

Do partial rotator cuff tears limit the indication for anatomic shoulder replacement? A systematic review

Andrea Marchetti^{1 2}, Tobias Schwäblein^{1 3}, Philipp Baumert^{1 4}, Riccardo D'Ambrosi^{5 6}, Sepp Braun^{1 7*}

(*) Corresponding author: s.braun@gelenkpunkt.com

1. Research Unit for Orthopaedic Sports Medicine and Injury Prevention (OSMI), Institute for Sports Medicine, Alpine Medicine and Health Tourism, UMIT TIROL - Private University for Health Sciences and Health Technology, 6060 Hall in Tirol, Austria
2. Orthopedics and Traumatology Unit, Department of Medicine, Surgery and Health Sciences, University of Trieste, 34127 Trieste, Italy
3. Department of Trauma and Reconstructive Surgery, BG Klinikum Bergmannstrost Halle, 06112 Halle, Germany
4. School of Sport and Exercise Sciences, Liverpool John Moores University, L3 5AH Liverpool, UK
5. IRCCS Ospedale Galeazzi - Sant'Ambrogio, 20157 Milan, Italy
6. Università degli Studi di Milano, Dipartimento di Scienze Biomediche per la Salute, 20133 Milan, Italy
7. Gelenkpunkt-Sports and Joint Surgery, FIFA Medical Centre of Excellence-Austria, 6020 Innsbruck, Austria



Background: Anatomic total shoulder arthroplasty (aTSA) is the gold standard for treating glenohumeral osteoarthritis. While there is evidence that a rotator cuff insufficiency can lead to poor outcomes and early failure of the anatomic implant, there is no clear consensus on the use of aTSA in the context of a concomitant partial thickness rotator cuff tear and the related outcomes.

Purpose: To systematically review clinical and radiological outcomes, complications, and revision rates of anatomic total shoulder arthroplasty in patients with glenohumeral osteoarthritis and preoperative partial-thickness rotator cuff tears.

Methods: A systematic review was performed based on the PRISMA guidelines in PubMed, Scopus, and Cochrane databases. Eligible studies reported clinical and radiological outcomes on patients treated with aTSA with established preoperative partial thickness rotator cuff tear on MRI. Extracted data included demographics, study design, follow-up times, overall clinical and radiological findings and complication rates.

Results: Three studies, including 595 patients and 636 shoulders, met the inclusion criteria. Overall, 95 patients (14.9%) had partial-thickness supraspinatus tendon tears (23 men and 72 women), with a mean age of 71.3 years and a mean follow-up ranging from 43 to 69.6 months. Across studies, patients with partial thickness tears showed improvements in functional outcomes and range of motion that were comparable to those without tears or with full thickness tears. One study reported a complication rate of 16%, and a 10.3% revision rate, with no correlation to the rotator cuff status. Osteolytic glenoid changes were observed in 22% of patients with partial tears in one study, though proximal migration was uncommon and led to revision in only one case.

Conclusions: Current evidence suggests that aTSA remains a viable treatment providing significant improvements in functional outcomes and range of motion, with complication rates comparable to those without tears. However, the available evidence is scarce and heterogeneous, and certainty is very low. No firm recommendations can be made, and further high-quality studies are needed.

What this study adds: This systematic review synthesizes the small and methodologically limited body of evidence on aTSA in patients with glenohumeral osteoarthritis and preoperative partial-thickness tears, and suggests that in carefully selected patients meaningful improvements in pain, function, and range of motion can be achieved, with complication and revision rates that appear comparable to those reported in series without partial tears, although the certainty of this evidence is very low.

Potential impacts on research, practice, or policy: These findings support a more individualized approach to implant selection in shoulder arthroplasty, where partial-thickness rotator cuff tears alone are not treated as an absolute contraindication to anatomic designs, and underscore the need for high-quality prospective studies to clarify long-term risks of tear progression and implant failure.

Study Design: Systematic review

Level of evidence: IV

Keywords: Glenohumeral osteoarthritis; Anatomic total shoulder arthroplasty (aTSA); Partial-thickness rotator cuff tear; Supraspinatus tendon tear; Systematic review

<https://doi.org/10.70885/hmsj.2026.06.002>

Introduction

Glenohumeral osteoarthritis is a common cause of shoulder pain and stiffness characterized by progressive cartilage loss, bony erosion, and deformity. It affects up to 20% of adults over 65 [1][2]. The growing incidence of this pathology reflects the significant increase in shoulder arthroplasty procedures performed. In the United States from 2012 to 2017, anatomic total shoulder arthroplasty (aTSA) increased from 9.5 to 12.5 cases per 100,000. In the same period, the incidence of primary reverse total shoulder arthroplasty (rTSA) increased from 7.3 to 19.3 cases per 100,000 persons [3]. Projections suggest a continued rise, with rTSA and aTSA volumes expected to increase by 91.9% to 349% by 2025, outpacing growth in hip and knee arthroplasty [4].

