Orthopaedics & Traumatology: Surgery & Research 105 (2019) 225–228

Contents lists available at ScienceDirect

Orthopaedics & Traumatology: Surgery & Research

journal homepage: www.elsevier.com

Original article

# Do we need to stabilize and treat the os acromiale when performing reverse shoulder arthroplasty?

Ali Erşen [a], Serkan Bayram [a,*], Ata Can Atalar [b], Mehmet Demirhan [c]

[a] Department of Orthopedics and Traumatology, Istanbul Faculty of Medicine, Istanbul University, 34050 Çapa Fatih, Istanbul, Turkey
[b] Department of Orthopedics and Traumatology, Acıbadem University Faculty of Medicine, Istanbul, Turkey
[c] Department of Orthopaedics and Traumatology, KOÇ University School of Medicine, Sariyer, Istanbul, Turkey

ARTICLE INFO

*Article history:*
Received 2 December 2017
Accepted 14 November 2018

*Keywords:*
Reverse shoulder arthroplasty
Os acromiale
Deltoid tension
Cuff tear arthopaty

ABSTRACT

*Introduction:* The purpose of this study is to investigate the incidence of os acromiale in patients who had reverse shoulder arthroplasty (RSA) for rotator cuff tear arthropathy and the effect of presence of os acromiale on the functional results.
*Hypothesis:* We hypothesize than in the presence of os acromiale, the contraction strength of the deltoid would decrease due to the dynamic downward depression of the bony fragment leading to less favorable clinical results.
*Material and method:* A total 46 patients with a mean age of 70.8 who had RSA and a minimum follow-up of 24 months were included in this study. Preoperative radiographs, computerized tomography scans and magnetic resonance images were examined to determine the presence of os acromiale.
*Results:* A total of 10 patients out of 46 (22%) with os acromiale, all of which were of mesoacromion type, were followed up for 59.7 months. While both groups had significant improvements in Constant, Q-DASH and VAS scores compared to their preoperative status, a significant difference between the groups could not be found. The radiological evaluation showed that the average acromiohumeral distance significantly increased postoperatively in both groups. The acromiohumeral distance was significantly shorter in patients with os acromiale.
*Discussion:* While the presence of os acromiale does not have an adverse effect on the clinical results of the RSA, the loose fragment can migrate distally in the postoperative period due to the tension in the deltoid.
*Level of evidence:* III, case-control study.



## 1. Introduction

Acromion develops from the fusion of its three ossification centers. If a fusion defect occurs in these ossification centers, they cannot fuse into a single bone, and the remaining unfused ossification center is called os acromiale. Although different subtypes have been described by Gruber, mesoacromion, which is seen adjacent to the acromioclavicular joint, is the most common type [1]. Os acromiale, which is reported to be present in 1–15% of the population, is generally considered to be asymptomatic, and it is usually found incidentally; however, there are studies that report it as a cause of shoulder pain [1–4]. The relationship of the presence of os acromiale and rotator cuff tear is speculative, where it could be suggested that, with deltoid contraction, pressure would be exerted on the rotator cuff leading to a tear in the long run [3,5].

RSA has been increasingly used in the recent years for the treatment of rotator cuff tear arthropathy, and it owes its success to the functional use of the deltoid muscle [5,6]. The purpose of this study is to investigate the frequency of os acromiale in patients who had RSA for rotator cuff tear arthropathy and the effect of the presence of os acromiale on the short-term clinical results of the RSA. We hypothesize that in the presence of os acromiale, the contraction strength of the deltoid would decrease due to the dynamic downward depression of the bony fragment leading to less favorable clinical results.

## 2. Patients and method

Sixty-two patients underwent RSA in our clinic between 2009 and 2015. RSA due to proximal humerus fractures and revision

* Corresponding author.
*E-mail address:* dr.serkanbayram89@gmail.com (S. Bayram).

https://doi.org/10.1016/j.otsr.2018.11.017
1877-0568/

RSA's were excluded. Patients with rotator cuff arthropathy and a minimum follow-up of 24 months were included in this study. Of these 62 patients, 46 patients (39 women, 7 men) were found eligible. These patients had a mean age of 70.8 (56–84).

While all the patients had reverse prostheses via the deltopectoral approach, none had a tendon transfer. The teres minor tendon was found to be intact in all patients, and they all underwent a similar postoperative rehabilitation program. Pre and postoperative Constant scores, the Q-DASH scores, VAS scores and range of motion were used to evaluate the functional results. Medical records, files, and preoperative axillary radiographs, computerized tomography scans, and magnetic resonance images were examined to determine the presence of os acromiale. Patients with os acromiale had no symptoms related to os acromiale preoperatively.

