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

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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.

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Neer et al first described rotator cuff tear arthropathy (CTA) in 1983. 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.2 There are, however, continuous concerns of humeral head instability, progressive bone loss, pain, and grossly impaired range of motion.27,29 The manufacturers 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.

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.5,22 The rate of revision varies from 2.4% to 8.5%,10,12,16,22 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...
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. 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 al4 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 6 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.1 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 years1 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

| 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%)  |

resurfacing arthroplasties (Biomet, Warsaw, Indiana) and 10 (24%) Global Advantage stemmed arthroplasties (DePuy).

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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.\textsuperscript{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.\textsuperscript{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).\textsuperscript{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

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**Table II**

| 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        | –6.5 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**

| Primary arthroplasty type | Type | Revision arthroplasty type | Reason for revision | Number of revisions | Age at primary surgery (years) | 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 |

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.\(^5\),\(^6\) 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.\(^5\),\(^6\) 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.

Conclusions

Our results indicate that RSA is a reliable treatment option for primary total shoulder arthroplasty to primary anatomic shoulder arthroplasty with a cemented all-polyethylene glenoid: results after 15 years. J Shoulder Elbow Surg 2018;27:831-8. https://doi.org/10.1016/j.jse.2017.10.037.

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