JSES International 6 (2022) 40–43

Contents lists available at ScienceDirect

JSES International

journal homepage: www.jsesinternational.org

Good long-term patient-reported outcome after shoulder arthroplasty for cuff tear arthropathy

Karoline P. Nielsen, MD*, Alexander Amundsen, MD, PhD, Bo S. Olsen, MD, PhD, Jeppe V. Rasmussen, MD, PhD

Department of Orthopedic Surgery, Herlev and Gentofte Hospital, University of Copenhagen, Denmark

ARTICLE INFO

Keywords:
Rotator cuff arthropathy
Hemiarthroplasty
Reverse shoulder arthroplasty
Long-term
Patient-reported outcome

Level of evidence: Level III; Retrospective Cohort Comparison; Treatment Study

Background: The use of the reverse shoulder arthroplasty (RSA) for cuff tear arthropathy (CTA) has increased within the last decades, but there is still limited information about the long-term outcome and how it performs in comparison with hemiarthroplasty (HA). The aim of this study was to compare the long-term patient-reported outcomes of RSA and HA for CTA.

Methods: We included all patients with CTA, who according to the Danish Shoulder Arthroplasty Registry, underwent either HA or RSA between 2006 and 2010. Patients who were alive were sent the Western Ontario Osteoarthritis of the Shoulder (WOOS) questionnaire in 2020. One hundred twenty (65%) patients returned a complete questionnaire. The linear regression model was used to compare RSA and HA. Sex, age, and previous surgery were included in the multivariable model.

Results: Forty-two HAs and 78 RSAs were evaluated with a mean follow-up time of 11.5 and 10.6 years, respectively. The mean WOOS score was 66.7 for HA and 71.7 for RSA. The difference of 5.0 was neither statistically significant nor clinically important (95% confidence interval: -4.3 to 14.2, $P = .17$), nor were there any significant risk of a worse WOOS score for sex, age, or previous surgery.

Conclusion: To our knowledge, this is the first study to compare the long-term patient-reported outcomes of HA and RSA for CTA. Our results indicate that RSA is a reliable and durable treatment option for CTA with good long-term results. Based on this observational study, it is not possible to make safe estimates about the effect of RSA compared with HA, but similar to RSA, HA was associated with relatively good long-term results.

Neer et al first described rotator cuff tear arthropathy (CTA) in 1983.[21] Along with the underlying mechanism and pathophysiology, criteria for the diagnosis were introduced. The following criteria are still the basis of the clinical diagnosis of rotator CTA: rotator cuff insufficiency, degenerative changes of the glenohumeral joint, and superior migration of the humeral head.[20,21]

The treatment strategy has changed over time. First anatomical total shoulder arthroplasty (TSA) was advocated for CTA. There were, however, high rates of complications, which was mainly related to glenoid component loosening and instability.[10,22] Today rotator CTA is considered a contraindication for TSA.[9,20] The disappointing outcomes led to a change in the treatment strategy with an increasing use of hemiarthroplasty (HA) which is still a viable treatment option.[9] There are, however, continuous concerns of humeral head instability, progressive bone loss, pain, and grossly impaired range of motion.[27,29] The manufactures have tried to improve the outcome of HA by introducing a humeral head component with an extended articular surface allowing articulation with acromion, but the results seem to be similar to that of a standard HA.[2]

The use of the reverse shoulder arthroplasty (RSA) for CTA has increased within the last decades.[16,28] The design of the arthroplasty gives an advantageous move of the center of rotation more distally and medially to improve stability and elevation of the shoulder, through stretching of the deltoid muscle.[14,15] Studies have reported superior short-term outcome compared with hemiarthroplasty and also high risk of instability, infection, and aseptic loosening.[5,23] The rate of revision varies from 2.4% to 8.5%,[1,6,12,16,22] and the risk of revision due to periprosthetic joint infection is 2.4 times higher than after anatomical shoulder arthroplasty.[3,19]

The purpose of this prospective registry study was to report the long-term patient-reported outcome of HA and RSA in patients

This study was approved by the Danish Data Protection Agency (j.no.:2012-58-0004, id.no.HGH-2017-099) and reviewed by the regional Research Ethics Committee (j.no.:H-18003430).

