Is there sufficient evidence to support intervention to manage shoulder arthritis?

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Abstract

Background: We explore the nature, extent and validity of research studies concerning the management of shoulder arthritis to identify whether current management recommendations are adequate.

Methods: A full electronic search for relevant studies published between 2002 and 2012 was performed. The search focused on level 1 and level 2 studies. Full texts of selected articles were retrieved and assessed for quality against validated criteria.

Results: Four hundred and eleven studies were identified on the initial search and screened. Sixteen studies were selected for inclusion in the review. The studies identified were unable to provide a clear indication of best intervention for shoulder arthritis. The inclusion of a range of shoulder pathologies in some studies and the diversity in outcome measures used made it difficult for systematic reviews to effectively pool data. Better outcomes have been shown with total shoulder replacement over hemiarthroplasty for shoulder osteoarthritis; however, primary studies were often of limited quality. Sparse evidence is available for all other interventions, regardless of whether operative or non-operative.

Conclusions: The present review highlights the need for standardization of outcome assessment following treatment of shoulder arthritis. More rigorous and robust primary studies are needed to guide clinical practice on the best interventions for arthritis of the shoulder.

Keywords

hemiarthroplasty, osteoarthritis, reverse, shoulder, tenodesis, total

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Introduction

Each year, 1% of the adult population in the UK over the age of 45 years present with new onset shoulder pain.¹ It is the third most common musculoskeletal pain seen in general practice behind back and knee pathologies.¹ Shoulder osteoarthritis is characterized by degeneration of articular cartilage and subchondral bone with narrowing of the glenohumeral joint. It causes significant pain, functional limitation and disability, with an estimated prevalence of between 4% and 26%.²

Current treatment options for shoulder arthritis are either operative or non-operative. Operative interventions include total shoulder arthroplasty (TSA), hemiarthroplasty, reverse shoulder arthroplasty (RSA) and arthroscopic debridement. Non-operative interventions include physiotherapy, nonsteroidal anti-inflammatory

(NSAIDs) medication, intra-articular corticosteroid injections and acupuncture.

In the UK, the provision of TSA and hemiarthroplasty is approximately one-tenth and one-fifth, respectively, per capita compared to the USA,³ where the number of shoulder arthroplasties, particularly TSA, is growing rapidly.⁴ Currently, 47, 000 shoulder

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replacements are performed annually in North America, of which approximately 27, 000 are TSA.⁴

The aim of this scoping review is to critically appraise and summarize the current body of evidence in the management of shoulder arthritis. We aim to explore the nature, extent and validity of research studies carried out in this field and to identify whether current management recommendations are adequate. By mapping a wide range of literature, we aim to identify where gaps and innovative approaches may lie.

Materials and Methods

For the purpose of this scoping review, the six-stage methodological framework developed by Arksey and O'Malley⁵ has been used. The framework is:

1. Identifying the research question.
2. Identifying relevant studies.
3. Study selection.
4. Charting the data (Table 1).
5. Collating, summarizing and reporting results.
6. Consultation.

This report covers the first five stages of the framework, providing the template for consultation with stakeholders.

Literature search

Evidence was gathered from *NHS Evidence*, *National Guideline Clearing House*, *Centre for Reviews and Dissemination*, *Cochrane Database of Systematic Reviews*, *Cochrane Central Register of Controlled Trials*, *Medline* and *Embase* from 2002 to 2012 using relevant controlled vocabulary terms and key terms related to shoulder arthritis and its treatments. The search focused on level 1 and level 2 randomized controlled trials (RCTs) and systematic reviews. The gathered literature was limited to publications in English. The only exclusion criterion used in the initial search was the medical management of rheumatoid arthritis.

Key words used included arthroscopy, total shoulder replacement, hemiarthroplasty, reverse shoulder replacement, reverse, polarity shoulder replacement, resurfacing shoulder replacement, steroid injection, supra-scapular nerve blocks, pain killers, NSAIDS, physiotherapy.

Selection of papers

Four hundred and eleven papers were identified on initial search, with 160 remaining after de-duplication. Fifty-six papers were excluded after being deemed not relevant, with a further 61 excluded as a result of an incorrect study design. Following initial review, 43

papers remained. The abstracts of these papers were independently assessed by two authors to assess their relevance and suitability for inclusion in the review. A third author acted as a referee in case of any disagreement. There was perfect agreement between the two authors in the selection of studies to be included. Sixteen papers were selected and full texts retrieved.^{6–21} Twenty-seven papers were excluded.^{22–48} Papers were excluded if they did not include patients with primary osteoarthritis of the shoulder or if they did not report clinical outcomes.