In the preoperative period and the final follow-up period, the acromiohumeral distance on the true AP radiography of the shoulder was measured using the digital software program (eXtreme-pacs), and the data were compared both within the groups and between two groups. Acromiohumeral distances were measured from the most lateral end of acromion and the top of the major tubercle. All radiological examinations were performed by one observer (AE).

## 3. Surgical technique

A standard reverse shoulder arthroplasty procedure was performed by two senior shoulder surgeons (M.D., A.C.A.) by utilising the deltopectoral approach. Implant designs used included Delta Xtend (DePuy, Warsaw, IN, USA) in 40 and Comprehensive (Zimmer-Biomet, Warsaw, IN, USA) in 6 patients. A 155° neck-shaft angle cut was utilised in the majority of the patients (40/46, 87%), a 135° cut angle was used preferred only in 6 patients (13%). The size of the glenosphere was 36–38 mm in all patients.

## 4. Postoperative rehabilitation

While all the patients used a sling during the first 6 weeks after surgery, they were allowed forward flexion and abduction starting on the 3rd postoperative day. They were not allowed to do internal and external rotation for 6 weeks in order to protect the subscapularis tendon repair. At 6 weeks postoperatively, all motions of the shoulder were allowed in an active-assistive manner, and the patients were given strengthening exercises at 12 weeks.

## 5. Statistics

All the statistical analysis was performed using the SPSS version 21 statistics software program (IBM Corp, 2011, Armonk, New York). Preoperative demographic data of the groups including age, range of motion and functional scores were compared with Student *t* test. Pre and postoperative functional results were compared using the paired *t* test, whereas the comparison of results between the two groups were done using Student's *t* test. A *p* value less than 0.05 was considered to be statistically significant.

## 6. Results

Forty-six patients, who had a RSA for rotator cuff tear arthropathy, were followed up for 59,7 months (24–105). Retrospective analysis revealed os acromiale, all of which were of mesoacromion type, in 10 patients (22%) (Figs. 1 and 2).

There were no statistically significant differences between the group who had os acromiale (group 1) and the group who did not have os acromiale (group 2) with regard to age (group 1: 71.8 vs group 2: 69.6, $p = 0.69$) and follow-up time (group 1: 62.3 vs group 2: 57.8 $p = 0.21$).

**Fig. 1.** Preoperative shoulder AP and Axiller x-ray show os acromiale.

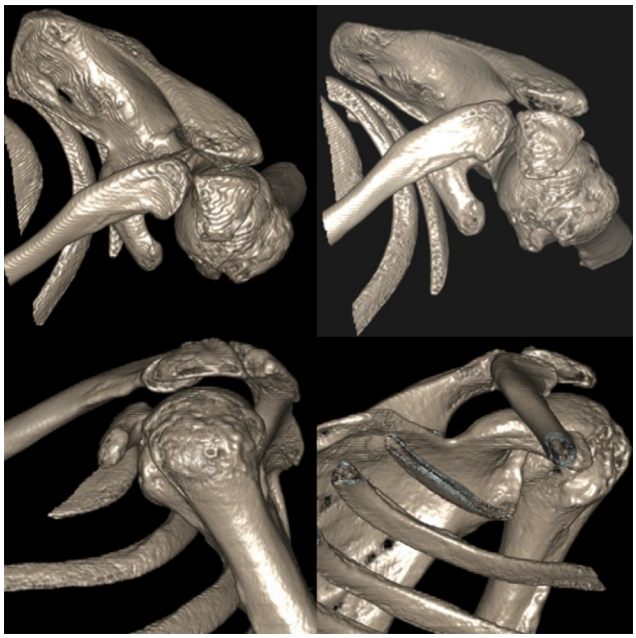

**Fig. 2.** Preoperative shoulder 3-D CT scan show os acromiale.

Groups were then compared with each other regarding preoperative forward flexion (group 1: 72.8° group 2: 69° $p = 0.7$), abduction (group 1: 61.4° group 2: 58.6° $p = 0.69$), external rotation (group 1: 24.3° group 2: 23.1° $p = 0.82$), Constant score (group 1: 35.7 group 2: 36 $p = 0.89$), Q-DASH score (group 1: 62.3 group 2: 64.9 $p = 0.76$), VAS score (group 1: 6.7 group 2: 6.3 $p = 0.82$) (Table 1).

