 40(4):771-81

29. Mata-Fink A, Meinke M, Jones C, Kim B, Bell JE. Reverse shoulder arthroplasty for treatment of proximal humeral fractures in older adults: A systematic review. Journal of Shoulder and Elbow Surgery. 2013; 22(12):1737-48

30. Namdari S, Horneff JG, Baldwin K. Comparison of hemiarthroplasty and reverse arthroplasty for treatment of proximal humeral fractures: A systematic review. Journal of Bone and Joint Surgery (American Volume). 2013; 95(18):1701-8

31. National Institute for Health and Care Excellence. Developing NICE guidelines: the manual [updated 2018]. London. National Institute for Health and Care Excellence, 2014. Available from: http://www.nice.org.uk/article/PMG20/chapter/1%20Introduction%20and%20overview

32. National Joint Registry. 15th annual report. Hertfordshire. 2018. Available from: http://www.njrreports.org.uk/Portals/0/PDFdownloads/NJR%2015th%20Annual%20Report%202018.pdf

33. Nijs S, Broos P. Outcome of shoulder hemiarthroplasty in acute proximal humeral fractures: A frustrating meta-analysis experience. Acta Orthopaedica Belgica. 2009; 75(4):445-51

34. Osterhoff G, O'Hara NN, D'Cruz J, Sprague SA, Bansback N, Evaniew N et al. A cost-effectiveness analysis of reverse total shoulder arthroplasty versus hemiarthroplasty for the management of complex proximal humeral fractures in the elderly. Value in Health. 2017; 20(3):404-411

35. Repetto I, Alessio-Mazzola M, Cerruti P, Sanguineti F, Formica M, Felli L. Surgical management of complex proximal humeral fractures: Pinning, locked plate and arthroplasty: Clinical results and functional outcome on retrospective series of patients. Musculoskeletal Surgery. 2017; 101(2):153-158

36. Sebastia-Forcada E, Cebrian-Gomez R, Lizaur-Utrilla A, Gil-Guillen V. Reverse shoulder arthroplasty versus hemiarthroplasty for acute proximal humeral fractures. A blinded, randomized, controlled, prospective study. Journal of Shoulder and Elbow Surgery. 2014; 23(10):1419-26

37. Shukla DR, McAnany S, Kim J, Overley S, Parsons BO. Hemiarthroplasty versus reverse shoulder arthroplasty for treatment of proximal humeral fractures: A meta-analysis. Journal of Shoulder and Elbow Surgery. 2016; 25(2):330-40

38. Singh JA, Sperling JW, Cofield RH. Ninety day mortality and its predictors after primary shoulder arthroplasty: An analysis of 4,019 patients from 1976-2008. BMC Musculoskeletal Disorders. 2011; 12:231

39. Spross C, Meester J, Mazzucchelli RA, Puskas GJ, Zdravkovic V, Jost B. Evidence-based algorithm to treat patients with proximal humerus fractures-a prospective study with early clinical and overall performance results. Journal of Shoulder and Elbow Surgery. 2019; 28(6):1022-1032

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40. Sumrein BO, Huttunen TT, Launonen AP, Berg HE, Fellander-Tsai L, Mattila VM. Proximal humeral fractures in Sweden-a registry-based study. Osteoporosis International. 2017; 28(3):901-907

41. Wang J, Zhu Y, Zhang F, Chen W, Tian Y, Zhang Y. Meta-analysis suggests that reverse shoulder arthroplasty in proximal humerus fractures is a better option than hemiarthroplasty in the elderly. International Orthopaedics. 2016; 40(3):531-9

42. Young SW, Segal BS, Turner PC, Poon PC. Comparison of functional outcomes of reverse shoulder arthroplasty versus hemiarthroplasty in the primary treatment of acute proximal humerus fracture. ANZ Journal of Surgery. 2010; 80(11):789-93

43. Young SW, Zhu M, Walker CG, Poon PC. Comparison of functional outcomes of reverse shoulder arthroplasty with those of hemiarthroplasty in the treatment of cuff-tear arthropathy: A matched-pair analysis. Journal of Bone and Joint Surgery (American Volume). 2013; 95(10):910-5

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Appendices

Appendix A: Review protocols

Table 3: Review protocol: shoulder arthroplasty after previous proximal humeral fracture

ID	Field	Content
0.	PROSPERO registration number	Not registered
1.	Review title	Shoulder arthroplasty after previous proximal humeral fracture
2.	Review question	In adults having primary elective shoulder replacement for pain and functional loss after a previous proximal humeral fracture (not acute trauma), what is the clinical and cost effectiveness of reverse total shoulder replacement versus humeral hemiarthroplasty versus conventional shoulder replacement?
3.	Objective	To assess whether the most effective form of shoulder replacement is conventional total shoulder arthroplasty, hemiarthroplasty or reverse total shoulder arthroplasty in people who have pain and functional loss after a previous proximal humeral fracture.
4.	Searches	The following databases will be searched: Cochrane Central Register of Controlled Trials (CENTRAL) Cochrane Database of Systematic Reviews (CDSR) Embase MEDLINE Searches will be restricted by: English language Human studies Letters and comments are excluded. Other searches: Inclusion lists of relevant systematic reviews will be checked by the reviewer. The searches may be re-run 6 weeks before final committee meeting and further studies retrieved for inclusion if relevant.