The selected studies were analyzed by the same two authors and key information was charted as shown in Table 1.

Quality assessment

The quality of the selected articles was assessed by two authors (DB and ATK) using one of three tools:

1. AMSTAR measurement tool to assess systematic reviews.
2. CONSORT 'Consolidated Standards of Reporting Trials' tool for RCTs.
3. TREND 'Transparent Reporting of Evaluations with Non randomised Designs' tool for nonrandomized trials.

Systematic reviews all scored well when assessed according to the AMSTAR checklist. The main omissions were failing to list all excluded studies and to assess publication bias. RCTs again scored well against the CONSORT checklist. Common shortcomings were recruitment periods not being defined and reasons for participant losses not being made clear. Observational studies all scored well against TREND criteria.

The level of agreement between both assessors was good, with a kappa value of 0.87.

Results

TSA and hemiarthroplasty

Function and pain outcome. Functional outcome was found to be significantly better for TSA over hemiarthroplasty in four studies.^{6,7,8,10} Outcome measures that reached significance reported by the studies were: patient satisfaction, range of motion (ROM), University of California Los Angeles (UCLA) shoulder score, American Shoulder and Elbow Surgeons (ASES) score and Constant score. Two studies, however, reported no significant functional advantage between the two treatment modalities.^{9,13} One study, however, was limited to 42 patients, reporting no significant difference in Western Ontario Osteoarthritis of the

Table 1. Charting of studies.

Author/timeline	Subject and inclusion/exclusion criteria	Intervention	Outcome measures	Results	Conclusion
Izquierdo 2010 Systematic review Guideline Level 1	Treatment of glenohumeral osteoarthritis Studies: 19 Inclusion: Studies that evaluate a treatment for osteoarthritis of the glenohumeral joint and fulfil the listed criteria: Published in peer review journal. English article published after 1965 Not cadaveric, animal, <i>in vitro</i> or biomechanical studies Enrolled greater than 10 patients. At least 80% of study population had osteoarthritis of the glenohumeral joint Follow-up of at least 2 years Only outcomes of the highest level of evidence included Only patient-orientated outcomes included	Any treatment for glenohumeral osteoarthritis	Pain score UCLA score Quality of life score Constant score Function ASES WOOS	Physical therapy, pharmacotherapy, corticosteroid injections, arthroscopic treatments, humeral resurfacing, biceps tenotomy. Inconclusive. No studies of sufficient quality Injectable viscosupplementation: Weak – one study showed statistical significant improvement in outcome measures Hemiarthroplasty and TSA: Weak – seven studies showing significant improvement in outcome measure from both Hemiarthroplasty versus TSA: Moderate in favour of TSA – two studies found global health assessment scores and pain relief better after TSA. No difference in function and quality of life outcomes. 14% of patients with hemiarthroplasty required revision to TSA	Quality of scientific data on treatment of glenohumeral osteoarthritis is poor
Bryant 2005 Systematic review Meta-analysis Level 1	Hemiarthroplasty versus TSA in patient with osteoarthritis Trials: Four RCTs Inclusion: RCTs comparing hemiarthroplasty with TSA in patients with primary diagnosis of primary shoulder osteoarthritis, with minimum follow-up of 2 years Exclusion: Condition other than shoulder osteoarthritis	Hemiarthroplasty or TSA	UCLA score ROM Pain score	One hundred and twelve patients: 50 hemiarthroplasty, 62 TSA Los Angeles Shoulder Score improvement TSA 8.1 ± 0.3 versus Hemiarthroplasty 6.6 ± 0.3 ($p < 0.001$) Pain score: TSA 8.6 ± 0.3 versus hemiarthroplasty 6.5 ± 0.3 ($p < 0.0001$) significant heterogeneity among studies noted Change in forward elevation: 13° in favour of TSA group (based on one poorly designed study)	At a short term follow-up of 2 years, TSA provides more consistent improvement in function than hemiarthroplasty for patients with primary osteoarthritis of the shoulder
Radnay 2007 Systematic review Meta-analysis Level 2	TSA versus hemiarthroplasty for treatment of primary osteoarthritis. Trials: 23 (mean level evidence 3.73) Inclusion: Studies level I–V & primary shoulder osteoarthritis. Exclusion: Inflammatory arthritis, rotator cuff instability, post-infectious arthropathy, osteonecrosis, post-traumatic arthritis	One thousand nine hundred and fifty-two patients who underwent total shoulder arthroplasty or hemiarthroplasty	Pain score Patient satisfaction Revision surgery	TSR provides improved pain relief (TSR 85.8 versus HHR 77.6), ROM (Forward elevation TSR 141.4° versus 124.9° HHR), and patient satisfaction (TSR 96.7% versus HHR 80.4%), low revision rate (TSR 6.5% versus 10.2%)	Total shoulder replacement improves pain relief, ROM, satisfaction and has a lower rate of revision surgery in comparison to hemiarthroplasty

