

Surgical Management of Os Acromiale

A Case Report and Review of the Literature

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The acromion develops from three separate ossification centers that, typically, fuse to each other between the 15th and 18th year of life. These three regions are referred to as the pre-acromion, meso-acromion and meta-acromion (Fig. 1). However, osseous union between the acromial apophysis and spine of the scapula may occur as late as age 25 years. If there is a failure of the anterior acromial apophysis to unite, an os acromiale is present (Fig 2). Classification of an os acromiale is based on which developmental ossification center fails to fuse. The meso-acromion form of os acromiale has been reported to be the most common center, as well as the most problematic, to treat.^{1,2}

This condition was described as early as 1863, when Gruber noted the presence of an os acromiale with fibrocartilaginous union of the anterior acromial ossification centers in three out of 100 cadaveric specimens (in a review by Kurtz and colleagues³). The reported frequency in anatomical and radiographic studies ranges from 1.3% to 30% percent and has a higher incidence in African Americans and males.¹⁻⁴

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Bilateral involvement is relatively common, with incidence rates ranging from 33% to as high as 62%.²⁻⁵

Os acromiale is often discovered as an incidental finding during the radiographic evaluation of a patient with shoulder pain, with the unfused acromial ossification centers being unrelated to the patient's symptomatology. Patients whose pain is attributable to the os acromiale after ruling out other possible pathologies, typically, experience discomfort secondary to two main sources. The first is that the lack of fusion may cause the deltoid to pull an unstable and mobile fragment down onto the rotator cuff, decreasing the size of the supraspinatus outlet leading to impingement type symptoms and shoulder pain.^{6,7} The second source may be inflammation and pain caused by abnormal motion directly at the site of nonunion.^{6,8}

The diagnosis of os acromiale is made with a careful history, physical examination, and an appropriate radiographic evaluation, including anteroposterior, scapular, and axillary views of the affected shoulder. Patients will, typically, describe symptoms similar to those of outlet impingement syndrome, such as night pain and difficulty with overhead activity.² Additionally, patients often report limited shoulder range of motion or a sensation of clicking during activity.^{9,10} Their symptoms will usually be atraumatic in origin. On examination, patients will have weakness with forward elevation, positive Hawkins and Neer signs, rotator cuff weakness, and pain on palpation over the acromion. The axillary view is often the best radiograph to demonstrate an os acromiale, enabling the surgeon to evaluate the size and shape of the unfused acromial segment, as well as to identify degenerative changes.^{2,5,11} A computed tomography (CT) scan may be helpful for further detail and magnetic resonance imaging (MRI) can be beneficial in assessing the status of the rotator cuff.¹²

Conservative treatment with nonsteroidal anti-inflammatory agents, physical therapy with rotator cuff exercises,

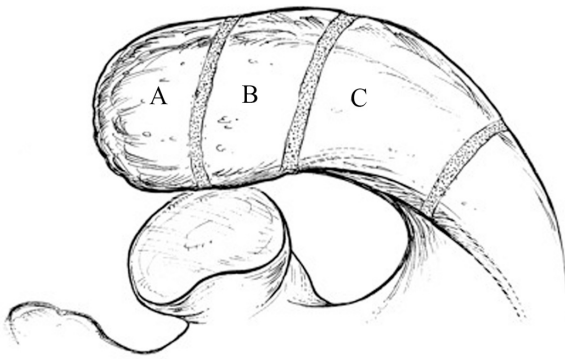


Figure 1 Ossification centers of the acromion. Failure of these centers to ossify results in an os acromiale of the pre-acromion type (A), meso-acromion type (B) and meta-acromion type (C).

and subacromial corticosteroid injections have been recommended for initial treatment of a symptomatic os acromiale. If conservative treatment fails to improve symptoms after a period of six months, surgical intervention is warranted. Treatment options of open fragment excision, arthroscopic subacromial decompression, and open reduction and internal fixation (ORIF) have had mixed results, with each technique having their own set of advantages and disadvantages.^{1,2,6,7,9,13,14}

Previous reports on ORIF treatment of unstable os acromiale have utilized a variety of materials and surgical techniques. These include Ticron suture or tension-band wire in a figure-of-eight position, as well as the use of bone graft from different locations, such as the acromion, iliac crest, and greater tuberosity. A case example is presented herein that details the procedure and clinical results of ORIF management of a symptomatic os acromiale of the meso type, using FiberWire® (Arthrex, Inc., Naples, Florida), humeral head bone graft, and a bone marrow-impregnated hydroxyapatite bone substitute (HEALOS® II bone graft



Figure 2 Failure of the anterior acromial apophysis to unite, resulting in an os acromiale (meso-acromion type).

substitute; DePuy Spine, Inc., Rayham, Massachusetts). We will also provide a treatment approach for this controversial problem.