Traditionally, aTSA is considered the gold standard procedure for treating glenohumeral osteoarthritis [5]. Although rotator cuff tears may be encountered during a shoulder replacement, their overall incidence in patients with primary glenohumeral osteoarthritis remains low. Their incidence ranges from 9.1% to 14.9% [6][7]. However, concomitant rotator cuff pathology is associated with poorer outcomes of aTSA due to eccentric loading with proximal migration of the humeral head and early failure of the glenoid component [8]. Therefore, the presence of a rotator cuff tear is traditionally considered a contraindication to aTSA. In this setting, rTSA was developed as a better alternative option [9].

The use of rTSA has increased significantly in recent years, surpassing aTSA in frequency by 2014 [10]. This trend is attributed to expanding surgical indications for rTSA, which is increasingly preferred over aTSA, even when rotator cuff deficiency is not present,[10][11] although aTSA is known to better preserve shoulder function [12].

Several studies have investigated the impact of previous surgeries [13][14] and concomitant rotator cuff repair [15][16] on the outcomes of shoulder arthroplasty. However, there is no clear consensus on the use of aTSA in the context of glenohumeral osteoarthritis and concomitant partial thickness rotator cuff tear and related outcomes.

The purpose of this systematic review is to investigate the outcomes and failure rates of aTSA with concomitant partial-thickness rotator cuff tears.

Materials and methods

The current systematic review was performed following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and is registered in the PROSPERO Registry CRD42024580020 [17][18].

Search strategy

A systematic search was conducted until 14th August 2024 in the PubMed (MEDLINE), Scopus and Cochrane Library databases. The following search terms were entered into the title, abstract, and keyword fields: ("aTSA" OR "TSA" OR "anatomical shoulder prosthesis" OR "anatomic total shoulder arthroplasty" OR "anatomic total shoulder replacement" OR "anatomic total shoulder arthroplasty") AND ("rotator cuff tear" OR "rotator cuff lesion").

The inclusion criteria were studies published providing clinical and/or radiological outcomes after anatomic total shoulder arthroplasty with established preoperative partial thickness rotator cuff tear on MRI scans. Studies conducted using randomized controlled trials, controlled (non-randomized) clinical trials, prospective and retrospective comparative cohort studies, case-control studies, and case series were included.

The exclusion criteria were non-English language papers and studies that did not provide clear clinical and/or radiological results. Studies with partial rotator cuff tears treated during the surgical procedure were excluded. Case reports, reviews of the literature, letters to editors, biomechanical reports, ex vivo or cadaveric studies, editorial commentary were excluded as well.

Data collection and analysis

The retrieved articles were first screened by the two authors (M.A. and T.S.) by title and, if found relevant, screened further by reading the abstract. After excluding studies not meeting the eligibility criteria, the entire content of the remaining articles was evaluated for eligibility. To minimize the risk of bias, the authors reviewed and discussed all the selected articles, references, and articles excluded from the study. In case of any disagreement between the reviewers, the senior investigator (S.B.) made the final decision. At the end of the process, further studies that might have been missed were manually searched by going through the reference lists of the included studies and relevant systematic reviews.

The data were extracted from the selected articles by the first two authors. Each article was validated again by the first author before analysis. The following data were extracted from each included study: demographics, study design, follow-up times, treatment groups, evaluation scores adopted, overall clinical and radiological findings and complication rates.

Assessment of methodological quality

The Oxford Levels of Evidence set by the Oxford Centre for Evidence-Based Medicine were used to categorize the level of evidence [19]. The quality of the selected studies was evaluated using the Methodological Index for

Nonrandomized Studies (MINORS) score [20]. The checklist consists of 8 items for non-comparative studies and 12 items for comparative studies, of which the last four are specific for

comparative studies. Each item could be scored from 0 to 2 points. The ideal score was set at 16 points for non-comparative studies and 24 for comparative studies.