*Corresponding author: Karoline P. Nielsen, MD, Friheds Alle 34, 6400 Sønderborg, Denmark.

E-mail address: karolineperch@hotmail.com (K.P. Nielsen).

https://doi.org/10.1016/j.jseint.2021.08.002

with CTA. We hypothesized that the long-term outcome of the two arthroplasties types would be in favor of RSA.

Methods

Data

Data were obtained from the Danish Shoulder Arthroplasty Registry. All Danish public hospitals and private clinics report data about the patient (name, date of birth and sex) and the procedure (hospital, date of surgery, diagnosis, previous surgery, and arthroplasty type).[26] Approximately 95% of the primary arthroplasties have been captured by the registry when compared with the Danish National Patient Registry which is an administrative database used by the Danish hospitals to reimburse expenses for any hospital admission including shoulder arthroplasty procedures.[24]

Study population

A total of 378 shoulders (369 patients) underwent either HA or RSA for CTA between 2006 and 2010. Patients were excluded if they did not live in Denmark, did not have a Danish civil registration number, or were diagnosed with a fracture or rheumatoid arthritis in the affected shoulder. In January 2020, 193 (52.3%) patients had died. The remaining 185 shoulders (176 patients), including those with a revised arthroplasty, were sent a Western Ontario Osteoarthritis of the Shoulder (WOOS) questionnaire. All patients who did not answer or returned an incomplete questionnaire were sent a reminder in May 2020. In total, 65 (35%) shoulders (62 patients) did not respond. Thus, a total of 120 shoulders (65%) (42 HA and 78 RSA) (116 patients) returned a complete questionnaire and were subsequently included in the study.

Outcome

The WOOS consists of 19 questions focused on shoulder-related quality of life. Each question is answered using a visual analog scale (VAS) ranging from 0 to 100. The total score ranges from 0 to 1900. In this study, the raw WOOS scores were converted to a percentage of the maximum scores, where a score of 100 was regarded as a healthy shoulder with no functional impairment.[18] The Danish version of the WOOS has been translated and validated for patients with osteoarthritis.[25] To our knowledge, a minimal clinically important difference of the WOOS score has not been defined.

Statistics

WOOS scores were given as mean with standard deviation (SD). The multivariable linear regression model was used to test for risk factors for a worse WOOS score. Sex, age, previous surgery, and arthroplasty type were included. A P value less than .05 was considered statistically significant. The SPSS software program (version 26; IBM, Armonk, NY, USA) was used for the analyses.

Results

Population

Demographics are presented in Table I. Mean follow-up time was 11.5 years in the HA group and 10.6 years in the RSA group. The use of HA and RSA changed during the study period (Fig. 1). At the final follow-up, the RSA group included 20 (26%) Delta III (DePuy, Warsaw, IN, USA) arthroplasties and 45 (58%) Delta Xtend (DePuy) arthroplasties. The HA group included 18 (43%) Copeland resurfacing arthroplasties (Biomet, Warsaw, Indiana) and 10 (24%) Global Advantage stemmed arthroplasties (DePuy).

Table I
Demographics for hemiarthroplasty (HA) and reverse shoulder arthroplasty (RSA).

Variables	HA (n = 42)	RSA (n = 78)
Age		
Mean age	69.8	71.2
Age groups		
<70	21 (50%)	32 (41%)
≥70	21 (50%)	46 (59%)
Gender		
Male	27 (64%)	26 (33%)
Female	15 (36%)	52 (67%)
Previous surgery		
Yes	15 (36%)	27 (35%)
No	27 (64%)	51 (65%)

Outcome

The mean WOOS score was 66.7 (SD, 23.6) in the HA group and 71.7 (SD, 24.7) in the RSA group. The difference of 5.0 was not statistically significant (95% confidence interval: −4.3 to 14.2, $P = .17$). Age, sex, and previous surgery were not associated with the risk of a worse WOOS score (Table II). Four (9.5%) HAs and four (5.1%) RSAs were revised between 7 and 97 months (HA) and between 20 and 81 months (RSA) (Table III). The number of revision arthroplasties was too low to directly compare the risk of revision or the outcome of revision arthroplasty.

