Os acromiale associated with tear of the rotator cuff treated operatively

REVIEW OF 33 PATIENTS

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Os acromiale is a rare anatomical abnormality and treatment is controversial. Our retrospective study analyses the outcome of excision, acromioplasty and bony fusion of the os acromiale when it is associated with a tear of the rotator cuff.

After a mean follow-up of 41 months, 33 patients were radiologically and clinically assessed using the Constant score. The surgical procedure was to repair the rotator cuff together with excision of the os acromiale in six patients, acromioplasty in five, and fusion in 22.

Of the 22 attempted fusions seven failed radiologically. The Constant scores were 82%, 81%, 81% and 84% for patients who had excision, acromioplasty, successful fusion and unsuccessful fusion respectively. There were no statistically significant differences.

We conclude that a small mobile os acromiale can be resected, a large stable os acromiale treated by acromioplasty and a large unstable os acromiale by fusion to the acromion. Even without radiological fusion the clinical outcome can be good.

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Os acromiale is an unfused epiphysis of the anterior extremity of the acromion in a mature individual. Gruber¹ was the first to describe its association with a distinct synovial joint with articular cartilage which was seen as an incidental finding in three of 100 cadavers. Other authors have described fibrous tissue and an imperfect articulation or a synchondrosis.²⁻⁴ Three different ossification centres of the acromion appear between the ages of 15 and 18 years and fuse between the ages of 22 and 25 years.⁵ If they fail to unite

Fig. 1

The types of os acromiale; A, the space between the os pre-acromiale and the acromion; B, the space between the os meso-acromiale and the acromion (note there is a communication with the acromioclavicular joint, found in all our patients); and C, the space between the os meta-acromiale and the acromion.

with the basi-acromion, three types of separate os acromiale can be differentiated; the pre-acromion, the meso-acromion and the meta-acromion (Fig. 1) of which the second is the most common⁶ (Fig. 2).

The os meso-acromiale and os pre-acromiale are the most common varieties to be reported in the surgical literature.⁷⁻¹³ Warner, Beim and Higgins¹⁴ reported three surgically treated patients with os acromiale located between the meta-acromion and the basi-acromion.

The reported incidence of os acromiale in the literature varies between 1.3% and 15%. It occurs bilaterally in between 33.3% and 62% of all cases.^{6,15,16} Os acromiale is well demonstrated on axial radiographs, CT or MRI.¹⁶⁻¹⁸ As a single uncomplicated condition it is rarely diagnosed, usually in association with subacromial impingement or a tear of the rotator cuff.^{9,13,19} The diagnosis of a simple os acromiale calls for no specific treatment. Since it is a rare entity, there are no prospectively controlled studies available and the published studies are, except for that from Neer's group,²⁰⁻²² of small numbers of patients (Table I).²³⁻²⁵

The wide range of surgical interventions for the condition, from arthroscopic acromioplasty to open osteosynthesis with iliac-crest bone graft, demonstrates the breadth of differing opinions.^{9,10,13,14} The purpose of our retrospective

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Fig. 2

Axillary radiograph of a 52-year-old woman showing the appearance of an os meso-acromiale. The black arrow indicates the line of the unfused epiphysis communicating with the acromioclavicular joint (OA, os acromiale).

study was to compare the clinical and radiological outcome of three different surgical procedures. In patients for whom fusion of the os acromiale was attempted, the effect of achieving or not achieving fusion was also analysed.

Patients and Methods

Between 1990 and 1999, 37 patients with a tear of the rotator cuff and a radiologically confirmed os acromiale, underwent open repair of the cuff and treatment for the os acromiale. We reviewed 33 patients (89%) after a mean of 42 months (24 to 95). There were ten women and 23 men with a mean age of 56 years (44 to 70); 19 also had symptomatic arthritis of the acromioclavicular joint (ACJ). There were 17 isolated tears of supraspinatus (16 full thickness and one Elmann 3 bursal side partial tear), 13 full-thickness tears of both supraspinatus and infraspinatus and three full-thickness tears of all three tendons – supraspinatus, infraspinatus and subscapularis.

Operative technique. We used an anterior approach releasing deltoid in all 33 patients and reconstructed the rotator cuff before treatment of the os acromiale. A tendon-to-bone repair was carried out with transosseous fixation of the tendon into a bony trough using modified Mason-Allan sutures. In patients with arthritis of the ACJ, the lateral centimetre of the clavicle was resected and the capsule of the joint repaired. If there was a partial tear or instability of the tendon of the long head of biceps, we undertook a tenodesis into the bicipital groove. After repair of the cuff, we used one of three surgical procedures to treat the os acromiale.