ID	Field	Content
		The full search strategies will be published in the final review.
5.	Condition or domain being studied	Primary elective shoulder joint replacement surgery
6.	Population	Inclusion: People who have pain and functional loss after a previous proximal humeral fracture and are indicated for shoulder arthroplasty. Exclude studies including people meeting any of the following criteria: Adults having joint replacement as immediate treatment following fracture Adults having revision joint replacement. Adults having joint replacement as treatment for primary or secondary cancer affecting the bones.
7.	Intervention/Exposure/Test	Reverse total shoulder arthroplasty Conventional total shoulder arthroplasty Shoulder humeral hemiarthroplasty
8.	Comparator/Reference standard/Confounding factors	Comparison of interventions
9.	Types of study to be included	Systematic reviews RCTs If no well-conducted RCTs are available, then observational studies with multivariate analysis will be investigated.
10.	Other exclusion criteria	Non-English language studies. Abstracts will be excluded as it is expected there will be sufficient full text published studies available.
11.	Context	N/A
12.	Primary outcomes (critical outcomes)	Mortality: life expectancy (dichotomous) Mortality: 30 day (dichotomous) Quality of life at 6 weeks or earlier, later than 6 weeks up to 1 year, at least 2 years (continuous) Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier, later than 6 weeks up to 1 year, at least 2 years

ID	Field	Content
		(continuous) Revision of joint replacement (time to event) Reoperation Patient Reported Outcome Measures (PROMs) at 6 weeks or earlier, later than 6 weeks up to 1 year, at least 2 years (dichotomous)
13.	Secondary outcomes (important outcomes)	Component failure (dichotomous) Dislocations within 1 year, after 1 year (dichotomous) Return to activity/sports (time to event) Deep surgical site Infection (dichotomous) Superficial surgical site infection (dichotomous) Length of stay (continuous) Major adverse events (including nerve injury, MI, VTE) (dichotomous) To be extracted when not included within an extracted PROM: Function at 6 weeks or earlier, later than 6 weeks up to 1 year, at least 2 years (continuous) Pain at 6 weeks or earlier, later than 6 weeks up to 1 year, at least 2 years (continuous)
14.	Data extraction (selection and coding)	EndNote will be used for reference management, sifting, citations and bibliographies. Titles and/or abstracts of studies retrieved using the search strategy and those from additional sources will be screened for inclusion. The full text of potentially eligible studies will be retrieved and will be assessed for eligibility in line with the criteria outlined above. 10% of the abstracts will be reviewed by two reviewers, with any disagreements resolved by discussion or, if necessary, a third independent reviewer. An in-house developed database; EviBase, will be used for data extraction. A standardised form is followed to extract data from studies (see Developing NICE guidelines: the manual section 6.4) and for undertaking assessment of study quality. Summary evidence tables will be produced including information on: study setting; study population and participant demographics and baseline characteristics; details of the intervention and control interventions; study methodology' recruitment and missing data rates; outcomes and times of measurement; critical appraisal ratings. A second reviewer will quality assure the extracted data. Discrepancies will be identified and resolved through discussion (with a third reviewer where necessary).
15.	Risk of bias (quality) assessment	Risk of bias will be assessed using the appropriate checklist as described in Developing NICE guidelines: the manual.

ID	Field	Content
		For Intervention reviews the following checklist will be used according to study design being assessed: Systematic reviews: Risk of Bias in Systematic Reviews (ROBIS) Randomised Controlled Trial: Cochrane RoB (2.0) Disagreements between the review authors over the risk of bias in particular studies will be resolved by discussion, with involvement of a third review author where necessary.
16.	Strategy for data synthesis	Where possible, data will be meta-analysed. Pairwise meta-analyses will be performed using Cochrane Review Manager (RevMan5) to combine the data given in all studies for each of the outcomes stated above. A fixed effect meta-analysis, with weighted mean differences for continuous outcomes and risk ratios for binary outcomes will be used, and 95% confidence intervals will be calculated for each outcome. Heterogeneity between the studies in effect measures will be assessed using the I^2 statistic and visually inspected. We will consider an I^2 value greater than 50% indicative of substantial heterogeneity. Sensitivity analyses will be conducted based on pre-specified subgroups using stratified meta-analysis to explore the heterogeneity in effect estimates. If this does not explain the heterogeneity, the results will be presented using random-effects. GRADE pro will be used to assess the quality of each outcome, taking into account individual study quality and the meta-analysis results. The 4 main quality elements (risk of bias, indirectness, inconsistency and imprecision) will be appraised for each outcome. If the population included in an individual study includes children aged under 12, it will be included if the majority of the population is aged over 12, and downgraded for indirectness if the overlap into those aged less than 12 is greater than 20%. Publication bias is tested for when there are more than 5 studies for an outcome. Other bias will only be taken into consideration in the quality assessment if it is apparent. Where meta-analysis is not possible, data will be presented and quality assessed individually per outcome. If sufficient data is available to make a network of treatments, WinBUGS will be used for network meta-analysis.
17.	Analysis of sub-groups	Age: Working age, non-working age Humeral component: stemmed, stemless Surgical fixation: cemented, uncemented