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Table 1. Continued

Author/timeline	Subject and inclusion/exclusion criteria	Intervention	Outcome measures	Results	Conclusion
Litchfield 2011 Journal shoulder and elbow surgery Prospective RCT Level 1	Cemented versus uncemented fixation of humeral components in TSA for osteoarthritis of the shoulder Inclusion: Primary osteoarthritis Exclusion: Trauma, infection, avascular necrosis, cuff tear arthropathy, dislocations, inflammatory arthropathy, previous shoulder surgery	One hundred and sixty-one TSA in two groups: Group 1: Cemented humeral component 80 Group 2: Uncemented humeral component 81	Primary: WOOS score Secondary: (1) Short Form 12 (2) ASES (3) MACTAR (4) Operative time (5) Complications (6) Incidence of revision surgery	WOOS score at 2 years: Cemented 87.9 versus uncemented 79.3 ($p < 0.03$) Short Form 12: Significant difference in favour of cemented at 12 months in mental component ASES & MACTAR score: No significant difference Operative times: 1.7 hours uncemented versus 2.26 hours cemented ROM and strength improvement from pre-operatively: Similar improvements between both groups, no statistical significance at 2 years Complication: Similar between groups One incidence of revision	Cemented humeral component fixation provides better WOOS score than uncemented fixation The effect is more significant for male patients
Lo 2005 JBJS Prospective RCT Level 2	TSA versus hemiarthroplasty Inclusion: Primary osteoarthritis Exclusion: Condition other than shoulder osteoarthritis	Forty-one patients randomized to undergo hemiarthroplasty (21) or TSA (20)	Primary: WOOS. Secondary: UCLA scale, Constant score, American Shoulder and Elbow Surgeons evaluation form, general health scales, global health measure	Patients assessed at six weeks then 3, 6, 12, 18 and 24 months post-operatively. No significant difference in WOOS score between the two groups at 2 years (TSA 90.6 ± 13.2 and Hemi 81.5 ± 24.1 points, $p = 0.18$). Similar results noted for secondary outcome measures	TSA and hemiarthroplasty resulted in significant improvement in quality of life in all domains of health. No significant difference between the two groups within the limits of the study
Edwards 2003 Journal shoulder and elbow surgery Retrospective cohort study Level 2	TSA versus hemiarthroplasty Inclusion: Shoulder osteoarthritis Exclusion: Inflammatory arthropathy, osteochondromatosis, acromiomegaly, Paget's disease, post-infectious arthropathy, skeletal dysplasia, neurological problems, osteonecrosis, shoulder trauma history, prior shoulder surgery, marked rotator cuff arthropathy	Six hundred and one TSA and 89 hemiarthroplasties evaluated, performed for primary osteoarthritis of the shoulder	Constant score (pain, activity, mobility, strength, total and adjusted), active forward flexion, active external rotation Glenoid radiolucency for loosening	Follow-up: 43.3 (24–110 months). Minimum 2 years TSA (hemiarthroplasty): Constant score: 70 (64) Adjusted constant score: 96% (86%) Active anterior elevation: 145° (130°) Active external rotation: 42° (36°) 94% TSA and 86% hemiarthroplasty had good or excellent results	Improvement in all domains for both groups. Total shoulder group significantly greater gains in activity, mobility, overall constant score, adjusted external rotation and active anterior elevation TSA superior results to hemiarthroplasty
Smith 2012 JBJS Systematic Review (Total 22 papers) Level 2	Indications for reverse shoulder replacement Inclusion: Studies presenting new data from more than one case & where functional outcome scores reported Exclusion: Studies with mixture of surgical techniques presented as a single group, cuff tear arthropathy studies published more than 5 years ago, studies with less than 50 patients or those from more than one centre	Twenty-two papers included in review Three address use of RSR to treat arthropathy with a cuff tear	Complication rate of dislocation, infection, glenoid loosening, acromial fractures, nerve palsy, notching	Painful pseudo-paralysis principle indication Minimum follow-up between 8 and 24 months Mean active external rotation reached between 7° and 14° but large variation between -44° to $+60^\circ$ Survival of prosthesis at ten years 89% (95% confidence interval 83 to 96) 72% when Constant score taken into account	Rate of complications is improving and good results can be achieved in reverse shoulder replacement for patients with cuff tear arthropathy Functional reach restored rotation still problematic. Recommended for older patient with limited demands