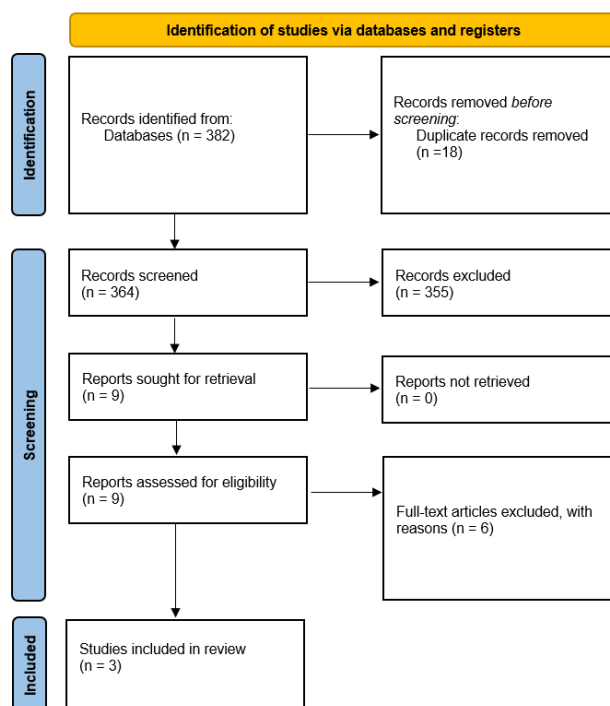


Figure 1. PRISMA flow diagram

Results

Study Characteristics

The electronic search yielded 382 studies. After 18 duplicates were removed, 364 studies remained, of which 355 were excluded after reviewing the abstracts, bringing the number down to 9. Subsequently, 6 additional articles were excluded after full-text reading based on the aforementioned inclusion and exclusion criteria. No additional studies were found by manually searching the reference lists of the selected articles. Finally, 3 studies met the inclusion criteria and were included for further analysis [7][21][22]. See PRISMA flowchart (Figure 1). The studies analyzed had an average MINORS score of 12, indicating the methodological quality of the available literature.

Table 1 shows the characteristics of the studies and a summary of their data. The level of evidence was rated as level 3 for two studies [7][21] and level 4 for one study [22]. The study by Edwards et al. [7] examined patients undergoing TSA with partial or full-thickness tears or without tears of the supraspinatus tendon. Choate et al. [21] compared patients with partial thickness tears to those without tears, whereas Raval et al. [22] evaluated patients undergoing anatomic TSA with only partial-thickness tears.

The studies evaluated a total of 595 patients with 636 shoulder arthroplasties including 170 (26.7%) men and 466 (73.3%) women, with a mean age of 70.6 years (range 42 – 89 years). Overall, 95 patients (14.9% of total) with partial-thickness supraspinatus tendon tears were included in the studies, with a mean age of 71.3 years; 23 (24.2%) of them were men, and 72 (75.8%) were women. The mean overall postoperative follow-up was 52 months (range 1-100 months). The mean follow-up of the partial rotator cuff tear group was 52.4 months (range 24-108 months) with Raval et al. [22] reporting the longest mean follow-up (69.6 months) and Choate et al. [21] reporting the shortest (43 months). No significant differences in the demographic factors were identified across the studies.

All patients were treated using anatomic total shoulder replacements, except in the study of Edwards et al. [7], where 77 patients underwent hemiarthroplasty replacement. Moreover, 10 (of 39) shoulders with partial-thickness tears and 5 (of 40) with full-thickness tears underwent hemiarthroplasty replacement. No additional surgical procedures were reported except for Edwards et al., where 7 (of 40) full-thickness and 4 (of 39) partial-thickness supraspinatus tears were treated with transosseous repair.

Author	MINOR S	Level of evidence	Patients	Gender (M:F)	Age	Follow-up (months)	Partial Tears	Fatty infiltration (Goutallier score)	Concomitant procedures of partial-thickness tears	Outcomes reported	Overall findings
Edwards et al. (2002)	13	III	Partial-thickness tear (n = 41) Full-thickness tear (n = 42) No tear (n = 472)	Overall: 144:411 Partial-thickness tear: (5:36) No tear: (132:340)	Overall: 67.6 years (range 42–89) Partial-thickness tears: 69.9 years No tear: 67.1	Overall: 43.1 (range: 1–110) Partial-thickness tears: 44.5 No tear: 42.3	Articular-sided partial-thickness supraspinatus tears. No quantification of tear size was performed	NR for the supraspinatus	4 tears repaired during surgery. 37 tears not repaired	VAS, PSS, SANE, ASES, ROM	Partial-thickness tears showed slightly worse pre-op scores compared to the no tear group, but post-op outcomes were similar between partial-thickness tears and no tear groups. Full-thickness tears had worse pre-op scores but comparable post-op improvements
Choate et al. (2017)	13	III	Partial-thickness tear (n = 18) No tear (n = 27)	Partial-thickness tear (4:14) No tear (8:19)	65 ± 10 years	43 (range: 24–73 months)	>50% supraspinatus tendon	Partial-thickness tear: 14 grade 0-2, 4 grade 3-4 No tear: 21 grade 0-2, 6 grade 3-6	NR	PSS, SANE, ASES, ROM	Partial-thickness tears (>50%) did not significantly impact clinical or functional outcomes compared to the no tear group. Both groups showed similar post-op improvements in range of motion and functional scores
Raval et al. (2020)	10	IV	Partial-thickness tear (n = 36)	14:22	79.2 years (range: 75–88)	69.6 (range: 60–108)	Ellmann classification: grade 1: 6 grade 2: 28 grade 3: 2	16 patients at grade 2, 14 at grade 3, and 6 at grade 4	NR	OSS, ROM, Torchia classification, Lazarus score	Good medium-term results in patients undergoing total anatomic arthroplasty with partial-thickness tears