Discussion

To our knowledge, this is the first study to directly compare the long-term outcome of RSA and HA for CTA. Previous studies on HA and RSA have a maximum follow-up of 6.8 years.[4,17,28] Barlow et al[4] included 26 HA and 21 RSA and found that RSA had significantly better American Shoulder and Elbow Surgeons shoulder scores, range of motion (ROM), and VAS pain after 38 months. Young et al found a significantly better Oxford Shoulder Score for RSA at six months postoperatively, in a study of 204 shoulders (102 HAs and 102 RSAs) from the New Zealand Joint Registry. The same significant difference in the mean Oxford Shoulder Score was found among a reduced number of patients (24 HAs and 20 RSAs) at five-year follow-up.[28] Furthermore, they found that higher age was a risk factor for an inferior outcome. Leung et al found a significantly better Shoulder Pain and Disability Index and ROM after RSA compared with HA.[17] It is important to bear in mind that the studies use different outcome measures and a shorter observation period, which make a direct comparison to our long-term results difficult.

The long-term outcomes of RSA have previously been reported in case series. Ernstbrunner et al reviewed 8 case series with long-term results of 365 RSAs for either CTA or massive irreparable rotator cuff tears.[7] Results with a minimum follow-up of 10 years were available for 74 arthroplasties. The results showed similar clinical outcome from 5 and until 10 years[7] with a mean relative Constant Murley score of 75 and 73, respectively. The results are not directly comparable with ours because of different outcome measures, but the inclusion of 74 patients in a systematic review signifies that our study with 78 RSAs is unique.

A study by Gerber et al evaluated the results of 22 RSA for irreparable rotator cuff tear and secondary pseudo-paralysis with a minimum follow-up of 15 years and found a significant reduction in active abduction from 8 to 19 years after surgery.[11] Gerber suggested that the findings were associated with nonphysiological muscle fiber recruitment of the deltoid muscle in relations to RSA

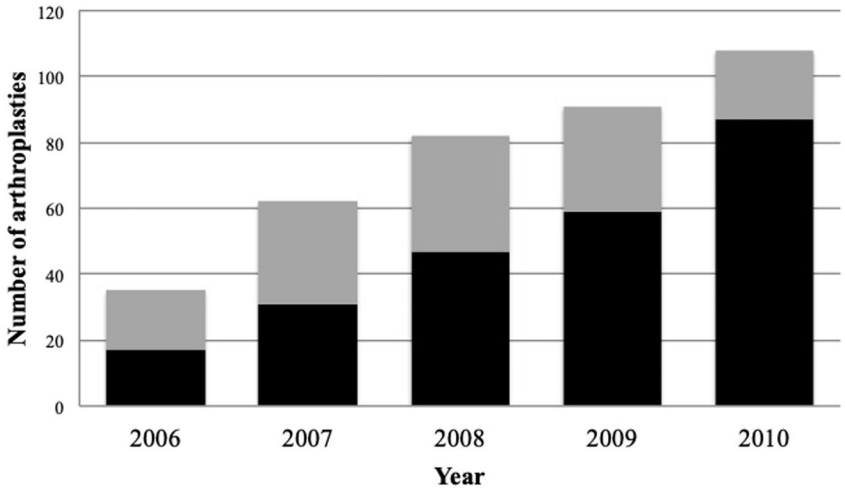

Figure 1 Number of hemiarthroplasties (*gray*) and reverse shoulder arthroplasties (*black*) registered in the DSR (Danish Shoulder Arthroplasty Registry) from 2006 to 2010.

Table II
Univariable and multivariable regression model with the WOOS score as the dependent variable and sex, age, previous surgery, and arthroplasty type as the independent variables.

Independent variables	Univariable			Multivariable		
	Mean difference	*P* value	95% CI	Mean difference	*P* value	95% CI
Sex						
Men	−0.01	1.0	−8.9 to 8.9	2.9	.54	−6.6 to 12.4
Women	1.0 (reference)			1.0 (reference)		
Age						
<70 years	−4.2	.35	−13.1 to 4.7	−4.8	.30	−13.9 to 4.3
≥70 years	1.0 (reference)			1.0 (reference)		
Previous surgery						
Yes	−6.5	.16	−15.7 to 2.7	−6.9	.14	−16.1 to 2.4
No	1.0 (reference)			1.0 (reference)		
Arthroplasty						
HA	−5.0	.29	−14.2 to 4.25	−5.4	.27	−15.0 to 4.3
RSA	1.0 (reference)			1.0 (reference)		

HA, hemiarthroplasty; *RSA*, reverse shoulder arthroplasty; *95% CI*, 95% confidence interval.