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Table 1. Continued

Author/timeline	Subject and inclusion/exclusion criteria	Intervention	Outcome measures	Results	Conclusion
Zavadii 2007 Journal of American Society of Extra-corporeal Technology Prospective Randomized Level 2	Autologous platelet gel and platelet poor plasma use in TSA Inclusion: Patients undergoing TSA by the study surgeon at a specific institution, primary pre-operative diagnosis of osteoarthritis, no previous shoulder surgery with the exception of arthroscopy, pre-operative platelet count of $\geq 100,000/\mu\text{L}$ Exclusion: Patient without a primary diagnosis of osteoarthritis	Autologous platelet gel & platelet poor plasma in patients undergoing TSA Random assignment to control or treatment group ($n = 20$ in each) Same surgical technique, PRP preparation and application for both groups	(1) Length of stay (2) 24 and 72 hour post-operative haemoglobin (3) Pain (4) Postoperative ROM at 6 weeks follow-up	(1) Treatment patients were discharged almost 9 hours earlier postoperatively (2) 24 and 72 hour postoperative haemoglobin and the percentage of pre-operative haemoglobin retained was higher in the treatment group but neither was statistically significant compared to the control group (3) Control group required more pain relief (fentanyl) (4) Increased internal rotation in treatment group postoperatively	Autologous platelet gel improves internal rotation, pain control and may help to maintain haemoglobin levels postoperatively Comparable studies have been performed with bovine plasma, which has been linked to coagulopathies
Ladermann 2011 JBJS Prospective Cohort study Level 2	Prevalence of neurological lesions after TSA Inclusion: All who had primary TSA by the author Exclusion: (1) Incomplete documentation. (2) Follow-up of less than 10 months. (3) Any comorbidity which might result in a neuropathy. (4) An abnormality of the ipsilateral or contralateral side that could influence the measurement of humeral length and side to side differences in the reverse arthroplasty group	Forty-one patients (42 shoulders) Reverse shoulder arthroplasty 19 and anatomic primary shoulder arthroplasty 23	Constant score Electromyography radiographs	Nine reverse shoulders showed sub-clinical EMG changes. Eight resolved in less than 6 months. One brachial plexus injury in anatomic shoulder arthroplasty group	RSA may allow for improved function in patients who were previously not amenable to any other treatment Complication rate is higher Occurrence of peripheral nerve lesions following RSA is common but symptoms usually recover. Additional prospective studies with larger sample sizes are needed
Singh 2011 JBJS Cohort study Level 2	Revision surgery following TSA Inclusion: All patients who underwent TSA between 1976 and 2008 Exclusion – nil	TSA	Revision rate Follow-up at years 1, 2 and 5 then 5 yearly thereafter	Two thousand two hundred and seven patients underwent 2588 TSA. Mean age 65 years Male: Female 47:53% 63% osteoarthritis, 17% rheumatoid arthritis, 15% trauma Revision rates: Total 212 (8.2%). Survival rates 5 years 94.2%, 10 years 90.2%, 20 years 84.5%	Univariate analysis: Male sex, uncemented implant, rotator cuff disease, tumour, younger age associated with higher revision risk BMI not associated with increased revision risk Multivariable analysis: Male sex and underlying diagnosis (rotator cuff disease/tumour) associated with higher risk of revision