Case Example

The patient is a 53-year-old, right-hand dominant female with no significant medical history, who presented, however, with a long history of right shoulder pain during overhead activity. Initial evaluation of the right shoulder revealed point tenderness over the acromioclavicular (AC) joint. Physical examination was also significant for a positive cross-arm adduction test and limited active, passive, and resisted range of motion. Radiographs revealed a type II acromion with degenerative changes in the AC joint, a sclerotic greater tuberosity, and a meso type of os acromiale (Fig. 3). MRI revealed a torn supraspinatus tendon, and confirmed the presence of the os acromiale (Fig. 4).

The patient was treated conservatively for 5 months without significant symptom relief. After failure of the trial of conservative management, she underwent an arthroscopic



Figure 3 Preoperative axillary views of the right shoulder demonstrating meso-type os acromiale (outlined in white).

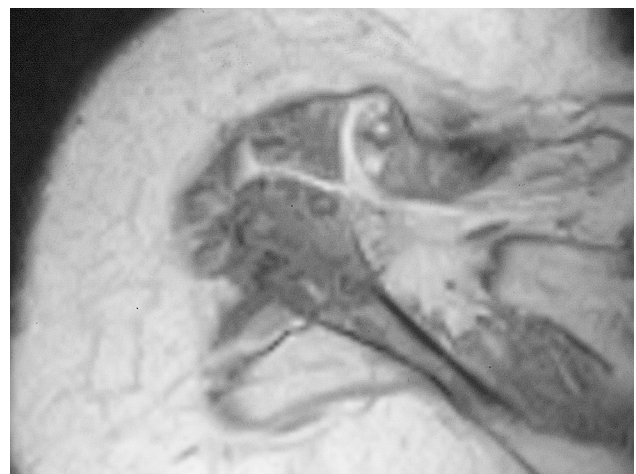


Figure 4 Preoperative MRI of the right shoulder demonstrating meso-type os acromiale.

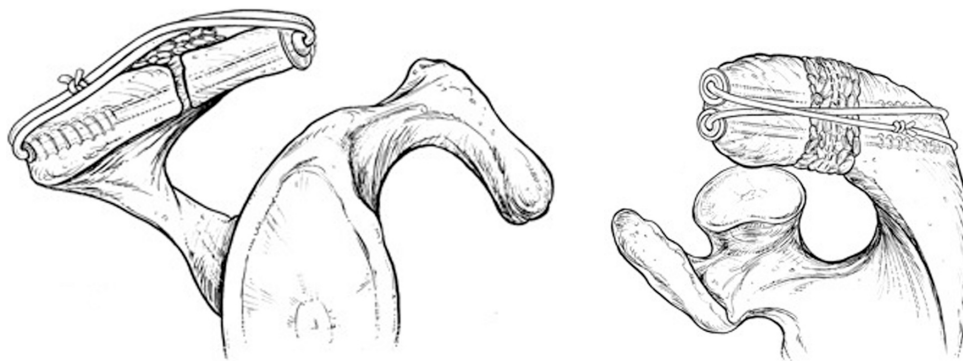


Figure 5 Operative fixation of the os acromiale using two cannulated 4.0 mm screws inserted anterior to posterior. Synthetic bone substitute (HEALOS® II bone graft substitute; DePuy Spine, Inc., Rayham, Massachusetts) was inserted into the trough and held in place by FiberWire® #5 and was secured in a figure of eight fashion.