Table III
Description of each revision of hemiarthroplasty (HA) and reverse shoulder arthroplasty (RSA).

Primary arthroplasty type	Type	Revision arthroplasty type	Reason for revision	Number of revisions	Age at primary surgery	Time to revision (months)	WOOS score at 10-year follow-up
HA	Global Advantage	Delta Xtend	Missing	1	67.2	32	35
HA	Global Advantage	Global Advantage	Missing	1	77.5	7	96
HA	Copeland	Bigliani Flatow	Glenoid wear	3	57.9	18	52
HA	Copeland	Delta Xtend	Loosening	1	60.8	97	85
RSA	Delta III	Delta Xtend	Loosening	1	71.4	29	19
RSA	Delta III	Global Advantage	Missing	1	64.4	81	39
RSA	Delta III	Missing	Infection	2	68.8	20	84
RSA	Global Xtend	Delta Xtend	Missing	1	77.2	38	85

and a progressive muscle weakness due to ageing. All other functional outcomes (active and passive ROMs, Constant Murley score, and Subjective Shoulder Value) remained unchanged.[7,11] This indicates that abduction but not the overall results of RSA deteriorates after 10 years.

Ammitzboell et al. reported a 1-year postsurgery WOOS score for 117 HAs and 233 RSAs from the Danish Shoulder Arthroplasty Registry, matched by age and sex.[2] The median WOOS score was 49 for HA and 77 for RSA. The difference was statistically significant. Patients who were older than 65 years showed significant difference in the WOOS score (HA = 48, RSA = 79), whereas young patients (<65 years) had poor results for both HA (58) and RSA (54).[2] In contrast to this finding, our long-term results did not show significant differences in the WOOS between arthroplasties, and age was not a risk factor for a worse WOOS score. If we compare the outcome of RSA at 10 years from our study (WOOS score = 72) with the outcome at one year reported by Ammitzboell et al (WOOS score = 77), the difference is small and probably not clinically relevant. Thus, the outcome of RSA does not seem to deteriorate during the first 10 years.

The indications for HA in the beginning of the study period might have been different from today's practice. Thus, HA was used in case of rotator cuff insufficiency and glenohumeral osteoarthritis and the arthroplasty could be revised to an RSA in case of a poor

function. Today, RSA is regarded as gold standard in the treatment of CTA. HA is only used in few selected patients where insertion of the glenoid component in RSA is impossible or in patients with low functional demands and high risk of dislocation.[9,20] In our study, only two HA were revised to RSA, which is too few to make any conclusions about the outcome of RSA for failed HA.

The conversion from RSA to HA has become more common owing to the increased use of RSA. The indications for revision are most often recurrent dislocation or deficiency of the glenoid component. HA is mostly used as a salvage procedure when no further revision is possible.[8,13] In our study, only one RSA was revised to HA with a WOOS score after 10 years of 39.

This study has limitations known to observational studies. The indication for surgery and for a specific arthroplasty type is not known. The use of a specific arthroplasty type may be influenced by many things, among these also the severity of CTA. This is important to bear in mind especially because there are no preoperative WOOS score. Finally, there was no information about the large number of patients who died or did not return a complete WOOS score. Any systematic difference in outcome between deceased patients or patients who did not respond and patients who returned a complete questionnaire may have influenced the results and the interpretation.

Conclusion

To our knowledge, this is the first study to compare the long-term patient-reported outcomes of HA and RSA for CTA. Our results indicate that RSA is a reliable treatment option for CTA with good long-term results. Based on this observational study, it is not possible to make safe estimates about the effect of RSA compared with HA, but similar to RSA, HA was associated with relatively good long-term results.