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Table 1. Continued

Author/timeline	Subject and inclusion/exclusion criteria	Intervention	Outcome measures	Results	Conclusion
Namdari 2011 JBJS Systematic Review Level 2	Biological glenoid resurfacing for glenohumeral osteoarthritis Inclusion: English language, level I,II,III, or IV study designed by JBJS criteria, minimum of 10 patients in their series who underwent biological glenoid resurfacing Exclusion: Review articles, case reports, technique articles, articles without reported patient data, or studies in which the inclusion criteria were not explicit	Seven level IV articles analyzed No study had a control group; no study used logistic regression to control for confounding factors, no blinding After pooling, 173 patients (176 shoulders) included in the postop analysis Mean follow-up of 46.6 months Mean age 46.4 years 73.2% male 26.8% female	(1) VAS (5 studies) (2) ASES score (4 studies) (3) Constant score (3 studies) (4) Modified UCLA and Rowe score (5) Physical examination (6) Satisfaction (7) Glenohumeral joint space on axillary radiographs immediately postoperatively and at last follow-up (3 studies) (8) Complications (9) Re-operations	VAS score of 2.5 postoperatively as compared to 7.5 pre-operatively ASES score of 76.7 postoperatively as compared to 32.7 pre-operatively Constant score of 68.8 postop as compared to 23.5 pre-operatively UCLA and Rowe 55 and 81 respectively postoperatively as compared to 15 and 29 pre-operatively Improved forward active elevation and active external rotation postoperatively 81% satisfaction from patients Glenohumeral joint space decreased from a frequency weighted mean of 2.9 mm immediately postoperatively to 1.3 mm at last follow-up Overall re-operation rate = 26.0% Complication rate = 13.3%	Patients and surgeons must be willing to accept a significant complication rate and likelihood for re-operation Authors are unable to draw meaningful conclusions regarding the long-term outcomes and benefits of this procedure compared to other treatment modalities
Brantingham 2011 Journal Manipulative & Physiological Therapeutics Systematic Review Level 2	Manipulative therapy for shoulder pain and disorders Inclusion: Shoulder peripheral diagnosis, manipulative therapy with/without multimodal or adjunctive therapy, osteopathic/physical therapy/other medical literature included Exclusion: Pain referred from spinal sites (without peripheral shoulder diagnosis), referral for surgical intervention, condition not amenable for MMT (RA/fracture/ligament tear), red flag diagnosis (infection, drug abuse, weight loss, previous malignancy, chronic non-mechanical pain, bone deformities, widespread neurological symptoms, violent trauma, swelling, pain at rest, night sweats, HIV), peripheral diagnosis absent a description of management or intervention Review-type articles, non peer-reviewed literature, conference proceedings, grand rounds and discussion articles	Included studies reporting MMT for patient with osteoarthritis: (1) Case Report (n=1) (2) RCT (n=1) (3) RCT (n=29, 76% with osteoarthritis)	(1) ROM/Pain (2) VAS, ROM, return to normal ADL, work and sport (3) ROM, physical functioning, pain	(1) After 6 weeks and after 5 months, no pain in shoulder reported at rest or with activity (2) Improved internal rotation 25° from initial 40–65° (at 5-month follow-up) (3) Pain descriptively improved in treatment group	Insufficient evidence to support MMT for the treatment of shoulder osteoarthritis

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Table 1. Continued

Author/timeline	Subject and inclusion/exclusion criteria	Intervention	Outcome measures	Results	Conclusion
Singh 2010 The Cochrane Collaboration Level 1	Surgery for shoulder osteoarthritis Studies: Seven RCTs Inclusions: Adults with osteoarthritis of the shoulder comparing surgical techniques versus placebo or sham surgery, nonsurgical modalities, no treatment, or comparison of one type of surgical technique with another. Patient reported outcomes or revision rates	Two hundred and thirty-eight patients included for analysis Two studies comparing hemiarthroplasty to TSA Three studies comparing pegged and keeled glenoid components One comparing navigation to conventional surgery One comparing polyethylene to metal backed implant	Pain, Constant score, UCLA score, ASES score, Neer rating, DASH score, WOOS score, Short Form 36, ROM, complications, revisions	ASES score better for TSA versus hemiarthroplasty, mean difference –10.05 (95% CI) Pain score TSA versus hemiarthroplasty mean difference 7.8 (95% CI) non-significant Short Form 36 physical component summary mean difference 0.8 (95% CI) nonsignificant Adverse events risk ratio 1.19 (95% CI) nonsignificant Revision rate higher in hemiarthroplasty versus TSA: Risk ratio 6.18 (95% CI) nonsignificant	TSA offers improved shoulder function over hemiarthroplasty Further studies required
Lathia 2009 Journal Alternative & Complementary medicine Single-blind RCT Level 2	Efficacy of acupuncture as a treatment for chronic shoulder pain Inclusion: Over 18 years old, shoulder pain for >8 weeks, total SPADI score of >30, not received previous treatment or failed conventional treatment at least 1 month prior to enrolment, naive to active acupuncture Conditions: Adhesive capsulitis, rotator cuff syndromes, rotator cuff tears, osteoarthritis, biceps tendonitis, subacromial bursitis Excluded = inflammatory/infectious arthritis, shoulder fracture, stroke, pregnancy, patients who received corticosteroid injection in past 3 months	Three groups: (1) Traditional acupuncture (n = 11) (2) Standardized acupuncture (n = 9) (3) Sham acupuncture (n = 9)	Mean change in SPADI Pain	Treatment groups showed statistically significant improvement in shoulder pain and function after 6 weeks as compared to sham acupuncture Change in SPADI score: Group 1: –20.3 Group 2: –20.4 Group 3: –6.5	Clinically significant improvement in acupuncture groups as compared to sham groups for pain and SPADI scores Lack of power in statistical analysis Lack of generalizability to other patient populations Study not limited to shoulder osteoarthritis