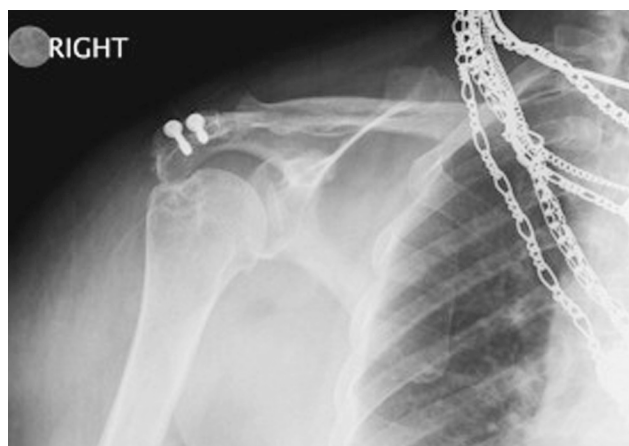


Figure 6 Anteroposterior and axillary views of the right shoulder taken 6 months postoperatively demonstrating union of the os acromiale.

subacromial decompression, distal clavicle coplaning, and an arthroscopic rotator cuff repair. The patient was followed for one year postoperatively and continued to report pain directly over the site of the os acromiale, as well as over the AC joint. She then underwent ORIF of the os acromiale augmented with HEALOS® II bone marrow impregnated hydroxyapatite bone substitute, with bone marrow taken from the humeral head. HEALOS® II bone graft substitute is a synthetic bone graft material, consisting of an osteoconductive mineralized collagen matrix that is composed primarily of type I bovine collagen and nonceramic hydroxyapatite. The material promotes bone regeneration and is remodeled into new bone as part of the healing process.

After exposure of the os acromiale, two cannulated guide wires were used to secure the fragment, and two cannulated 4.0 mm screws were inserted. FiberWire® #5 was passed through each of the screws, and a trough was created between the os acromiale fragment and the native acromion. Thereafter, the synthetic bone substitute was inserted into the

trough, and bone marrow, retrieved from the humeral head, was added to the synthetic bone substitute. The FiberWire® was used to hold down the bone graft and the bone substitute in the trough, bridging the os acromiale as well as the native acromion (Fig. 5). The rotator cuff, arthroscopically repaired at the first procedure, was fully healed.

At the six months follow-up visit, the patient was doing well, with full right shoulder range of motion, negative impingement signs, and without tenderness on palpation over the acromion and AC joint. Radiographs at this postoperative time point demonstrated union of the os acromiale (Fig. 6).

Discussion

The optimal surgical treatment for symptomatic os acromiale remains controversial. The treating orthopedic surgeon has several options, including excision of the unfused segment, arthroscopic acromioplasty, and several osteosynthesis techniques. Furthermore, there is very little literature with

large sample sizes and no randomized prospective trials to provide specific guidelines.^{1,2,6,13,15-17} This creates a dilemma for the orthopedic surgeon, who must weigh the advantages and disadvantages of the various options in order to provide the best individualized treatment for the patient.

Fragment excision has been reported to have mixed results.^{6,9} This is related to the morbidity of deltoid dysfunction. Mudge and colleagues⁹ reported excellent results in four of six patients who underwent a fragment excision and rotator cuff repair. They did, however, recommend that large fragments should be retained. Edelson and associates,¹ in a series of five cases treated with fragment excision and deltoid advancement, reported satisfactory results in 80% of their cases. Armengol and coworkers¹⁸ had five fragment excisions in their series of 42, and none of the five had satisfactory results. Similarly, two of three patients treated with fragment excision by Warner and colleagues⁶ had poor outcomes, with persistent pain and deltoid weakness. Based on these results, it appears that open excision should only be considered if there is a small pre-acromion or as salvage to a failed ORIF, in which case care must be taken to securely repair the deltoid.

An arthroscopic subacromial decompression has been proposed to have the advantages of addressing concomitant intra-articular pathology and avoiding problems of nonunion, hardware irritation, and deltoid dysfunction. Wright and associates reported on a series of 13 shoulders that presented with impingement symptoms in the presence of a meso type os acromiale.¹⁹ Following a failure of conservative treatment, these patients underwent an arthroscopic subacromial decompression. Arthroscopic acromioplasty was performed with resection of bone to remove the anterior acromial tip. Full strength of the anterior deltoid and rotator cuff muscles were achieved in 13 shoulders by 6 months. Twelve patients rated their shoulders as having satisfactory results. Some investigators have described a recurrence of pain after a period of symptom relief from the arthroscopic procedure. Hutchinson and Veenstra²⁰ described two of three patients undergoing an arthroscopic decompression who had symptoms, again, one year postoperatively, requiring reoperation.