Excision of the os acromiale. In six patients it was thought that the mobile fragment was too small or unsuitable for reattachment and therefore the fragment or fragments were removed and the deltoid reattached directly to the bone.

Table I. Current literature review of the surgical treatment of os acromiale

	Year	Number of patients	Method*
Armengol et al ²⁰	1994	41	Fusion/excision/ASD
Bigliani et al ²¹	1993	42	Fusion/excision/ASD
Edelson et al ²³	1993	2	Fusion
Edelson et al ²³	1993	5	Excision
Hertel et al ⁷	1998	15	Fusion
Hutchinson and Veenstra ⁹	1993	3	ASD
Jerosch et al ¹⁰	1994	12	ASD
Mudge et al ¹⁹	1984	6	Excision
Norris et al ²²	1983	21	Fusion/excision/acromioplasty
Richmann et al ¹¹	1997	1	Fusion
Satterlee ¹²	1999	6	Fusion
Sterling et al ²⁴	1995	1	Fusion
Swain et al ²⁵	1996	1	Removal
Warner et al ¹⁴	1998	15	Fusion
Wright et al ¹³	2000	13	ASD

*ASD, arthroscopic subacromial decompression

Anterior acromioplasty. Five patients with a stable os acromiale underwent an acromioplasty as described by Neer²⁶ with transosseous reattachment of the deltoid.

Fusion. In 22 patients the os acromiale was demonstrably mobile. It was stabilised using a tension band technique. The articular surfaces and fibrous tissue of the pseudarthrosis were resected. The anterior aspect of the acromion was elevated from underneath to approximate it to the posterior surface of the acromion and to separate it from the head of the humerus. The os acromiale was then stabilised; two parallel unthreaded 2.2 mm Kirschner wires were drilled from the anterior aspect of the acromion across the pseudarthrosis, emerging on the posterior aspect of the acromion and secured with a figure-of-eight cerclage wire (1.1 mm). The ends of the Kirschner wires were bent over and cut off. A partial acromioplasty was carried out if there were acromial osteophytes. The deltoid muscle was re-attached to the os acromiale with transosseous sutures.

In all but one patient the metalwork was subsequently removed.

Postoperative management. The arm was placed on an abduction pillow at 45° to 60° of abduction, 30° of flexion and in neutral rotation for six weeks. Passive physiotherapy and continuous passive motion commenced on the first post-operative day and continued for six weeks. Patients left hospital at three weeks, which was the standard time after repair of the rotator cuff. After six weeks, full active movement was allowed and strengthening exercises began at 12 weeks.

Assessment of the results. The clinical assessment included active and passive ranges of movement and functional scoring according to Constant and Murley.²⁷ The strength of abduction was measured with the patient in a sitting position with the forearm in pronation and the humerus at 90° of abduction and 30° of anteversion in the scapular plane using an ISOBEX device (Cursor AG, Bern, Switzerland) fixed to the subject's wrist over a period of five seconds. Each result

Fig. 3

Axillary radiograph of fusion of an os meso-acromiale in a 58-year-old man (Constant score 86%).

was the mean of three measurements. These were compared with age- and gender-matched normal values.²⁸ The age- and gender-matched values for the Constant score were reported as percentages; scores higher than 91% were rated as excellent, between 81% and 90% as good, 71% and 80% as satisfactory, 61% and 70% as moderate, 51% and 60% as fair and less than 50% as poor.²⁹ The patients were also asked whether, in the light of the result, they would have agreed to have the operation again, and how they would grade their result using a grading system from one to six (one being excellent and six poor). Radiological examination included standard axillary views of patients in whom fusion had been attempted to assess its success.

Statistical analysis. Since the patient sample was small, non-parametric tests were used. For all analyses, alpha was set at 0.05 and beta at 0.8. The individual pain scores both before and after treatment were recorded with the Wilcoxon test for independent samples. We sought a difference in the age-adjusted Constant score with the Mann-Whitney U test for independent samples between patients with and those without lateral resection of the clavicle. The modified chi-squared test was used to demonstrate the differences between the results of the four groups: excision of the os (6 patients); anterior acromioplasty (5); successful fusion (15); unsuccessful fusion (7).