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Table 1. Continued

Author/timeline	Subject and inclusion/exclusion criteria	Intervention	Outcome measures	Results	Conclusion
Fama 2004 Orthopaedics Multicentric study Retrospective review Level 2	Concomitant biceps tenodesis in shoulder arthroplasty Inclusion: Primary osteoarthritis Exclusion: Inflammatory arthropathy, osteochondromatosis, acromiomegaly, Paget's disease, postinfectious arthropathy, skeletal dysplasia, neurological problems, osteonecrosis, any history of shoulder trauma, instability or prior shoulder surgery, marked rotator cuff pathology	Seven hundred and sixty-six shoulders in 725 patients Sixty excluded because of death, biceps tendon rupture, or loss of follow-up Ultimately, 688 shoulders available for evaluation Mean age 68 years 75% female; 25% male Dominant shoulder in 60% of cases Only Aequalis prosthesis used 99 shoulders underwent hemiarthroplasty, 589 shoulders underwent TSA One hundred and twenty-one shoulders had biceps tenodesis at arthroplasty. Five hundred and sixty-seven shoulders underwent no additional biceps procedure	Pre-operatively: Constant score, active and passive pre-operative mobility for forward flexion in the plane of the scapula and external rotation with the arm at the side Postoperatively: Constant score, adjusted Constant score, measure of same mobility parameters evaluated pre-operatively, subjective patient results graded as excellent, good, fair or poor. Radiographic evaluation of glenoid radiolucencies	Mean follow-up was 43.4 months Among the hemiarthroplasty group, significantly higher average post-operative activity score, mobility score, and active anterior elevation Among the TSA group, significantly higher average scores in all modalities measured Subjectively, both groups undergoing concomitant biceps tenodesis had higher ratings Overall, 19% complication rate but no statistical difference existed between rate or types of complications	Improved results of shoulder arthroplasty when concomitant biceps tenodesis is performed in shoulder with primary osteoarthritis Tenodesis did not provide significantly improve pain scores No significantly increased complication rate in tenodesis group noted Weaknesses: Unstandardized surgical techniques Unclear indications for biceps tenodesis Significant difference in mean patient age Average follow-up was only 43 months for tenodesis group No record of pre-operative state of the biceps tendon
Rahme 2009 JBJS Am Prospective randomized trial Level I	Stability of cemented in-line pegged glenoid versus keeled glenoid components in TSA Inclusion: Primary and secondary osteoarthritis Patients undergoing TSA	Two groups (25 patients total): 1: 13 keeled glenoid 2: 14 pegged glenoid	Microtranslation Constant score	Mean Constant score pre-operatively and at 2 years postoperatively: Keeled 25 & 70 Pegged 22 & 70 Average translation for both pegged and keeled at 2 years < 1 mm Median value < 0.3 mm	No specific pattern to movement could be identified for the two components Both pegged and keeled components have similar stability in first 2 years Study underpowered for clinical outcomes

ADL, activities of daily living; ASES, American Shoulder and Elbow Surgeons; BMI, body mass index; CI, confidence interval; DASH, Disabilities of the Arm, Shoulder and Hand; EMG, electromyogram; HHR, humeral head replacement; MACTAR, McMaster-Toronto Arthritis Patient Preference Disability Questionnaire; MMT, manual and manipulative therapy; RA, Rheumatoid Arthritis; RCT, randomized controlled trial; ROM, range of motion; SPADI, Shoulder Pain and Disability Index; TSA, total shoulder arthroplasty; TSR, Total Shoulder Replacement; UCLA, University of California Los Angeles; VAS, visual analogue scale; WOOS, Western Ontario Osteoarthritis of the Shoulder.