ID	Field	Content			
18.	Type and method of review	☒	Intervention		
		☐	Diagnostic		
		☐	Prognostic		
		☐	Qualitative		
		☐	Epidemiologic		
		☐	Service Delivery		
		☐	Other (please specify)		
19.	Language	English			
20.	Country	England			
21.	Anticipated or actual start date	05/12/18			
22.	Anticipated completion date	20/03/20			
23.	Stage of review at time of this submission	Review stage		Started	Completed
		Preliminary searches		☑	☐
		Piloting of the study selection process		☑	☐
		Formal screening of search results against eligibility criteria		☐	☐
		Data extraction		☐	☐
		Risk of bias (quality) assessment		☐	☐
		Data analysis		☐	☐
24.	Named contact	5a. Named contact National Guideline Centre 5b Named contact e-mail Headches@nice.org.uk			

ID	Field	Content
		5e Organisational affiliation of the review National Institute for Health and Care Excellence (NICE) and the National Guideline Centre
25.	Review team members	From the National Guideline Centre: Carlos Sharpin [Guideline lead] Alex Allen [Senior Systematic Reviewer] Rafina Yarde [Systematic reviewer] Robert King [Health economist] Agnès Cuyàs [Information specialist] Eleanor Priestnall [Project Manager]
26.	Funding sources/sponsor	This systematic review is being completed by the National Guideline Centre which receives funding from NICE.
27.	Conflicts of interest	All guideline committee members and anyone who has direct input into NICE guidelines (including the evidence review team and expert witnesses) must declare any potential conflicts of interest in line with NICE's code of practice for declaring and dealing with conflicts of interest. Any relevant interests, or changes to interests, will also be declared publicly at the start of each guideline committee meeting. Before each meeting, any potential conflicts of interest will be considered by the guideline committee Chair and a senior member of the development team. Any decisions to exclude a person from all or part of a meeting will be documented. Any changes to a member's declaration of interests will be recorded in the minutes of the meeting. Declarations of interests will be published with the final guideline.
28.	Collaborators	Development of this systematic review will be overseen by an advisory committee who will use the review to inform the development of evidence-based recommendations in line with section 3 of Developing NICE guidelines: the manual. Members of the guideline committee are available on the NICE website: [NICE guideline webpage].
29.	Other registration details	
30.	Reference/URL for published protocol	
31.	Dissemination plans	NICE may use a range of different methods to raise awareness of the guideline. These include standard approaches such as: notifying registered stakeholders of publication publicising the guideline through NICE's newsletter and alerts issuing a press release or briefing as appropriate, posting news articles on the NICE website, using social media channels, and publicising the guideline within NICE.

ID	Field	Content	
32.	Keywords	Shoulder Joint replacement surgery, arthroplasty, proximal humeral fracture	
33.	Details of existing review of same topic by same authors	N/A	
34.	Current review status	☒	Ongoing
		☐	Completed but not published
		☐	Completed and published
		☐	Completed, published and being updated
		☐	Discontinued
35..	Additional information	N/A	
36.	Details of final publication	www.nice.org.uk	

1 **Table 4: Health economic review protocol**

Review question	All questions – health economic evidence
Objectives	To identify health economic studies relevant to any of the review questions.
Search criteria	• Populations, interventions and comparators must be as specified in the clinical review protocol above. • Studies must be of a relevant health economic study design (cost–utility analysis, cost-effectiveness analysis, cost–benefit analysis, cost–consequences analysis, comparative cost analysis). • Studies must not be a letter, editorial or commentary, or a review of health economic evaluations. (Recent reviews will be ordered although not reviewed. The bibliographies will be checked for relevant studies, which will then be ordered.) • Unpublished reports will not be considered unless submitted as part of a call for evidence. • Studies must be in English.
Search strategy	A health economic study search will be undertaken using population-specific terms and a health economic study filter – see appendix B below.
Review strategy	Studies not meeting any of the search criteria above will be excluded. Studies published before 2003, abstract-only studies and studies from low or middle-income countries (e.g. most non-OECD countries) or the USA will also be excluded. Each remaining study will be assessed for applicability and methodological limitations using the NICE economic evaluation checklist which can be found in appendix H of Developing NICE guidelines: the manual (2014).[31] **Inclusion and exclusion criteria** • If a study is rated as both 'Directly applicable' and with 'Minor limitations' then it will be included in the guideline. A health economic evidence table will be completed and it will be included in the health economic evidence profile. • If a study is rated as either 'Not applicable' or with 'Very serious limitations' then it will usually be excluded from the guideline. If it is excluded then a health economic evidence table will not be completed and it will not be included in the health economic evidence profile. • If a study is rated as 'Partially applicable', with 'Potentially serious limitations' or both then there is discretion over whether it should be included. **Where there is discretion** The health economist will make a decision based on the relative applicability and quality of the available evidence for that question, in discussion with the guideline committee if required. The ultimate aim is to include health economic studies that are helpful for decision-making in the context of the guideline and the current NHS setting. If several studies are considered of sufficiently high applicability and methodological quality that they could all be included, then the health economist, in discussion with the committee if required, may decide to include only the most applicable studies and to selectively exclude the remaining studies. All studies excluded on the basis of applicability or methodological limitations will be listed with explanation in the excluded health economic studies appendix below. The health economist will be guided by the following hierarchies. *Setting:* • UK NHS (most applicable). • OECD countries with predominantly public health insurance systems (for example, France, Germany, Sweden). • OECD countries with predominantly private health insurance systems (for example,

	Switzerland). • Studies set in non-OECD countries or in the USA will be excluded before being assessed for applicability and methodological limitations. *Health economic study type:* • Cost–utility analysis (most applicable). • Other type of full economic evaluation (cost–benefit analysis, cost-effectiveness analysis, cost–consequences analysis). • Comparative cost analysis. • Non-comparative cost analyses including cost-of-illness studies will be excluded before being assessed for applicability and methodological limitations. *Year of analysis:* • The more recent the study, the more applicable it will be. • Studies published in 2003 or later but that depend on unit costs and resource data entirely or predominantly from before 2003 will be rated as 'Not applicable'. • Studies published before 2003 will be excluded before being assessed for applicability and methodological limitations. *Quality and relevance of effectiveness data used in the health economic analysis:* • The more closely the clinical effectiveness data used in the health economic analysis match with the outcomes of the studies included in the clinical review the more useful the analysis will be for decision-making in the guideline.