In comparison to their preoperative status, both groups were found to be significantly better functionally at their final follow-up. The preoperative Constant score of 35,7 in group 1 improved to 66.4 at final follow-up ($p < 0.001$), and in group 2 the Constant score improved from 36 to 69.1 ($p < 0.001$) (Table 2). Again, Q-DASH scores decreased from 62.3 to 22 ($p < 0.001$) and from 64.9 to 27 ($p < 0.001$). VAS scores decreased from 6.7 to 1.2 and 6.3 to 0.9 ($p < 0.001$) in groups 1 and 2, respectively. When the postoperative Constant, Q-DASH and VAS scores between both groups were compared, there was no statistically significant difference ($p = 0.24$, $p = 0.38$ and $p = 0.61$). Comparison of preoperative and postoperative ranges of motion revealed a significant increase in forward

**Table 1**
Comparison preoperative range of motion and functional scores between the patients who had os acromiale (group 1) and the patients who did not have os acromiale (group 2).

| | Patients with an os acromiale | | Patients without an os acromiale | | *p* value |
|---|---|---|---|---|---|
| | Mean | Min–Max | Mean | Min–Max | |
| *n* | 10 | | 36 | | |
| Age | 71.5 | 56–84 | 70.3 | 62–81 | 0.66 |
| Forward Flexion | 72.8 | 30–100 | 69 | 20–120 | 0.7 |
| Abduction | 61.4 | 30–80 | 58.6 | 30–100 | 0.69 |
| External Rotation | 24.3 | 0–50 | 23.1 | 0–50 | 0.82 |
| Constant Score | 35.7 | 31–48 | 36 | 18–55 | 0.89 |
| Q-DASH Score | 62.3 | 56–68 | 64.9 | 54–77 | 0.76 |
| VAS Score | 6.7 | 4–9 | 6.3 | 5–9 | 0.82 |
| Acromiohumeral Distance | 4.93 | 4–7 | 5.52 | 4–8 | 0.73 |

**Table 2**
Comparison postoperative range of motion and functional scores between the patients who had os acromiale (group 1) and the patients who did not have os acromiale (group 2).

| | Postoperative Comparison | | | | |
|---|---|---|---|---|---|
| | Patients with an os acromiale | | Patients without an os acromiale | | *p* value |
| | Mean | Min–Max | Mean | Min–Max | |
| Forward Flexion | 130 | 90–170 | 138 | 90–170 | 0.26 |
| Abduction | 103 | 80–130 | 104 | 70–160 | 0.37 |
| External Rotation | 29.2 | 20–40 | 28.3 | 15–40 | 0.41 |
| Constant Score | 66.4 | 36–84 | 69.1 | 39–84 | 0.24 |
| Q-DASH Score | 22 | 16.1–36.4 | 27 | 9.1–59.1 | 0.38 |
| VAS Score | 1.2 | 0–3 | 0.9 | 0–2 | 0.61 |
| Acromiohumeral Distance | 19.3 | 16–22 | 32.3 | 20–43 | 0.038* |

* There is statistically significant difference between two groups.

flexion and abduction but external rotation was not significantly increase in both groups. When the groups were compared with each other, both forward flexion (group 1: 130°, group 2: 138°) and abduction (group 1: 103°, group 2: 104°) did not show a significant difference ($p = 0.26$ and $p = 0.37$). Similarly, there was no statistically significant difference between the groups regarding the range of external rotation (29.2° and 28.5°, $p = 0.41$) (Table 2).

Evaluation of the acromiohumeral distance measurements in the postoperative period revealed that both groups had a significant increase compared to the preoperative period. The radiological evaluation showed that the average acromiohumeral distance significantly increased from $4.93 \pm 0.7$ (4–7) mm preoperatively to $19.3 \pm 1.86$ (16–22) mm postoperatively in patients with os acromiale (group 1) and $5.52 \pm 1.23$ (4–8) preoperatively to $32.3 \pm 3.12$ (20–43) mm postoperatively in patients without os acromiale (group 2). The acromiohumeral distance was significantly shorter in patients with os acromiale (group 1) than those without os acromiale (group 2) ($p = 0.038$) (Fig. 3). In patients with os acromiale, mesoacromion was found to have migrated distally due to the tension of the deltoid. Of note, all patients with os acromiale were asymptomatic regarding os acromiale, pre and postoperatively.

