



Arthroscopically assisted internal fixation of the symptomatic unstable os acromiale with absorbable screws

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Background: Symptomatic meso- type os acromiale is a common pathology with inconsistent outcomes of treatment with various surgical techniques. We report the outcome of a new technique for arthroscopic fusion of symptomatic os acromiale with absorbable screws.

Materials and methods: The study included 8 shoulders in 8 patients with symptomatic meso- type os acromiale who were treated with the use of a new technique for arthroscopic fusion with absorbable screws. The mean age was 54 years (range, 38-67 years), and the mean time from onset of symptoms to surgery was 18 months (range, 9-25 months). No patients reported a specific traumatic event before the onset of symptoms, and all noted the insidious onset of pain with no precipitating event.

Results: The average length of follow-up was 22 months (range, 12-36 month). The average Constant score improved from 49 points (range, 35-57 points) to 81 points (range, 75-86 points). The average satisfaction score improved from 4.5 of 10 (range, 2-6) to 8.5 of 10 (range 7-9). All patients made a good clinical recovery at 3 to 6 months after surgery. At the last follow-up, full radiographic union was observed in 6 patients, partial union in 1 patient, and persistent radiologic nonunion in 1 patient. Anterior bulging of the absorbable screws was noted in 2 patients, and the screws were trimmed 6 months after the first procedure.

Conclusions: We have found that this new arthroscopic technique of fixation of os acromiale with absorbable screws provides promising clinical, cosmetic, and radiologic results with high patient satisfaction.

Level of evidence: Level IV, Case Series, Treatment Study.

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Keywords: Shoulder; os acromiale; arthroscopic; fusion; absorbable screws

The acromial apophysis develops from 4 main ossification centers (pre-, meso-, meta-, and basiacromion). Os acromiale represents a failure of union between 2 of these apophysis. Although the reported prevalence of os

acromiale in skeletally mature shoulders has ranged from 1.3% to 30%,^{5,12,13,16,20} it is not frequently diagnosed as a cause of pain.^{5,20,24}

The diagnosis of a symptomatic os acromiale is made by the finding of pain and local tenderness on the anterior acromion and the nonunion site,^{4,12,24} a hyper mobile fragment at the anterior acromion,¹² positive impingement signs,^{10,14,21,22,24,25} and positive local injection tests.^{10,12}

Ethics approval was not required for this study.

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In patients with symptomatic os acromiale, the pain is usually attributed to one of the following causes: local inflammation at the non union site,^{11,23,24} arthritic changes of the acromioclavicular joint due to the hypermobility of the os,⁶ and outlet impingement syndrome due to the pull of the deltoid on the unstable fragment down onto the sub-acromial space.^{21,22,24}

When nonsurgical treatment fails, surgical management is warranted. A number of surgical techniques have been described, including fragment excision,^{2,14,15} acromioplasty,^{9,10} and open reduction and internal fixation (ORIF).^{2,8,19,21,24} Although the excision of a preacromion is usually satisfactory, the outcomes of the treatment of a symptomatic mesoacromion are inconsistent. Mesoacromion is a failure of fusion between the mesoacromion and the meta-acromion. This nonunion has been reported to be the most common and most problematic to treat.^{2,5,12,16,17,21} Weakness of the deltoid, recurrent impingement, hardware complications, and failure of union have been described as causes of unsatisfactory surgical results.

The purpose of this report is to present our analysis of the outcome for the treatment of symptomatic os acromiale with a new arthroscopic technique of reduction and internal fixation by absorbable screws. To the best of our knowledge, this is the first description of an arthroscopic technique for the fixation of os acromiale.

Materials and methods

Between April 2008 and October 2009, 8 consecutive patients (7 women, 1 man) with symptomatic os acromiale were treated with arthroscopic fusion using absorbable screws by the senior author (O.L.). The clinical records, operative reports, and preoperative and follow-up radiographs were reviewed.

The inclusion criteria were (1) severe pain or loss of function, (2) meso type os acromiale, (3) unsuccessful result after at least 12 months of activity modification, nonsteroidal anti-inflammatory medication, and physical therapy, (4) pain localized to the anterosuperior acromion or the nonunion site, and (5) gross instability of the os during the arthroscopic evaluation.

The patients had a mean age of 54 years (range, 38-67 years), and the mean time from onset of symptoms to surgery was 18 months (range, 9-25 months). The right shoulder was involved in 5 patients, the left shoulder in 3, and was the dominant extremity in 6. None of the patients reported a specific traumatic event before the onset of symptoms: all noted the insidious onset of pain with no precipitating event.