Abbreviations: PSS = Penn Shoulder Score; SANE = Single Assessment Numeric Evaluation; ASES = American Shoulder and Elbow Surgeons score; OSS = Oxford Shoulder Score; ROM = Range Of Motion; NR = Not Reported, VAS = Visual Analogue Scale

Table 1. Study Characteristics

Outcomes

Clinical outcomes used in the studies included Constant Score, Penn Shoulder Score, Single Assessment Numeric Evaluation, American Shoulder and Elbow Surgeons score, Oxford Shoulder Score, and measurements of range of motion (ROM). The findings are summarized in **Table 2**.

Functional and Clinical Outcome Scores

Across the available studies, postoperative functional outcome scores improved, and no statistically significant differences were detected between groups defined by cuff status.

Edwards et al. reported improvements in shoulder function as measured by the Constant Score, with no significant differences across the groups. Specifically, patients with no tears improved from 44.3 preoperatively to 70.2 postoperatively. Those with partial-thickness tears improved from 41.5 to 66.5, while patients with full-thickness tears showed an increase from 39.5 to 67.1. Overall, while shoulders with a complete supraspinatus tear had significantly greater improvement in the pain score compared to others ($p = 0.016$), postoperative strength was significantly diminished ($p = 0.002$). Regarding demographic factors, increased age was found to negatively impact Constant scores for pain, strength, and the adjusted Constant score (all $p < 0.018$) regardless of the status of the cuff. Female gender was linked with lower scores for pain, strength, total Constant

score, adjusted Constant score, and active external rotation (all $p < 0.05$).

Choate et al. found no statistically significant differences in the outcomes between the no-tear and partial-thickness tear groups. Penn Shoulder Score improved to an average score of 69.8 ± 22.6 in the no tear group and 77.6 ± 21.6 in the partial-thickness group ($p = 0.28$). Further, the partial-tear group tended to show better outcomes, particularly in the Penn Shoulder Score function sub score ($p = 0.09$). The results of the Single Assessment Numeric Evaluation score at the end of the follow-up were 69.1 ± 29.7 and 79.5 ± 30.1 for, respectively, the no-tear and partial-thickness groups ($p = 0.29$). Additionally, American Shoulder and Elbow Surgeons scores were reported as 72.8 ± 21.7 for patients without tears, and 82.6 ± 21.1 in those with partial-thickness tears ($p = 0.19$).

Raval et al. reported good outcomes in patients with partial-thickness tears. The Oxford Shoulder Score improved significantly from an average of 14 (range 9-19) to 42 (range 32-48) ($p=0.001$).

Range of Motion (ROM)

All three studies demonstrated improvements in range of motion (ROM) postoperatively. Although the degree of improvement varied between groups, no significant differences were observed between patients with no tears, partial-thickness tears, or full-thickness tears.

Author	Rotator cuff status	Constant Score (Total)	PSS total (Penn Shoulder Score)	SANE (Single Assessment Numeric Evaluation)	ASES (American Shoulder and Elbow Surgeons)	OSS (Oxford Shoulder Score)	Forward Elevation (ROM)	External Rotation (ROM)	Abduction (ROM)	Complications related to partial-thickness tears
Edwards et al. (2002)	No tear	44.3 pre-op, 70.2 post-op	NR	NR	NR	NR	99.3° pre-op, 143.6° post-op	33.0° pre-op, 42.0° post-op	NR	16% total complications (90 cases). No correlation between the presence of partial-thickness tears and the rate/type of complications.
	Partial-thickness tear	41.5 pre-op, 66.5 post-op	NR	NR	NR	NR	95.3° pre-op, 141.6° post-op	29.3° pre-op, 35.6° post-op	NR	No cases of superior humeral migration.
	Full-thickness tear	39.5 pre-op, 67.1 post-op	NR	NR	NR	NR	82.9° pre-op, 140.7° post-op	28.4° pre-op, 40.9° post-op	NR	10.3% reoperations for prosthesis-related issues, but no link to partial-thickness tears.
Choate et al. (2017)	No tear	NR	69.8 ± 22.6 SD post-op	69.1 ± 29.7 SD post-op	72.8 ± 21.7 SD post-op	NR	136.1 ± 29.8° SD post-op	41.9 ± 17.1° SD post-op	NR	
	Partial-thickness tear	NR	77.6 ± 21.6 SD post-op	79.5 ± 30.1 SD post-op	82.6 ± 21.1 SD post-op	NR	135 ± 34.6° SD post-op	51.4 ± 13.9° SD post-op	NR	No complications
Raval et al. (2020)	Partial-thickness tear	NR	NR	NR	NR	pre-op 14.7 (range 9-19), post op 42 (range 32-46)	80° pre-op, 140° post-op	20° pre-op, 40° post-op	45° pre-op, 90° post-op	8 of patients developed osteolytic glenoid lesions. 4 patients with weakness RC and of these, 2 had proximal migration of the implant. 1 DAIR for infection