Disclaimers:

Funding: No funding was disclosed by the authors.
Conflicts of interest: The authors, their immediate families, and any research foundation with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

References

1. Aibinder WSB, Parsons M, Watling J, Kevin Ko J, Gobbato B, Throckmorton T, et al. Risk factors for complications and revision surgery after anatomic and reverse total shoulder arthroplasty. J Shoulder Elbow Surg 2021. https://doi.org/10.1016/j.jse.2021.04.029. Epub ahead of print.
2. Ammitzboell M, Baram A, Brorson S, Olsen BS, Rasmussen JV. Poor patient-reported outcome after shoulder replacement in young patients with cuff-tear arthropathy: a matched-pair analysis from the Danish Shoulder Arthroplasty Registry. Acta Orthop 2019;90:119-22. https://doi.org/10.1080/17453674.2018.1563855.
3. Baram A, Ammitzboell M, Brorson S, Olsen BS, Amundsen A, Rasmussen JV. What factors are associated with revision or worse patient-reported outcome after reverse shoulder arthroplasty for cuff-tear arthropathy? A study from the Danish shoulder arthroplasty registry. Clin Orthop Relat Res 2020;478:1089-97. https://doi.org/10.1097/corr.0000000000001114.
4. Barlow JD, Jamgochian G, Wells Z, Bateman DK, Schmerfeld AA, Abboud JA, et al. Reverse shoulder arthroplasty is superior to hemiarthroplasty for cuff tear arthropathy with preserved motion. Arch Bone Jt Surg 2020;8:75-82. https://doi.org/10.22038/abjs.2019.38427.2016.
5. Boileau P, Watkinson D, Hatzidakis AM, Hovorka I. Neer Award 2005: the Grammont reverse shoulder prosthesis: results in cuff tear arthritis, fracture sequelae, and revision arthroplasty. J Shoulder Elbow Surg 2006;15:527-40. https://doi.org/10.1016/j.jse.2006.01.003.
6. Brown JS, Gordon RJ, Peng Y, Hatton A, Page RS, Macgroarty KA. Lower operating volume in shoulder arthroplasty is associated with increased revision rates in the early postoperative period: long-term analysis from the Australian Orthopaedic Association National Joint Replacement Registry. J Shoulder Elbow Surg 2020;29:1104-14. https://doi.org/10.1016/j.jse.2019.10.026.
7. Ernstbrunner L, Andronic O, Grubhofer F, Camenzind RS, Wieser K, Gerber C. Long-term results of reverse total shoulder arthroplasty for rotator cuff dysfunction: a systematic review of longitudinal outcomes. J Shoulder Elbow Surg 2019;28:774-81. https://doi.org/10.1016/j.jse.2018.10.005.
8. Familiari F, Rojas J, Nedim Doral M, Huri G, McFarland EG. Reverse total shoulder arthroplasty. EFORT Open Rev 2018;3:58-69. https://doi.org/10.1302/2058-5241.3.170044.
9. Feeley BT, Gallo RA, Craig EV. Cuff tear arthropathy: current trends in diagnosis and surgical management. J Shoulder Elbow Surg 2009;18:484-94. https://doi.org/10.1016/j.jse.2008.11.003.
10. Franklin JL, Barrett WP, Jackins SE, Matsen FA 3rd. Glenoid loosening in total shoulder arthroplasty. Association with rotator cuff deficiency. J Arthroplasty 1988;3:39-46.
11. Gerber C, Canonica S, Catanzaro S, Ernstbrunner L. Longitudinal observational study of reverse total shoulder arthroplasty for irreparable rotator cuff dysfunction: results after 15 years. J Shoulder Elbow Surg 2018;27:831-8. https://doi.org/10.1016/j.jse.2017.10.037.
12. Gill DRJ, Page RS, Graves SE, Rainbird S, Hatton A. A comparison of revision rates for osteoarthritis of primary reverse total shoulder arthroplasty to primary anatomic shoulder arthroplasty with a cemented all-polyethylene glenoid: analysis from the Australian Orthopaedic Association National Joint Replacement Registry. Clin Orthop Relat Res 2021;479:2216-24. https://doi.org/10.1097/corr.0000000000001869.