There were no prosthesis infection and radiolucent lines noted around the humeral and glenoid components at final radiographic follow-up in both groups. In addition, there was no dislocation at the last follow up in both groups. Scapular notching was noted in 8 (17.3%) shoulders and was grade 1 in 4, grade 2 in 2, and grade 3 in 2 patients.

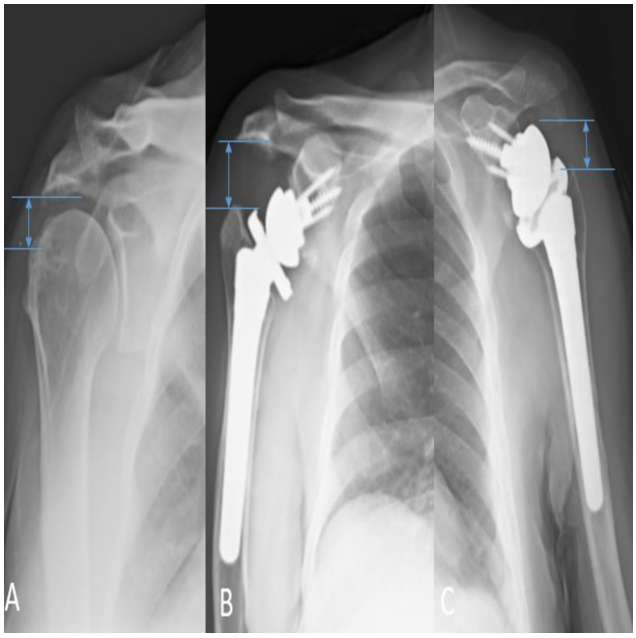


**Fig. 3.** A. Preoperative acromiohumeral distance. B. Postoperative acromiohumeral distance change in patient without os acromiale. C. Postoperative acromiohumeral distance change in patient with os acromiale. Postoperative shoulder x-ray show os acromiale migrate distally.

## 7. Discussion

The first question investigated in this study was the frequency of os acromiale in patients who had a RSA for cuff tear arthropathy. While the highest incidence of os acromiale in the population has been reported to be 15% and an incidence of 8% has been reported in the most comprehensive research on its incidence, the frequency found in this study was 22%, which is probably higher than in the population [2,8]. This suggests that os acromiale might have a role in the development of rotator cuff tear and the subsequent development of cuff tear arthropathy. Although many theories have been put forward regarding the mechanisms in the development of cuff tear arthropathy, which patients would develop arthropathy and which patients would have well-preserved function have not been completely understood in patients with a massive tear [4–9]. Although the study includes a small number of patients, the

high incidence of os acromiale in patients who developed cuff tear arthropathy reinforces the idea that os acromiale may predispose the patients with a massive tear to development of arthropathy. This idea should be reevaluated in larger series studying the frequency of os acromiale in patients with cuff tear arthropathy.

The other topic that was investigated in this study was the effect of os acromiale on the results of the RSA. A significant increase in the functional results and the range of motion has been reported with RSA in the treatment of cuff tear arthropathy. In a review by Frankle et al., average postoperative Constant score was found to be 68.2 in 60 patients who were treated with RSA for cuff tear arthropathy, and forward flexion and abduction were measured on average as 105° and 102°, respectively [8]. Although there are studies in the literature with similar results, the relationship between os acromiale and the functional results of RSA is not investigated [10–12]. Walch et al., in their series of 10 patients with os acromiale who underwent RSA, stated that presence of os acromiale was not a contraindication for the RSA, but they could not clearly demonstrate the effect of os acromiale on the results due to the different etiologies in their patients [13]. Aibinder et al. [14] reported that the outcome of RSA does not seem to be negatively affected by the presence of an os acromiale. They also reported that inferior tilting of os acromiale is observed after RSA for all, and that does not seem to change the overall outcome of the procedure. In this study all patients had cuff tear arthropathy, thus could be compared regarding os acromiale.

Regarding the RSA, the tension of the deltoid is believed to play a role in functional results and motion, and measurement of acromiohumeral distance in the postoperative period is thought to give an idea about this tension [6]. In a study by Jobin et al., an acromiohumeral distance of more than 38 mm was found to be associated with a better functional result and range of motion. However, in the presence of os acromiale, the effect of the tension of the deltoid on the mesoacromion fragment is not clearly known. In this study, the mesoacromion fragment has been observed to migrate distally due to the tension in the anterior deltoid in all patients who are known to have os acromiale. In connection with this, when the postoperative acromiohumeral distance was measured from this fragment, the distance was found to be significantly shorter as compared to the group of patients without os acromiale (19 mm vs 32 mm).