Abbreviations: PSS = Penn Shoulder Score; SANE = Single Assessment Numeric Evaluation; ASES = American Shoulder and Elbow Surgeons score; OSS = Oxford Shoulder Score; ROM = Range Of Motion; NR = Not Reported, SD = Standard Deviation

Table 2. Outcomes

Edwards et al. found similar improvements in forward elevation and external rotation regardless of cuff status. Comparing the concomitant transosseous repair of the rotator cuff, shoulders with repair of a full-thickness supraspinatus tear showed only better postoperative active external rotation than shoulders with no repair of such tears ($p = 0.043$). Conversely, no differences were found in shoulders with the repair of a partial-thickness rotator cuff tear compared with those without a repair.

Choate et al. found improvements in ROM in both no-tear and partial-thickness group. No statistical differences were found between the two groups, but the partial thickness tear group showed a trend to perform better in the external rotation ($41.9 \pm 17.1^\circ$ vs $51.4 \pm 13.9^\circ$) ($p = 0.1$).

Raval et al. also observed significant improvements in ROM in patients with partial-thickness tears: forward flexion improved from 80° preoperatively to 140° at the end of the follow-up ($p = 0.015$). Similarly, external rotation increased from 20° to 40° ($p=0.001$), and abduction increased from 45° preoperatively to 90° postoperatively ($p = 0.016$).

Fatty infiltration

All three studies reported fatty infiltration, although its clinical relevance varied. Choate et al. found grade 3–4 Goutallier fatty infiltration in 22% of patients, with no significant difference according to cuff status ($p = 0.65$) and no association between Goutallier grade and clinical outcomes;

patients with grade 3–4 changes tended to be older than those with grade 0–2 changes (71.8 ± 7.8 vs 64.3 ± 10.2 years; $p = 0.06$). Raval et al. found no significant association between fatty infiltration and overall clinical outcomes, although infraspinatus Goutallier grade negatively correlated with postoperative forward elevation ($p = 0.02$) and external rotation ($p = 0.05$). Similarly, Edwards et al. reported that infraspinatus fatty degeneration was associated with lower total and adjusted Constant scores and reduced active external rotation (all $p < 0.001$).

Complications

Two studies reported complications.^{7,22} Edwards et al. reported overall 90 complications (16%) and 57 prostheses (10.3%) underwent revision. No cases of superior humeral migration, and no significant difference was found in loosening rates of the humeral stem or glenoid component were found between the groups. No association was found between the rotator cuff status and the rate or type of complications, nor with the need for revision related to the prosthesis.

Raval et al. showed that 8 patients (22%) developed osteolytic glenoid lesions at 5 years of follow-up, of which 6 patients demonstrated grade 1 Lazarus changes and 2 grade 2 Lazarus changes. Four patients were found to have weakness of the rotator cuff and, of these, 2 showed proximal migration of the implant. At the end of the follow up,

of these 2 patients with proximal migration, only one underwent revision because of the failure of the implant.

Discussion

To our knowledge, this is the first systematic review to evaluate outcomes of anatomic total shoulder arthroplasty in patients with glenohumeral osteoarthritis and preoperative partial thickness tears of the supraspinatus tendon. Across the included studies, partial thickness tears were not consistently associated with worse functional outcomes, range of motion or complication rates compared with shoulders without tears or with full thickness tears. Patients generally achieved substantial improvements in pain, shoulder function and range of motion, and revision rates did not appear higher in those with partial tears.

However, the certainty of evidence remains low because the included studies were few, methodologically limited, and heterogeneous in tear definitions, imaging criteria, implant types, and surgical techniques.

Our findings need to be interpreted against a broader literature that has linked rotator cuff insufficiency to eccentric loading, proximal humeral migration and early glenoid failure after aTSA [23][24]. Biomechanical studies have shown that cuff deficiency increases deltoid forces and alters glenohumeral contact mechanics, which contribute to the so called rocking horse phenomenon and glenoid component loosening [25][26]. In the present review, only one study reported osteolytic glenoid changes in 22% of patients with partial tears at five years, with very few cases of proximal migration or revision [22]. These complication rates appear broadly comparable to those reported for aTSA in mixed cuff populations [27], but the small numbers preclude robust risk estimates for patients with partial tears.