Appendix B: Literature search strategies

The literature searches for this review are detailed below and complied with the methodology outlined in Developing NICE guidelines: the manual.[31]

For more detailed information, please see the Methodology Review.

B.1 Clinical search literature search strategy

Searches were constructed using a PICO framework where population (P) terms were combined with Intervention (I) and in some cases Comparison (C) terms. Outcomes (O) are rarely used in search strategies for interventions as these concepts may not be well described in title, abstract or indexes and therefore difficult to retrieve. Search filters were applied to the searches where appropriate.

Due to the size of retrieval, only the population was used in this search.

Table 5: Database date parameters and filters used

Database	Dates searched	Search filter used
Medline (OVID)	1946 – 01 May 2019	Exclusions Randomised controlled trials Systematic review studies Observational studies
Embase (OVID)	1974 – 01 May 2019	Exclusions Randomised controlled trials Systematic review studies Observational studies
The Cochrane Library (Wiley)	Cochrane Reviews to 2019 Issue 5 of 12 CENTRAL to 2019 Issue 5 of 12	None

Medline (Ovid) search terms

1.	arthroplasty, replacement, shoulder/
2.	shoulder prosthesis/
3.	(shoulder* adj4 (replace* or prosthe* or endoprosthe* or implant* or artificial or arthroplast* or hemiarthroplast* or reverse)).ti,ab.
4.	or/1-3
5.	letter/
6.	editorial/
7.	news/
8.	exp historical article/
9.	Anecdotes as Topic/
10.	comment/
11.	case report/
12.	(letter or comment*).ti.
13.	or/5-12
14.	randomized controlled trial/ or random*.ti,ab.
15.	13 not 14
16.	animals/ not humans/

17.	exp Animals, Laboratory/
18.	exp Animal Experimentation/
19.	exp Models, Animal/
20.	exp Rodentia/
21.	(rat or rats or mouse or mice).ti.
22.	or/15-21
23.	4 not 22
24.	limit 23 to English language
25.	randomized controlled trial.pt.
26.	controlled clinical trial.pt.
27.	randomi#ed.ti,ab.
28.	placebo.ab.
29.	randomly.ti,ab.
30.	Clinical Trials as topic.sh.
31.	trial.ti.
32.	or/25-31
33.	Meta-Analysis/
34.	exp Meta-Analysis as Topic/
35.	(meta analy* or metanaly* or metaanaly* or meta regression).ti,ab.
36.	((systematic* or evidence*) adj3 (review* or overview*)).ti,ab.
37.	(reference list* or bibliograph* or hand search* or manual search* or relevant journals).ab.
38.	(search strategy or search criteria or systematic search or study selection or data extraction).ab.
39.	(search* adj4 literature).ab.
40.	(medline or pubmed or cochrane or embase or psychlit or psyclit or psychinfo or psycinfo or cinahl or science citation index or bids or cancerlit).ab.
41.	cochrane.jw.
42.	((multiple treatment* or indirect or mixed) adj2 comparison*).ti,ab.
43.	or/33-42
44.	Epidemiologic studies/
45.	Observational study/
46.	exp Cohort studies/
47.	(cohort adj (study or studies or analys* or data)).ti,ab.
48.	((follow up or observational or uncontrolled or non randomi#ed or epidemiologic*) adj (study or studies or data)).ti,ab.
49.	((longitudinal or retrospective or prospective or cross sectional) and (study or studies or review or analys* or cohort* or data)).ti,ab.
50.	Controlled Before-After Studies/
51.	Historically Controlled Study/
52.	Interrupted Time Series Analysis/
53.	(before adj2 after adj2 (study or studies or data)).ti,ab.
54.	or/45-54
55.	exp case control study/
56.	case control*.ti,ab.
57.	or/56-57
58.	55 or 58

ISBN

59.	Cross-sectional studies/
60.	(cross sectional and (study or studies or review or analys* or cohort* or data)).ti,ab.
61.	or/60-61
62.	55 or 62
63.	55 or 58 or 62
64.	24 and (32 or 43 or 63)