Shoulder (WOOS) score, Constant score, and UCLA and ASES scores at 2 years.⁹ TSA was shown to result in significantly improved pain scores in three studies,^{7,8,13} with three others finding no significant difference.^{6,9,10}

Revision. One systematic review reported 81% survival of TSAs at 20 years.¹² The study included TSA performed for a number of diagnoses; thus, it is difficult to extract data pertaining solely to TSA performed for osteoarthritis. It is not possible, from the study, to define risk factors for the osteoarthritis group alone; however, it was generally found that male sex, underlying rotator cuff disease and tumour were associated with an increased risk of revision. Body mass index (BMI) and co-morbidity were not found to increase revision risk. In a further systematic review,⁷ revision rates were reported to be 10.2% for hemiarthroplasties compared to 6.5% for TSA. Some 8.1% of hemiarthroplasties required conversion to TSA as a result of pain, suggesting the glenoid progressively erodes over time, resulting in worsening outcomes. In TSA, the type of glenoid component employed appeared to have an impact on revision rates, with 6.8% of TSAs with metal backed glenoids requiring revision compared to 1.7% of TSAs with polyethylene glenoids. A Cochrane Collaboration review¹⁰ reported greater revision rates for hemiarthroplasty based on two studies, although significance was not reached. An RCT¹¹ comparing cemented and uncemented humeral components reported glenoid loosening in four patients, three periprosthetic fractures and one TSA revision within 2 years of index procedure.

Cemented versus uncemented. A level one RCT¹¹ that compared cemented and uncemented humeral components in TSA found a significant improvement in WOOS score for the cemented group, which was more pronounced in males. No significant difference in ROM and strength was detected between the two groups.

Glenoid components in TSA. One RCT¹⁴ evaluated 25 patients comparing the stability of cemented, all-polyethylene, keeled versus pegged glenoid components. They found no significant difference in the stability of either during the 2-year study period. Both components were found to have an average translation of less than 1 mm. Clinical outcomes were evaluated using the Constant score, which showed improvement across the board. No significant difference in clinical outcome was found between the two types of glenoid components.

Concomitant biceps tenodesis in shoulder arthroplasty

One study¹⁵ compared TSAs and hemiarthroplasties undergoing concomitant biceps tenodesis against those that did not. Six hundred and eighty-eight shoulders (99 hemiarthroplasties and 589 TSAs) were included in which 121 underwent biceps tenodesis at arthroplasty. The improvement in outcome measures was found to be even greater in the group receiving tenodesis, except for pain scores, which did not show significant difference. Subjectively, patients also described better results if a concomitant biceps tenodesis was performed. There was no statistical difference in the complication rate between the groups. The study indicates that biceps tenodesis can improve results of shoulder arthroplasty; however, despite the positive results, several limitations exist. The surgical technique was not fully standardized, the condition of the biceps tendon was not recorded and a significant difference in patient mean age was noted. Average follow-up for the nontenodesis group was significantly longer than that of the tenodesis group; therefore, it may be that the superior results found in the group receiving tenodesis will be lost over time.

Biological glenoid resurfacing

Namdari et al.¹⁶ performed a systematic review of seven case series (180 patients) to critically examine the outcomes of biological glenoid resurfacing in the treatment of glenohumeral arthritis. Pre-operative indications for resurfacing were not limited to primary osteoarthritis. Patients were followed up for a mean of 46.6 months. The outcome measures reported were multiple with no uniformity amongst studies. Statistically significant improvements were found in most outcome measures evaluated post-operatively, which indicated resurfacing can be successful in the short term; however, little evidence exists for any long-term results. The overall complication rate was 13.3% and the re-operation rate was 26%, which is higher than the reported values for other treatment options.

Reverse shoulder arthroplasty

Smith et al.¹⁷ conducted a systematic review of 22 articles to evaluate the functional outcomes of RSA. Three of the included articles evaluated the use of RSR in arthropathy with associated cuff tear. The results showed that, after a minimum follow-up of between 8 and 24 months, the majority of patients will regain a functional reach and achieve better pain control, although rotation can remain problematic. Survival of

the prosthesis at 10 years was reported to be 89%; however, the Constant score gradually declined with time and, when taken into account, survival fell to 79%. Complications associated with RSA for arthropathy with a cuff tear included dislocation (2% to 2.8%), infection (0% to 4%), glenoid loosening (0% to 4%), acromial fractures (1.4% to 4%), nerve palsy (0% to 1.4%) and scapular notching (49% to 70%). A further study¹⁸ evaluated 19 RSAs and 23 TSAs for postoperative nerve injury. The incidence of peripheral neurological lesions was found to be significantly more common in the RSA group, with a 10.9-fold higher risk than the TSA group. Out of nine RSAs with a postoperative neurological deficit, eight resolved within 6 months. Mean arm lengthening after RSA of 2.7 ± 1.8 cm is suggested as a possible cause of the increased risk of neurological complications. There is limited evidence showing short-term benefit with use of RSA in arthropathy with cuff tear in older patients with low demands.