The role of fatty infiltration as a modifier of outcomes after aTSA also remains uncertain. Previous work has suggested that preoperative fatty infiltration and atrophy are common in candidates for aTSA [28] and may be associated with glenoid bone loss and later secondary cuff dysfunction [29][30][31]. In the studies included in this review, fatty infiltration of the infraspinatus was variably associated with poorer Constant scores and reduced postoperative forward elevation and external rotation, whereas fatty infiltration of the supraspinatus did not consistently correlate with worse patient reported outcomes [7][21][22]. Given the small sample sizes and incomplete reporting of degenerative changes in the partial tear subgroups, these observations should be considered exploratory and used with caution.

Another unresolved issue is whether partial thickness tears should be repaired at the time of aTSA. Concomitant cuff repair has been reported to yield good short term outcomes

in selected patients, although some series suggest declining results in two years and a risk of tear progression [15][32][33]. In one of the included studies, repair of full thickness tears was associated with better postoperative external rotation, whereas no clear benefit was demonstrated for repairing partial thickness tears [7]. None of the studies identified in this review directly compared aTSA with and without repair of partial tears using contemporary implants and standardised rehabilitation. As such, there is insufficient evidence to recommend routine repair of all partial tears in this setting.

The increasing preference for reverse total shoulder arthroplasty in older patients, even in the absence of evident cuff deficiency, further complicates decision making [10][11]. Although rTSA may offer advantages in the presence of severe glenoid bone loss or marked posterior subluxation [34], several comparative series suggest that aTSA better restores native biomechanics and range of motion in patients with an intact or reparable cuff [12][35][36]. The present review suggests that selected patients with partial supraspinatus tears can achieve good outcomes with aTSA, including older patients, as shown by Raval et al., in whom the mean age was 79.2 years and the mean follow-up was 69.6 months [22]. These findings support a more personalized approach to implant selection that considers tear depth, tendon quality, fatty infiltration, glenoid morphology, and patient expectations, with rTSA reserved for cases with poor tendon quality, advanced fatty infiltration, instability, marked glenoid deformity, or concern for progression to cuff insufficiency.

Limitations

This review has important limitations. Only three studies met the inclusion criteria, and only 95 patients with partial thickness tears were identified, which limits statistical power and increases imprecision. Study designs were observational, and surgical techniques, implant designs and rehabilitation protocols were not standardised. Key details such as tear size, location and chronicity were incompletely reported in two of the three studies, and imaging criteria for classifying partial thickness tears differed between authors [7][21][22]. These factors introduce substantial clinical and methodological heterogeneity and may confound the observed associations. Publication bias cannot be excluded, and no study directly compared aTSA with rTSA in patients with partial tears. Moreover, follow-up was relatively short in some included studies, limiting conclusions regarding late complications, such as implant loosening and subsequent revision surgery.

Conclusion

The available evidence on aTSA in the presence of preoperative partial-thickness tears is scarce and

heterogeneous. Based on only the three studies included it seems that aTSA remains a viable treatment for patients with glenohumeral osteoarthritis and partial rotator cuff tears, providing significant improvements in functional scores and ROM without a considerable increase in complications compared to patients without tears.

However, certainty of evidence is low, and these findings should be interpreted with caution. Therefore, no firm conclusions can be drawn. Further studies are needed.

Open access statement

This is an open-access article distributed under the terms of the Creative Commons Attribution Licence for Commercial and Non-Commercial Purposes (CC BY 4.0, see <https://creativecommons.org/licenses/by/4.0/>), which allows free use, distribution, adaptation, and commercial use of a work, provided proper credit is given to the creator.

Conflict of interest statement

S. Braun discloses a consultancy for Arthrex; however, this relationship is unrelated to the content of this manuscript. All other authors declare that they have no competing interests.

Funding

There is no funding to report related to this study.

Ethics statement

Institutional review approval was not required for this review article.

Data availability statement: The data supporting the findings of this study are available within the article. Further inquiries can be directed to the corresponding author.