13. Glanzmann MC, Kolling C, Schwyzer HK, Audigé L. Conversion to hemiarthroplasty as a salvage procedure for failed reverse shoulder arthroplasty. J Shoulder Elbow Surg 2016;25:1795-802. https://doi.org/10.1016/j.jse.2016.03.011.
14. Grammont PM, Baulot E. Delta shoulder prosthesis for rotator cuff rupture. Orthopedics 1993;16:65-8.
15. Juhan T, Stone M, Jalali O, Curtis W, Prodromo J, Weber AE, et al. Irreparable rotator cuff tears: current treatment options. Orthop Rev (Pavia) 2019;11:8146. https://doi.org/10.4081/or.2019.8146.
16. Lehtimaki K, Rasmussen JV, Mokka J, Salomonsson B, Hole R, Jensen SL, et al. Risk and risk factors for revision after primary reverse shoulder arthroplasty for cuff tear arthropathy and osteoarthritis: a Nordic Arthroplasty Register Association study. J Shoulder Elbow Surg 2018;27:1596-601. https://doi.org/10.1016/j.jse.2018.02.060.
17. Leung B, Horodyski M, Struk AM, Wright TW. Functional outcome of hemiarthroplasty compared with reverse total shoulder arthroplasty in the treatment of rotator cuff tear arthropathy. J Shoulder Elbow Surg 2012;21:319-23. https://doi.org/10.1016/j.jse.2011.05.023.
18. Lo IK, Griffin S, Kirkley A. The development of a disease-specific quality of life measurement tool for osteoarthritis of the shoulder: the Western Ontario Osteoarthritis of the Shoulder (WOOS) index. Osteoarthritis Cartilage 2001;9:771-8.
19. Moeini S, Rasmussen JV, Salomonsson B, Domeij-Arverud E, Fenstad AM, Hole R, et al. Reverse shoulder arthroplasty has a higher risk of revision due to infection than anatomical shoulder arthroplasty: 17 730 primary shoulder arthroplasties from the Nordic Arthroplasty Register Association. Bone Jt J 2019;101-b:702-7. https://doi.org/10.1302/0301-620x.101b6.bjj-2018-1348.r1.
20. Nam D, Maak TG, Raphael BS, Kepler CK, Cross MB, Warren RF. Rotator cuff tear arthropathy: evaluation, diagnosis, and treatment: AAOS exhibit selection. J Bone Joint Surg Am 2012;94:e34. https://doi.org/10.2106/JBJS.K.00746.
21. Neer CS 2nd, Craig EV, Fukuda H. Cuff-tear arthropathy. J Bone Joint Surg Am 1983;65:1232-44.
22. Nwakama AC, Cofield RH, Kavanagh BF, Loehr JF. Semiconstrained total shoulder arthroplasty for glenohumeral arthritis and massive rotator cuff tearing. J Shoulder Elbow Surg 2000;9:302-7.
23. Ramirez MA, Ramirez J, Murthi AM. Reverse total shoulder arthroplasty for irreparable rotator cuff tears and cuff tear arthropathy. Clin Sports Med 2012;31:749-59. https://doi.org/10.1016/j.csm.2012.07.009.
24. Rasmussen JVE-GA, Thillemann TM, Jensen SL. High completeness and accurate reporting of key variables make data from the Danish shoulder arthroplasty registry a valuable source of information. Clin Epidemiol 2021:141-8. https://doi.org/10.2147/CLEP.S291972.
25. Rasmussen JV, Jakobsen J, Olsen BS, Brorson S. Translation and validation of the Western Ontario Osteoarthritis of the Shoulder (WOOS) index - the Danish version. Patient Relat Outcome Meas 2013;4:49-54. https://doi.org/10.2147/PROM.S50976.
26. Rasmussen JV, Olsen BS, Fevang BT, Furnes O, Skytta ET, Rahme H, et al. A review of national shoulder and elbow joint replacement registries. J Shoulder Elbow Surg 2012;21:1328-35. https://doi.org/10.1016/j.jse.2012.03.004.
27. Sanchez-Sotelo J, Cofield RH, Rowland CM. Shoulder hemiarthroplasty for glenohumeral arthritis associated with severe rotator cuff deficiency. J Bone Joint Surg Am 2001;83:1814-22.
28. 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. J Bone Joint Surg Am 2013;95:910-5. https://doi.org/10.2106/JBJS.L.00302.
29. Zuckerman JD, Scott AJ, Gallagher MA. Hemiarthroplasty for cuff tear arthropathy. J Shoulder Elbow Surg 2000;9:169-72.