1 **Embase (Ovid) search terms**

1.	shoulder replacement/
2.	shoulder prosthesis/
3.	(shoulder* adj4 (replac* or prosthe* or endoprosthe* or implant* or artificial or arthroplast* or hemiarthroplast* or reverse)).ti,ab.
4.	or/1-3
5.	letter.pt. or letter/
6.	note.pt.
7.	editorial.pt.
8.	case report/ or case study/
9.	(letter or comment*).ti.
10.	or/5-9
11.	randomized controlled trial/ or random*.ti,ab.
12.	10 not 11
13.	animal/ not human/
14.	nonhuman/
15.	exp Animal Experiment/
16.	exp Experimental Animal/
17.	animal model/
18.	exp Rodent/
19.	(rat or rats or mouse or mice).ti.
20.	or/12-19
21.	4 not 20
22.	limit 21 to English language
23.	random*.ti,ab.
24.	factorial*.ti,ab.
25.	(crossover* or cross over*).ti,ab.
26.	((doubl* or singl*) adj blind*).ti,ab.
27.	(assign* or allocat* or volunteer* or placebo*).ti,ab.
28.	crossover procedure/
29.	single blind procedure/
30.	randomized controlled trial/
31.	double blind procedure/
32.	or/23-31
33.	systematic review/
34.	meta-analysis/
35.	(meta analy* or metanaly* or metaanaly* or meta regression).ti,ab.
36.	((systematic* or evidence*) adj3 (review* or overview*)).ti,ab.
37.	(reference list* or bibliograph* or hand search* or manual search* or relevant

	journals).ab.
38.	(search strategy or search criteria or systematic search or study selection or data extraction).ab.
39.	(search* adj4 literature).ab.
40.	(medline or pubmed or cochrane or embase or psychlit or psyclit or psychinfo or psycinfo or cinahl or science citation index or bids or cancerlit).ab.
41.	cochrane.jw.
42.	((multiple treatment* or indirect or mixed) adj2 comparison*).ti,ab.
43.	or/33-42
44.	Clinical study/
45.	Observational study/
46.	family study/
47.	longitudinal study/
48.	retrospective study/
49.	prospective study/
50.	cohort analysis/
51.	follow-up/
52.	cohort*.ti,ab.
53.	52 and 53
54.	(cohort adj (study or studies or analys* or data)).ti,ab.
55.	((follow up or observational or uncontrolled or non randomi#ed or epidemiologic*) adj (study or studies or data)).ti,ab.
56.	((longitudinal or retrospective or prospective or cross sectional) and (study or studies or review or analys* or cohort* or data)).ti,ab.
57.	(before adj2 after adj2 (study or studies or data)).ti,ab.
58.	or/45-51,54-58
59.	exp case control study/
60.	case control*.ti,ab.
61.	or/60-61
62.	59 or 62
63.	cross-sectional study/
64.	(cross sectional and (study or studies or review or analys* or cohort* or data)).ti,ab.
65.	or/64-65
66.	59 or 66
67.	59 or 62 or 66
68.	22 and (32 or 43 or 67)

1 **Cochrane Library (Wiley) search terms**

#1.	MeSH descriptor: [Arthroplasty, Replacement, Shoulder] this term only
#2.	MeSH descriptor: [Shoulder Prosthesis] this term only
#3.	(shoulder* near/4 (replac* or prosthe* or endoprosthe* or implant* or artificial or arthroplast* or hemiarthroplast* or reverse)):ti,ab
#4.	(OR #1-#3)

2

B.2 Health Economics literature search strategy

Health economic evidence was identified by conducting a broad search relating to the joint replacement population in NHS Economic Evaluation Database (NHS EED – this ceased to be updated after March 2015) and the Health Technology Assessment database (HTA) with no date restrictions. NHS EED and HTA databases are hosted by the Centre for Research and Dissemination (CRD). Additional health economics searches were run in Medline and Embase..

Table 6: Database date parameters and filters used

Database	Dates searched	Search filter used
Medline	2014 – 01 May 2019	Exclusions Health economics studies
Embase	2014 – 01 May 2019	Exclusions Health economics studies
Centre for Research and Dissemination (CRD)	HTA - Inception – 01 May 2019 NHSEED - Inception to March 2015	None

Medline (Ovid) search terms

1.	arthroplasty/ or arthroplasty, replacement/ or arthroplasty, replacement, hip/ or arthroplasty, replacement, knee/ or arthroplasty, replacement, shoulder/ or hemiarthroplasty/
2.	joint prosthesis/ or hip prosthesis/ or knee prosthesis/ or shoulder prosthesis/
3.	((joint* or knee* or shoulder* or hip*) adj5 (surger* or replace* or prosthe* or endoprosthe* or implant* or artificial or arthroplast* or hemiarthroplast*)).ti,ab.
4.	or/1-3
5.	letter/
6.	editorial/
7.	news/
8.	exp historical article/
9.	Anecdotes as Topic/
10.	comment/
11.	case report/
12.	(letter or comment*).ti.
13.	or/5-12
14.	randomized controlled trial/ or random*.ti,ab.
15.	13 not 14
16.	animals/ not humans/
17.	exp Animals, Laboratory/
18.	exp Animal Experimentation/
19.	exp Models, Animal/
20.	exp Rodentia/
21.	(rat or rats or mouse or mice).ti.
22.	or/15-21
23.	4 not 22
24.	limit 23 to English language

25.	Economics/
26.	Value of life/
27.	exp "Costs and Cost Analysis"/
28.	exp Economics, Hospital/
29.	exp Economics, Medical/
30.	Economics, Nursing/
31.	Economics, Pharmaceutical/
32.	exp "Fees and Charges"/
33.	exp Budgets/
34.	budget*.ti,ab.
35.	cost*.ti.
36.	(economic* or pharmaco?economic*).ti.
37.	(price* or pricing*).ti,ab.
38.	(cost* adj2 (effective* or utilit* or benefit* or minimi* or unit* or estimat* or variable*)).ab.
39.	(financ* or fee or fees).ti,ab.
40.	(value adj2 (money or monetary)).ti,ab.
41.	or/25-40
42.	24 and 41