Several investigators recommend internal fixation for an os acromiale using various techniques, including the use of tension-band wire, sutures, Herbert screws, and cannulated screws, with or without the use of bone graft. Peckett and coworkers²¹ reported a series of 26 cases treated with ORIF and bone grafting. Fixation was achieved with K-wires, lag screws and tension-band wire technique, or sutures with local bone graft. Of the 26 patients, 25 had clinical and radiographic signs of union within an average of 4 months. Eight patients required a second procedure of hardware removal, secondary to implant related discomfort.

Warner and colleagues⁶ reported a study of 12 shoulders with symptomatic os acromiale treated with ORIF. In this series, five shoulders had ORIF with a tension-band pro-

cedure and use of pins and wires; the result was osseous union in one case and nonunion in the other four, the latter secondary to loss of fixation. Seven shoulders underwent ORIF with the use of cannulated screws and a tension-band construct resulting in osseous union in six cases. Overall, among the twelve cases, seven achieved radiographic and clinical union at a mean of 9 weeks (range, 7 to 20 weeks). However, most patients in this series reported discomfort that was secondary to the prominent wires; a majority of patients, subsequently, had them removed.

Ryu and associates,¹³ in a series of four shoulders treated with ORIF and bone grafting from the greater tuberosity, demonstrated 100% radiographic union in 10 to 16 weeks.¹³ Armengol and coworkers¹⁸ reported 14 shoulders with an unfused acromial epiphysis and associated rotator cuff tear that underwent ORIF.¹⁸ Five of these cases received supplemental bone grafting and only eight cases in this series achieved satisfactory results.

Satterlee⁷ reported on six patients with impingement syndrome associated with an unstable meso-acromion who underwent ORIF. The technique used 4.5 mm cannulated Herbert screws and bone graft from the anterior acromion. The investigator found that tilting the meso-acromion up and into a flat position through a dorsal closing wedge osteotomy helped relieve the impingement without performing a subacromial decompression. The construct was further secured with a nonabsorbable suture that was passed in a figure-of-eight technique through the screws. Postoperatively, the patient wore an abduction brace. At 3 to 6 years of follow-up, all six shoulders were rated as excellent by the American Shoulder and Elbow Surgeons (ASES) rating system; all shoulders were demonstrated to have clinical and radiographic union.

Hertel and colleagues¹⁶ reported on 15 meso-acromiale treated with ORIF. Seven shoulders were approached through an anterior deltoid-off approach, potentially devascularizing the os acromiale. The remaining eight shoulders were approached transacromially, and, therefore, the deltoid origin and branches of the thoracoacromial artery were preserved. The ORIF technique of tension-band wiring (2.5 mm K-wire and 1.6 mm cerclage wire) was the same for both groups. Axial radiographs demonstrated a union in three of seven shoulders with a devascularized os acromiale and seven of eight shoulders with a vascularized os acromiale. This series illustrated the importance of preserving the branches of the thoracoacromial artery as part of the ORIF of os acromiale.

Armengol and associates¹⁸ reported the treatment results in 42 os acromiale cases, including 33 meso types. The study was comprised of three groups: resection, ORIF, and acromioplasty. The acromioplasty group consisted of both open and arthroscopically treated patients. None of the excision patients had satisfactory results. Only 52% of the ORIF patients had a satisfactory result, and 86% of the acromioplasty group had good to excellent results.¹⁸

The current case involved a patient with a symptomatic meso type os acromiale and rotator cuff tear that was treated initially conservatively but without pain relief. Our operative fixation procedure involved the use of FiberWire® #5, humeral head autograft, bone-marrow impregnated hydroxyapatite bone substitute (HEALOS® II Bone Graft Substitute), and 4.0 mm cannulated screws. In our case, we used bone marrow impregnated hydroxyapatite substitute in order to help improve upon the poor union rates reported among os acromiale patients treated with ORIF. We also feel another advantage of our technique is the fact that the nonabsorbable suture does not cause the hardware irritation that has been associated with the use of metal wire, thus, decreasing the need for reoperation. We also feel that the FiberWire® suture continues to provide adequate support for union and maintains the bone graft's position in the trough just as well as the wire. This technique, in our patient, established radiographic union without complaints of shoulder pain or hardware discomfort, as previously described in other studies.

Disclosure Statement

None of the authors have a financial or proprietary interest in the subject matter or materials discussed, including, but not limited to, employment, consultancies, stock ownership, honoraria, and paid expert testimony.

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