References

- Chillemi C, Franceschini V. Shoulder Osteoarthritis. Arthritis. 2013;2013:1-7. doi:10.1155/2013/370231
- Ibounig T, Simons T, Launonen A, Paavola M. Glenohumeral osteoarthritis: an overview of etiology and diagnostics. Scand J Surg. 2021;110(3):441-451. doi:10.1177/1457496920935018
- Best MJ, Aziz KT, Wilckens JH, McFarland EG, Srikanth U. Increasing incidence of primary reverse and anatomic total shoulder arthroplasty in the United States. Journal of Shoulder and Elbow Surgery. 2021;30(5):1159-1166. doi:10.1016/j.jse.2020.08.010
- Farley KX, Wilson JM, Daly CA, Gottschalk MB, Wagner ER. The Incidence of Shoulder Arthroplasty: Rise and Future Projections Compared to Hip and Knee Arthroplasty. JSES Open Access. 2019;3(4):244. doi:10.1016/j.jses.2019.10.047
- Occhiboi EP, Clement RD. Anatomic Total Shoulder Arthroplasty and Reverse Total Shoulder Arthroplasty: Indications, Outcomes, and Complications. JOPA JBJS. 2020;8(1):0025. doi:10.2106/JBJS.JOPA.19.00025
- Norris TR, Iannotti JP. Functional outcome after shoulder arthroplasty for primary osteoarthritis: A multicenter study. Journal of Shoulder and Elbow Surgery. 2002;11(2):130-135. doi:10.1067/mse.2002.121146
- Edwards TB, Boulahia A, Kempf JF, Boileau P, Némaz C, Walch G. THE INFLUENCE OF ROTATOR CUFF DISEASE ON THE RESULTS OF SHOULDER ARTHROPLASTY FOR PRIMARY OSTEOARTHRITIS: RESULTS OF A MULTICENTER STUDY. The Journal of Bone and Joint Surgery-American Volume. 2002;84(12):2240-2248. doi:10.2106/00004623-200212000-00018
- Bohsali KI. Complications of Total Shoulder Arthroplasty. J Bone Joint Surg Am. 2006;88(10):2279. doi:10.2106/JBJS.F.00125
- Grammont PM, Baulot E. DELTA SHOULDER PROSTHESIS FOR ROTATOR CUFF RUPTURE. Orthopedics. 1993;16(1):65-68. doi:10.3928/0147-7447-19930101-11
- Palsis JA, Simpson KN, Matthews JH, Traven S, Eichinger JK, Friedman RJ. Current Trends in the Use of Shoulder Arthroplasty in the United States. Orthopedics. 2018;41(3). doi:10.3928/01477447-20180409-05
- Chalmers PN, Salazar DH, Romeo AA, Keener JD, Yamaguchi K, Chamberlain AM. Comparative Utilization of Reverse and Anatomic Total Shoulder Arthroplasty: A Comprehensive Analysis of a High-volume Center. J Am Acad Orthop Surg. 2018;26(24):e504-e510. doi:10.5435/JAAOS-D-17-00075
- Schoch BS, King JJ, Zuckerman J, Wright TW, Roche C, Flurin PH. Anatomic versus reverse shoulder arthroplasty: a mid-term follow-up comparison. Shoulder & Elbow. 2021;13(5):518-526. doi:10.1177/1758573220921150
- Apfel A, Lin CC, Burfeind W, Dillon MT, Navarro RA. Characteristics of Rotator Cuff Repairs Revised to Shoulder Arthroplasty. ABJS. 2020;8(5). doi:10.22038/abjs.2020.39006.2042
- Frank RM, Lee S, Sumner S, et al. Shoulder Arthroplasty Outcomes After Prior Non-Arthroplasty Shoulder Surgery. JBJS OA. 2018;3(3):e0055. doi:10.2106/JBJS.OA.17.00055
- Simone JP, Streubel PH, Athwal GS, Sperling JW, Schleck CD, Cofield RH. Anatomical total shoulder replacement with rotator cuff repair for osteoarthritis of the shoulder. The Bone & Joint Journal. 2014;96-B(2):224-228. doi:10.1302/0301-620X.96B.32890
- Livesey M, Horneff JG, Sholder D, Lazarus M, Williams G, Namdari S. Functional Outcomes and Predictors of Failure After Rotator Cuff Repair During Total Shoulder Arthroplasty. Orthopedics. 2018;41(3). doi:10.3928/01477447-20180226-06
- Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. Published online March 29, 2021:n71. doi:10.1136/bmj.n71
- Sideri S, Papageorgiou SN, Eliades T. Registration in the international prospective register of systematic reviews (PROSPERO) of systematic review protocols was associated with increased review quality. Journal of Clinical Epidemiology. 2018;100:103-110. doi:10.1016/j.jclinepi.2018.01.003