1 Embase (Ovid) search terms

1.	*arthroplasty/ or *replacement arthroplasty/ or *hip replacement/ or *knee replacement/ or *shoulder replacement/ or *hemiarthroplasty/
2.	*joint prosthesis/ or *hip prosthesis/ or *knee prosthesis/ or *shoulder prosthesis/
3.	((joint* or knee* or shoulder* or hip*) adj5 (surger* or replace* or prosthe* or endoprosthe* or implant* or artificial or arthroplast* or hemiarthroplast*)).ti,ab.
4.	or/1-3
5.	letter.pt. or letter/
6.	note.pt.
7.	editorial.pt.
8.	case report/ or case study/
9.	(letter or comment*).ti.
10.	or/5-9
11.	randomized controlled trial/ or random*.ti,ab.
12.	10 not 11
13.	animal/ not human/
14.	nonhuman/
15.	exp Animal Experiment/
16.	exp Experimental Animal/
17.	animal model/
18.	exp Rodent/
19.	(rat or rats or mouse or mice).ti.
20.	or/12-19
21.	4 not 20

ISBN

22.	limit 21 to English language
23.	health economics/
24.	exp economic evaluation/
25.	exp health care cost/
26.	exp fee/
27.	budget/
28.	funding/
29.	budget*.ti,ab.
30.	cost*.ti.
31.	(economic* or pharmaco?economic*).ti.
32.	(price* or pricing*).ti,ab.
33.	(cost* adj2 (effective* or utilit* or benefit* or minimi* or unit* or estimat* or variable*)).ab.
34.	(financ* or fee or fees).ti,ab.
35.	(value adj2 (money or monetary)).ti,ab.
36.	or/23-35
37.	22 and 36

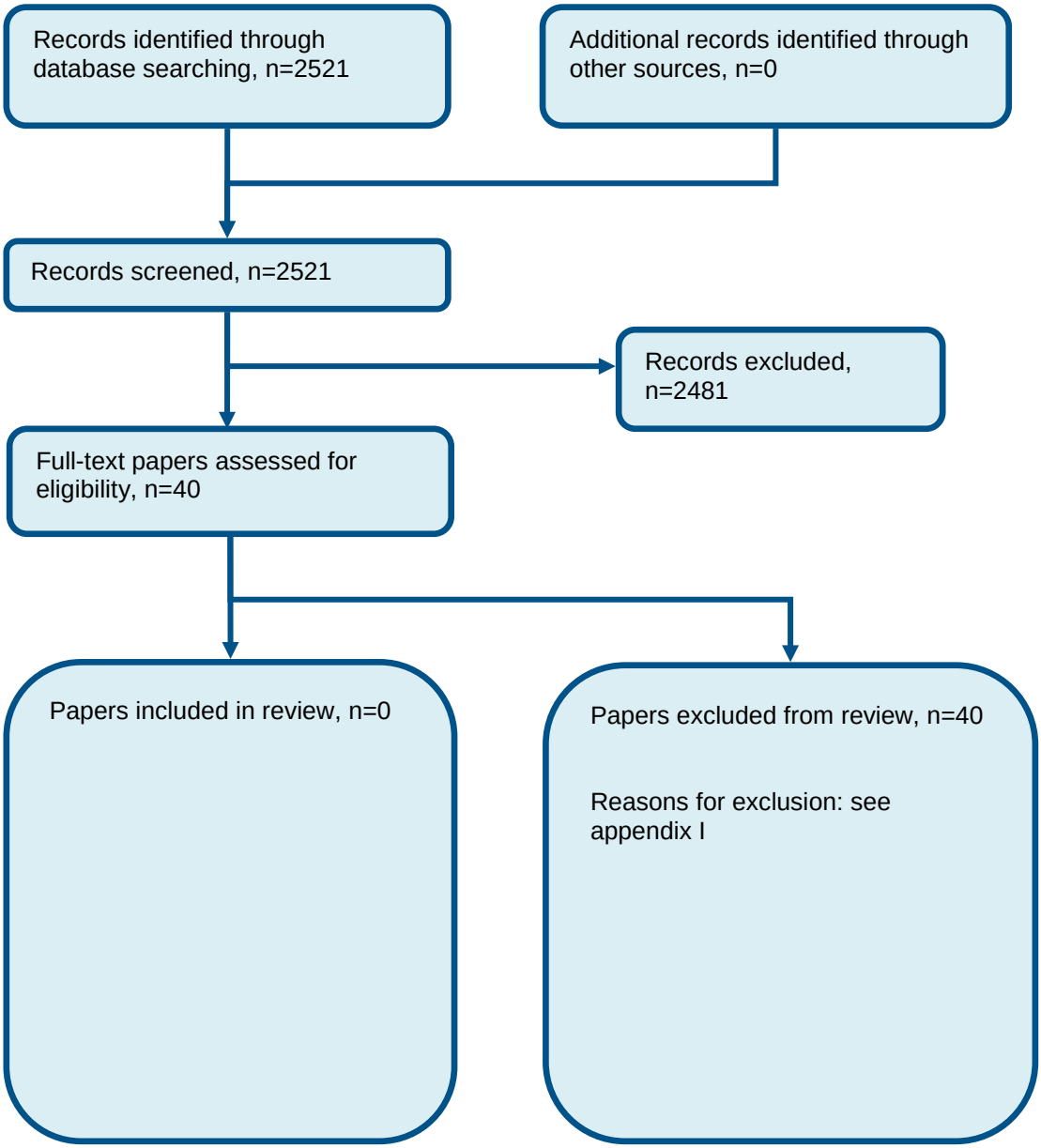
1 **NHS EED and HTA (CRD) search terms**