Results

Excision of os acromiale. Of the six patients who had an excision, three had an os pre-acromiale, one a bipartite os meso-acromiale and two had a small os meso-acromiale which was too soft for fixation. Their mean age at surgery was 51 years (45 to 55) and the mean follow-up was 38 months (25 to 52). All patients had tears of two tendons (supraspinatus and infraspinatus) four resection of the lat-

eral clavicle and four a tenodesis of the long head of biceps. One patient suffered a deep infection requiring further surgery at eight days. Patients stayed in hospital for a mean of 32 days (13 to 57). Subjectively, three patients rated the result as excellent and three good. The mean preoperative pain component of the Constant score of 3.3 improved significantly to 13.4 after treatment ($p = 0.027$). The mean total Constant score was 73.2 (age- and gender-matched 82%; range 74% to 91%) with two excellent, two good and two satisfactory objective results.

Anterior acromioplasty. All five patients had an os meso-acromiale. Their mean age at surgery was 52 years (47 to 58) and the mean follow-up was 37 months (24 to 44). Two patients had two tendon tears (supraspinatus and infraspinatus) and three an isolated tear of supraspinatus. Tenodesis of the long head of biceps was carried out in one; two patients had deep infection with further surgery at six and ten days. The mean stay in hospital was 24 days (14 to 39). One patient rated the result as excellent, two good and one each satisfactory and fair. The mean preoperative pain component of the Constant score of 4.6 improved significantly to 12.2 after treatment ($p = 0.042$). The mean total Constant score was 72 (age- and gender-matched 81%, range 71% to 93%) with one excellent, two good and two satisfactory objective results.

Attempted fusion. All 15 patients with radiological fusion (Fig. 3) of the os acromiale had an os meso-acromiale. Their mean age at surgery was 59 years (37 to 69), and the mean follow-up was 42 months (24 to 95). Three patients had two tendon tears (supraspinatus and infraspinatus), two had three tendon tears, including subscapularis, and ten had an isolated tear of supraspinatus. In 11 patients, resection of the lateral clavicle was also carried out and in two, a tenodesis of the long head of biceps. In one patient, a posterior defect of the cuff could not be closed with local tissue and transfer of latissimus dorsi was undertaken. One patient had a deep infection with further surgery on days seven and 12. Superficial wound infections occurred in two patients which were treated successfully with antibiotics. The mean length of stay in hospital was 23 days (9 to 70). The wires were removed after a mean of 94 days (18 to 320); one patient declined to have the metalwork removed. Subjectively, seven patients rated the result as excellent, seven good, one moderate and one poor. The mean preoperative pain component of the Constant score of 4.5 improved significantly to 13.1 after treatment ($p = 0.001$). The mean total Constant score was 73.8 (age- and gender-matched 81%, range 44% to 102%) with four excellent, six good, two satisfactory, two fair and two poor objective results.

All seven patients in whom radiological fusion was not demonstrated (Fig. 4) had an os meso-acromiale. Their mean age at surgery was 58 years (49 to 70) and the mean follow-up 36 months (24 to 70). Two patients had tears of two tendons, one patient tears of three tendons, and four patients an isolated tear of supraspinatus. In four patients resection of the lateral clavicle was undertaken and in two

Fig. 4

Axial radiograph of an unfused meso-acromion with lateral deviation in a 54-year-old woman (Constant score 91%). Despite the palpable mobility of the os acromiale the patient is pain free. The black arrow indicates the area without radiological evidence of fusion and the arrowhead, postoperative ossification (OA, os acromiale).

patients, a tenodesis of the long head of biceps. No infection or other surgical complication occurred. The metalwork was removed at a mean of 80 days (43 to 156). Patients stayed in hospital for a mean of 19 days (13 to 31). Subjectively one patient rated the result as excellent, five good and one satisfactory. The mean preoperative pain component of the Constant score improved significantly to 11.3 after treatment ($p = 0.027$). The mean total Constant score was 74.2 (age- and gender-matched 84%, range 71% to 102%); three were excellent, one good and three gave satisfactory objective results.

Differences between the four groups. Before surgery, the four groups showed no significant difference in the three categories of pain, activities of daily living and active range of movement ($p = 0.889$). As the measurement of strength was missing from the records of six patients, the Constant score could not be completed in those patients. The postoperative results regarding the age- and gender-related Constant scores, did not show a significant difference between the groups ($p = 0.795$).

Effect of resection of the lateral clavicle. In 19 patients, the lateral 1 cm of the clavicle was excised. The mean Constant score of these patients was 70 (age- and gender-matched 81%) and did not show a significant difference ($p = 0.535$) from the score of 71 (age- and gender-matched 82%) of the 14 patients without resection of the clavicle. We conclude that resection had no significant effect.