Autologous platelet preparations

One RCT¹⁹ examined the effect of autologous platelet gel (APG) and activated platelet-poor plasma (PPP) treatment on 38 TSA patients postoperatively. The results of the study showed that APG and PPP therapy did not significantly influence retained postoperative haemoglobin and volume of auto-transfused blood. However, the therapy was shown to significantly improve postoperative pain scores and internal rotation in the treatment group.

Acupuncture

Lathia et al.²⁰ conducted a single-blind randomized study of 31 patients to evaluate whether acupuncture was effective in treatment of chronic shoulder pain. The patients were allocated randomly to three groups: two treatment groups with different methods of acupuncture and one control group where 'sham' nonpuncturing acupuncture needles were used. The groups consisted of patients over 18 years of age with shoulder pain for at least 8 weeks duration and with a Shoulder Pain and Disability Index (SPADI) score of 30 or more. The shoulder pathology was nonspecific and included a range of pathologies. The results of this study showed that, after 6 weeks of treatment, all three groups experienced clinical improvement demonstrated by a lower SPADI score, although this was only clinically significant in the acupuncture groups. The study is, however, not specific to osteoarthritis of the shoulder and the results cannot be extrapolated to recommend the use of acupuncture in shoulder arthritis.

Manipulative therapy

One systematic review²¹ was found that investigated the effect of manual and manipulative therapy (MMT) for common shoulder pain and disorders. A myriad of shoulder pathologies were included, such as osteoarthritis, rotator cuff injuries, adhesive capsulitis, soft tissue disorders, neurogenic shoulder pain, shoulder pain secondary to cervical/thoracic and adjacent rib dysfunction. None of the included studies focused solely on osteoarthritis and the number of patients was very small, hence the benefit of MMT for osteoarthritis is impossible to extrapolate.

Discussion

This scoping review assessed the quality and content of recent published evidence over the last decade regarding the treatment of shoulder arthritis. The studies identified were unable to provide a clear indication of the best treatment for shoulder arthritis. The inclusion of a range of shoulder pathologies in some studies and the diversity in outcome measures used made it difficult for systematic reviews to effectively pool data. There is a need for standardization of outcome assessment following treatment of shoulder arthritis to enable meaningful comparisons in the future. There is generally a pressing need for good quality randomized trials to investigate the effectiveness of nonsurgical interventions, as well the need for a comparison of nonsurgical versus surgical interventions to determine the superiority of one intervention over the other.

Most of the reviewed literature focuses on surgical interventions and the debate about TSA versus hemiarthroplasty. The systematic reviews of TSA versus hemiarthroplasty were of good quality, although the primary studies included in these reviews were generally of limited quality and had weaknesses. Better outcomes have been shown with TSA over hemiarthroplasty for shoulder osteoarthritis. This needs to be interpreted with caution in light of the limitations identified in these reviews. Regarding other operative interventions, there is limited evidence of insufficient quality to suggest that RSA is effective in relieving pain and improving function in the management of arthropathy with cuff tear. There is also insufficient evidence to recommend biological glenoid resurfacing or arthroscopic debridement.

Sparse evidence is available for all other interventions, whether it be operative or non-operative. The quality of evidence for nonsurgical management of shoulder arthritis remains limited. The majority of non-operative interventions address shoulder pain in its entirety and do not focus on osteoarthritis alone. Evidence for interventions such as physiotherapy and intra-articular corticosteroid injections is poor.

One of the current debates is whether better outcomes with TSA over hemiarthroplasty for shoulder osteoarthritis in the short and medium term will be offset by higher revision rates for TSA in the long term. The literature suggests that, in the short/medium term, the revision rate of glenoid components after TSA is significantly less than that of conversion from hemiarthroplasty to TSA as a result of poor outcomes such as progressive pain. We found little to document the long-term revision rates of TSA. Most studies performed consist of a small number of patients with relatively short follow-up, making it difficult to identify any risk factors for revision. The literature suggests that males are more likely to undergo revision surgery and that co-morbidities such as BMI confer no statistically significant increased risk of earlier revision.

The present review highlights the need for standardization of outcome assessment following the treatment of shoulder arthritis. The introduction of the collection patient-reported outcome measure (PROMS) for upper limb arthroplasty would be a potential way of achieving this. There is need to obtain good quality primary evidence for the common interventions used in the treatment of shoulder arthritis. Determining the effectiveness of nonsurgical treatments, the optimal timing of surgical intervention and the effectiveness of surgical interventions would be best achieved by conducting large, multicentre randomized clinical trials. Comparative studies of newer technologies such as resurfacing arthroplasty and stemless shoulder arthroplasty to establish their effectiveness are essential, and should be one of the areas of focus for future clinical trials.

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