This study has some limitations such as being a retrospective study with a small number of patients. The functional results are short-term due to short follow up (2 years). However, presence of comparable groups of patients, use of a standard surgical procedure, and use of a standard postoperative rehabilitation program are clearly the strengths of the study.

## 8. Conclusion

According to the results of this study, os acromiale can be seen more frequently in patients who develop cuff tear arthropathy as compared to general population, and its probable role in the development of cuff tear arthropathy should be investigated with studies involving larger number of patients.

While the presence of os acromiale does not have an adverse effect on the clinical results of the RSA, the loose fragment can migrate distally in the postoperative period due to the tension in the deltoid. Although this limits the increase in the acromiohumeral distance measured radiographically, it has not been shown to have an adverse effect on function.

## Disclosure of interest

The authors declare that they have no competing interest.

## Funding sources

There is no funding source.

## Authors' contribution

Ali Erşen: drafted the paper; Serkan Bayram: acquisition of data; Ata Can Atalar: critical revision; Mehmet Demirhan: critical revision.

## References

[1] Barbier O, Block D, Dezaly C, Sirveaux F, Mole D. Os acromiale, a cause of shoulder pain, not to be overlooked. Orthop Traumatol Surg Res 2013;99–4:465–72.
[2] Spiegl UJ, Smith SD, Todd JN, Wijdicks CA, Millett PJ. Biomechanical evaluation of internal fixation techniques for unstable meso-type os acromiale. J Shoulder Elbow Surg 2015;24–4:520–6.
[3] Mudge MK, Wood VE, Frykman GK. Rotator cuff tears associated with os acromiale. J Bone Joint Surg Am 1984;66:427–9.
[4] Yammine K. The prevalence of os acromiale: a systematic review and meta-analysis. Clin Anat 2014;27:610–21.
[5] Barbiera F, Bellissima G, Iovane A, De Maria M. OS acromiale producing rotator cuff impingement and rupture. A case report. Radiol Med 2002;104–4:359–62.
[6] Jobin CM, Brown GD, Bahu MJ, Gardner TR, Bigliani LU, Levine WN, Ahmad CS. Reverse total shoulder arthroplasty for cuff tear arthropathy: the clinical effect of deltoid lengthening and center of rotation medialization. J Shoulder Elbow Surg 2012;21–10:1269–77.
[7] Wellmann M, Struck M, Pastor MF, Gettmann A, Windhagen H, Smith T. Short and midterm results of reverse shoulder arthroplasty according to the preoperative etiology. Arch Orthop Trauma Surg 2013;133–4:463–71.
[8] Sammarco VJ. Os acromiale: frequency, anatomy, and clinical implications. J Bone Joint Surg Am 2000;82–3:394–400.
[9] 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;94-6:e34.
[10] Frankle M, Levy JC, Pupello D, Siegal S, Saleem A, Mighell M, Vasey M. The reverse shoulder prosthesis for glenohumeral arthritis associated with severe rotator cuff deficiency. A minimum two-year follow-up study of sixty patients surgical technique. J Bone Joint Surg Am 2006;88:178–90.
[11] Sirveaux F, Favard L, Oudet D, Huquet D, Walch G, Mole D. Grammont inverted total shoulder arthroplasty in the treatment of glenohumeral osteoarthritis with massive rupture of the cuff. Results of a multicentre study of 80 shoulders. J Bone Joint Surg Br 2004;86-3:388–95.
[12] Young SW, Everts NM, Ball CM, Astley TM, Poon PC, The SMR. The SMR reverse shoulder prosthesis in the treatment of cuff-deficient shoulder conditions. J Shoulder Elbow Surg 2009;18–4:622–6.
[13] Mottier F, Wall B, Nove-Josserand L, Galoisy Guibal L, Walch G. RSA and os acromiale or acromion stress fracture. Rev Chir Orthop Reparatrice Appar Mot 2007;93–2:133–41.
[14] Aibinder WR, Schoch BS, Cofield RH, Sperling JW, Sánchez-Sotelo J. Reverse shoulder arthroplasty in patients with os acromiale. J Shoulder Elbow Surg 2017;26:1598–602.