The 33 patients achieved a mean total Constant score of 73 (32 to 91) (age- and gender-matched 82%, range 44% to 102%). All but one patient said they would agree to have the operation again; 29 patients (88%) rated their result as excellent or good. Since the numbers in the subgroups are

small, an analysis of the impact of the size of the tear on the results was not statistically possible. All pre-acromiale lesions were associated with tears of two tendons, but with only three patients this can only be rated as a trend.

Discussion

The clinical relevance of the os acromiale as a cause of pain in the shoulder has not yet been satisfactorily investigated. Its reported incidence in anatomical and radiological studies ranges from 1.3% to 15%.^{6,15} Descriptions of the prevalence of the os acromiale in symptomatic patients are few. Mudge et al¹⁹ found nine patients with an os acromiale out of 145 with tears of the rotator cuff (6.2%) and Jerosch et al¹⁰ 12 out of 122 patients (9.8%) with subacromial impingement without a tear of the rotator cuff. Comparison of these findings with the prevalence quoted in the most recent osteological studies of 8%^{16,30} and 8.2%²³ raises the question as to whether an os acromiale is a pathological condition of the shoulder, causing impingement and damage to the rotator cuff. The radiological findings of an asymptomatic os acromiale in a skeletally mature patient have also been reported by Burkhart.⁸ According to Warner et al,¹⁴ the clinical relevance of an os acromiale as a cause of pain in the shoulder remains unclear, but clinical symptoms with tenderness over an os acromiale in patients with a tear of the rotator cuff suggest that the os acromiale contributes to the pain. In those symptomatic patients in whom there is both an os acromiale and a tear of the rotator cuff, the surgeon should treat both. Neer³¹ reported that a large os acromiale, associated with a tear of the rotator cuff, should be stabilised rather than resected when the rotator cuff is repaired. Resection may lead to weakness especially if the fragment is large.^{21,32} In our series, the patients who underwent resection of a small meso-acromiale and pre-acromiale achieved a mean Constant score of 82%, with no fair or poor results. Armengol et al²⁰ suggested that subacromial decompression, either as an arthroscopic or an open procedure rather than open reduction and internal fixation, is a reliable form of operative management in patients who have pain in the shoulder which is due to an os acromiale. Jerosch et al¹⁰ found that arthroscopic decompression of the os acromiale in 12 patients with subacromial impingement, did not give significantly different results from those in patients without an os acromiale, and Wright et al¹³ reported 11 satisfactory outcomes out of a series of 13 patients.

Fusion of an os acromiale has been attempted by many authors using different methods. Satterlee¹² used two cannulated Herbert screws after a superior wedge osteotomy of the os acromiale in six patients with excellent results documented with ASES-scores in excess of 90. Hertel et al⁷ reported better results in eight patients using a transacromial approach than in seven patients using a 'deltoid-off' approach with fixation by tension-band wiring across two Kirschner wires in both groups. Warner et al¹⁴ recommended the use of cannulated screws instead of Kirschner

wires, because they achieved a rate of union of 86% in seven patients with screws and only 20% in five patients with Kirschner wires. By contrast, Bigliani et al²¹ and Armegol et al,²⁰ describing similar numbers of patients, found unsatisfactory results in 43% of 14 patients with open reduction and internal fixation with further surgery being required in 86% because of complications related to metalwork. They found good and excellent results in 86% of patients with open or arthroscopic acromioplasty, which led them to recommend this rather than fusion of the os acromiale.

In large posteriorly located tears of the rotator cuff with an unstable os acromiale, a transacromial approach as described by Richmann et al¹¹ and Hertel et al,⁷ may be used to avoid compromising the anterior blood supply of the os acromiale and to allow better visualisation of the posterior rotator cuff. Our total Constant scores were within the range reported by others.³³⁻⁴²

In small unstable or fragmented os meso-acromiale and os pre-acromiale, excision of the fragment gives good results and is recommended. In tears of the rotator cuff associated with a stable os meso-acromiale, a modest acromioplasty is the treatment of choice. With a large unstable os meso-acromiale, fixation using Kirschner wires and tension band wires gives good and reliable results, even if fusion does not occur. Therefore, the question must be raised as to whether the presence of an os acromiale is relevant in patients with pain in the shoulder and whether it can cause tears of the rotator cuff. A prospective study is required to answer this question, and also whether an unstable os acromiale can be treated by acromioplasty alone.

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