19. Ball C, Sackett D, Phillips B, Haynes B, Straus S (2009) Levels of evidence and grades of recommendations. In: EBM (Web site of the Oxford Centre for Evidence-Based Medicine). <http://www.cebm.net/index.aspx?o=5653>
20. Slim K, Nini E, Forestier D, Kwiatkowski F, Panis Y, Chipponi J. Methodological index for non-randomized studies (MINORS): development and validation of a new instrument. *ANZ Journal of Surgery*. 2003;73(9):712-716. doi:10.1046/j.1445-2197.2003.02748.x
21. Choate WS, Shanley E, Washburn R, et al. The incidence and effect of fatty atrophy, positive tangent sign, and rotator cuff tears on outcomes after total shoulder arthroplasty. *Journal of Shoulder and Elbow Surgery*. 2017;26(12):2110-2116. doi:10.1016/j.jse.2017.05.022
22. Raval P, Gibbs VN, Pandey R. Preoperative partial-thickness rotator cuff tears do not compromise anatomic total shoulder replacement outcomes: medium-term follow-up. *Journal of Shoulder and Elbow Surgery*. 2021;30(4):871-876. doi:10.1016/j.jse.2020.07.037
23. Franklin JL, Barrett WP, Jackins SE, Matsen FA. Glenoid loosening in total shoulder arthroplasty. *The Journal of Arthroplasty*. 1988;3(1):39-46. doi:10.1016/S0883-5403(88)80051-2
24. Melis B, Bonnevalle N, Neyton L, et al. Glenoid loosening and failure in anatomical total shoulder arthroplasty: is revision with a reverse shoulder arthroplasty a reliable option? *Journal of Shoulder and Elbow Surgery*. 2012;21(3):342-349. doi:10.1016/j.jse.2011.05.021
25. Chen Z, Fan X, Gao Y, et al. Effect of Rotator Cuff Deficiencies on Muscle Forces and Glenohumeral Contact Force After Anatomic Total Shoulder Arthroplasty Using Musculoskeletal Multibody Dynamics Simulation. *Front Bioeng Biotechnol*. 2021;9:691450. doi:10.3389/fbioe.2021.691450
26. Sneppen O, Fruensgaard S, Johannsen HV, Olsen BS, Søjbjerg JO, Andersen NH. Total shoulder replacement in rheumatoid arthritis: Proximal migration and loosening. *Journal of Shoulder and Elbow Surgery*. 1996;5(1):47-52. doi:10.1016/S1058-2746(96)80030-9
27. Papadonikolakis A, Neradilek MB, Matsen FA. Failure of the Glenoid Component in Anatomic Total Shoulder Arthroplasty: A Systematic Review of the English-Language Literature Between 2006 and 2012. *The Journal of Bone & Joint Surgery*. 2013;95(24):2205-2212. doi:10.2106/JBJS.L.00552
28. Naimark M, Berliner J, Zhang AL, Davies M, Ma CB, Feeley BT. Prevalence of Rotator Cuff Atrophy and Fatty Infiltration in Patients Undergoing Total Shoulder Arthroplasty. *Journal of Shoulder and Elbow Arthroplasty*. 2017;1:2471549217708323. doi:10.1177/2471549217708323
29. Donohue KW, Ricchetti ET, Ho JC, Iannotti JP. The Association Between Rotator Cuff Muscle Fatty Infiltration and Glenoid Morphology in Glenohumeral Osteoarthritis. *The Journal of Bone and Joint Surgery*. 2018;100(5):381-387. doi:10.2106/JBJS.17.00232
30. Lapner PLC, Jiang L, Zhang T, Athwal GS. Rotator Cuff Fatty Infiltration and Atrophy Are Associated With Functional Outcomes in Anatomic Shoulder Arthroplasty. *Clinical Orthopaedics & Related Research*. 2015;473(2):674-682. doi:10.1007/s11999-014-3963-5
31. Young AA, Walch G, Pape G, Gohlke F, Favard L. Secondary Rotator Cuff Dysfunction Following Total Shoulder Arthroplasty for Primary Glenohumeral Osteoarthritis: Results of a Multicenter Study with More Than Five Years of Follow-up. *Journal of Bone and Joint Surgery*. 2012;94(8):685-693. doi:10.2106/JBJS.J.00727
32. Frandsen JJ, Quinlan NJ, Smith KM, Lu CC, Chalmers PN, Tashjian RZ. Symptomatic Rotator Cuff Tear Progression: Conservatively Treated Full- and Partial-Thickness Tears Continue to Progress. *Arthroscopy, Sports Medicine, and Rehabilitation*. 2022;4(3):e1091-e1096. doi:10.1016/j.asmr.2022.03.006
33. Gorica Z, McFarland K, O'Neill CN, Vanderbeck J, Vap AR. Anatomic Shoulder Arthroplasty in the Setting of Concurrent or Prior Rotator Cuff Repair: A Systematic Review. *Journal of Shoulder and Elbow Arthroplasty*. 2023;7:24715492231152733. doi:10.1177/24715492231152733
34. Harris AB, Familiari F, Russo R, Lukasiewicz P, McFarland EG. Shoulder arthroplasty in patients with glenohumeral osteoarthritis, glenoid bone loss and an intact rotator cuff: an algorithmic approach and review of the literature. *Ann Joint*. 2023;8:18-18. doi:10.21037/aoj-22-53
35. Latif V, Denard PJ, Young AA, Liotard JP, Walch G. Bilateral Anatomic Total Shoulder Arthroplasty Versus Reverse Shoulder Arthroplasty. *Orthopedics*. 2012;35(4). doi:10.3928/01477447-20120327-25
36. Poondla RK, Sheth MM, Heldt BL, et al. Anatomic and reverse shoulder arthroplasty in patients 70 years of age and older: a comparison cohort at early to midterm follow-up. *Journal of Shoulder and Elbow Surgery*. 2021;30(6):1336-1343. doi:10.1016/j.jse.2020.08.030