#1.	MeSH DESCRIPTOR arthroplasty
#2.	MeSH DESCRIPTOR arthroplasty, replacement
#3.	MeSH DESCRIPTOR arthroplasty, replacement, hip
#4.	MeSH DESCRIPTOR arthroplasty, replacement, knee
#5.	MeSH DESCRIPTOR arthroplasty, replacement, shoulder
#6.	MeSH DESCRIPTOR hemiarthroplasty
#7.	MeSH DESCRIPTOR joint prosthesis
#8.	MeSH DESCRIPTOR hip prosthesis
#9.	MeSH DESCRIPTOR knee prosthesis
#10.	MeSH DESCRIPTOR shoulder prosthesis
#11.	(((joint* or knee* or shoulder* or hip*) adj5 (surger* or replace* or prosthe* or endoprosthe* or implant* or artificial or arthroplast* or hemiarthroplast*)))
#12.	(#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11) IN NHSEED
#13.	(#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11) IN HTA

2

Appendix C: Clinical evidence selection

Figure 1: Flow chart of clinical study selection for the review of shoulder arthroplasty after previous proximal humeral fracture



Appendix D: Clinical evidence tables

No evidence was identified.

ISBN

Appendix E: Forest plots

No evidence was identified.

ISBN

Appendix F: GRADE tables

No evidence was identified

ISBN

Appendix G: Health economic evidence selection

Figure 2: Flow chart of health economic study selection for the guideline

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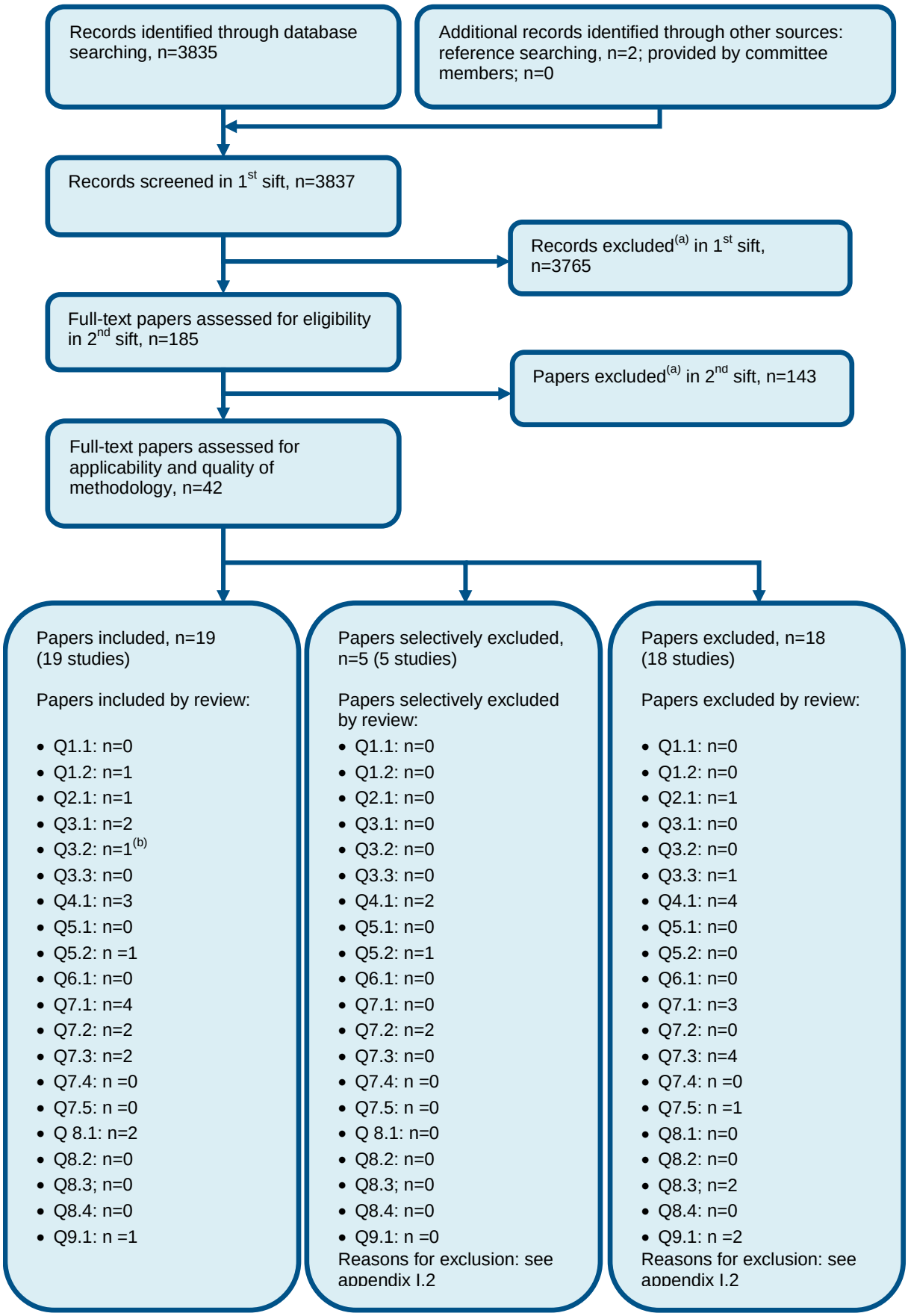

a) Non-relevant population, intervention, comparison, design or setting; non-English language
b) One study was applicable to both Q3.1 and Q3.2

1

1

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Appendix H: Health economic evidence tables

None

ISBN

Appendix I: Excluded studies

I.1 Excluded clinical studies

Table 7: Studies excluded from the clinical review

Study	Exclusion reason
Alentorn-geli 2015[1]	Systematic review protocol does not match this review. Included studies were checked.
Anakwenze 2014[2]	Systematic review protocol does not match this review. Included studies were checked.
Antuna 2002[3]	Observational study that does not account for confounding factors
Baudi 2014[4]	Not review population
Boileau 2001[5]	Inappropriate comparison
Bonnevialle 2016[6]	Not review population
Boons 2012[7]	Inappropriate comparison
Boyer 2017[8]	Observational study without adjustment for confounding factors
Boyle 2013[9]	Not review population
Brorson 2013[10]	Systematic review protocol does not match this review. Included studies were checked.
Cabarcas 2018[11]	Incorrect population. Included studies were checked.
Chalmers 2014[12]	Not review population
Chen 2016[13]	Systematic review protocol does not match this review. Included studies were checked.
Cuff 2013[14]	Observational study without adjustment for confounding factors
Cvetanovich 2016[15]	Not review population
Den hartog 2010[16]	Systematic review protocol does not match this review. Included studies were checked.
Du 2017[17]	Systematic review protocol does not match this review. Included studies were checked.
Farng 2011[18]	Inappropriate comparison
Ferrel 2015[19]	Systematic review protocol does not match this review. Included studies were checked.
Fialka 2008[20]	Inappropriate comparison
Gallinet 2009[21]	Systematic review protocol does not match this review. Included studies were checked.
Gallinet 2018[22]	Not review population
Garrigues 2012[23]	Not review population
Gulotta 2015[24]	Incorrect study design
Handoll 2015[25]	Systematic review protocol does not match this review. Included studies were checked.
Holton 2017[26]	Systematic review protocol does not match this review. Included studies were checked.
Launonen 2015[27]	Systematic review protocol does not match this review. Included studies were checked.
Lopiz 2016[28]	Not review population
Mata-fink 2013[29]	Systematic review protocol does not match this review. Included

Study	Exclusion reason
	studies were checked.
Namdari 2013[30]	Systematic review protocol does not match this review. Included studies were checked.
Nijs 2009[33]	Systematic review with incorrect population. Included studies were checked for this review.
Repetto 2017[35]	Not review population
Sebastia-forcada 2014[36]	Not review population
Shukla 2016[37]	Systematic review protocol does not match this review. Included studies were checked.
Singh 2011[38]	Not review population
Spross 2019[39]	Treatment algorithm
Sumrein 2017[40]	Not review population
Wang 2016[41]	Systematic review protocol does not match this review. Included studies were checked.
Young 2010[42]	Not review population
Young 2013[43]	Not review population

I.21 Excluded health economic studies

2 **Table 8: Studies excluded from the health economic review**

Reference	Reason for exclusion
Osterhoff 2017[34]	This study was assessed as not applicable as it does not cover the review population

3

Appendix J: Research recommendations

J.1 Procedures for shoulder replacement for people with a previous proximal humeral fracture

Research question: In adults having primary elective shoulder replacement for pain and functional loss after a previous proximal humeral fracture (not acute trauma), what is the clinical and cost effectiveness of reverse total shoulder replacement compared with humeral hemiarthroplasty?

Why this is important:

The number of people having shoulder replacement surgery is increasing year on year with over 6,500 people having their shoulder replaced in the UK in 2017. Some of these are done for acute fractures but the vast majority are elective procedures for arthritic problems. Many acute fractures of the proximal humerus are treated non-operatively. A number of these go onto to develop post traumatic problems such as a non-union or post traumatic arthritis. For these people with post traumatic shoulder problems following a proximal humeral fracture, there is no consensus on which procedure has the best outcomes. National Joint Registry data now indicates that an increasing number of people are being treated with a reverse total shoulder replacements as opposed to a humeral hemiarthroplasty or in some circumstances a conventional total shoulder replacement. This NICE guideline was unable to find any evidence to make a recommendation on which type of shoulder replacements to use in patients pain and functional loss following previous proximal humeral fractures (not acute trauma).

PICO question	**Population**: People with pain and functional loss after a previous proximal humeral fracture (not acute trauma) in need of a shoulder replacement procedure. **Intervention(s)**: Reverse Total Shoulder replacement **Comparison:** Humeral Hemiarthroplasty **Outcome(s):** Quality of life and Patient Reported Outcome Measues (PROMs) 2 year after surgery. Cost outcomes to enable cost-effectiveness analysis. Time to event data for revision surgery after 5 and 10 years.
Study design	Randomised controlled trial nested in NJR for longer term follow up
Other details	Decision making around which shoulder replacement type for different problems made the top 10 research priorities of the 2015 James Lind Alliance PSP on Shoulder Surgery.