The Constant score and patient satisfaction score along with anteroposterior and axillary radiographs of the shoulder were obtained in all patients preoperatively and at each follow-up appointment. Patient satisfaction was determined by use of a visual analog scale ranging from 0 to 10 points, in increasing order of satisfaction.

Surgical technique

The patient is placed in the lateral decubitus position with longitudinal traction. An arthroscope is introduced to the glenohumeral

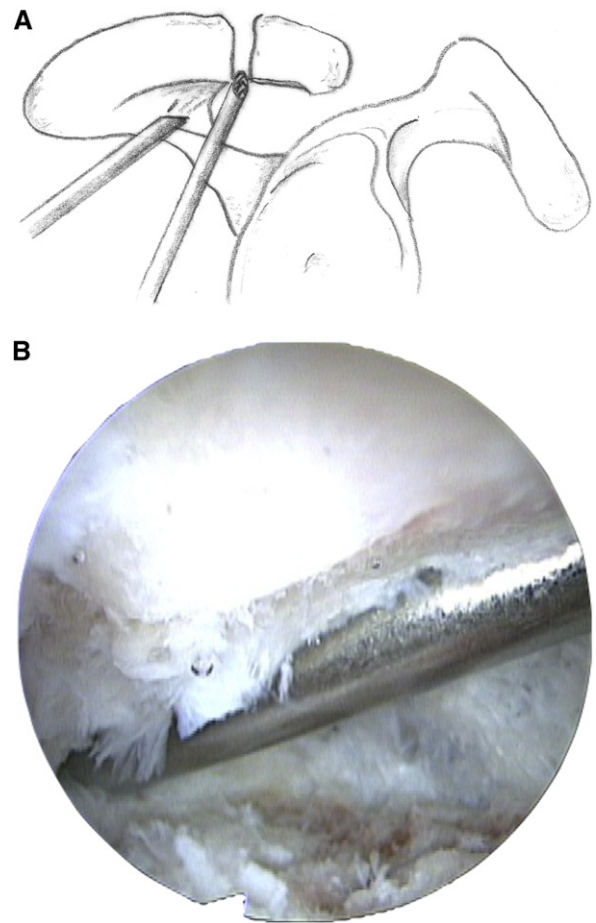


Figure 1 (A) Schematic drawing shows the fibrous tissue being shaved from the nonunion site and the creation of parallel bony surfaces between the acromion and the os fragment. (B) Arthroscopic view shows the parallel bony surfaces between the acromion and the os fragment after the fibrous tissue has been shaved.

joint through a standard posterior portal, and a thorough examination of the intra-articular structures is performed.

The arthroscope is introduced to the subacromial space through the same skin incision, and an evaluation of the bursal side of the rotator cuff, acromion, and os is performed. A shaver blade is introduced through a standard lateral portal (4- to 5-cm lateral to the lateral edge of the acromion at the line of the anterior distal clavicle) and used to expose the os acromiale by removing the inferior soft tissues. The stability of the os fragment is assessed by direct palpation with the shaver and by a digital pressure that is placed on the anterosuperior aspect of the acromion; the unstable os has clear macro motion, whereas in cases of stable nonunion, there is no obvious motion. Stable os are treated with minimal decompression of the very anterior acromion, avoiding the area of the pseudoarthrosis. These shoulders were excluded from the study.

After this, the shaver blade is used to remove the soft tissue and 1 to 2 mm of bone from each boundary of the nonunion site to create parallel surfaces between the mesoacromion and the meta-acromion (Fig. 1). Two parallel 0.062-inch guidewires are then introduced, free handed, from posterior to anterior percutaneously from the acromion into the os acromiale. The guidewires are introduced under arthroscopic control, confirming their central location in both fragments (Fig. 2).

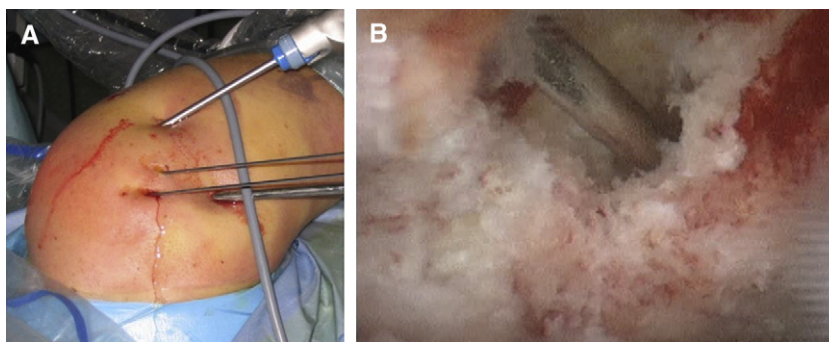


Figure 2 (A) Intraoperative image of the right shoulder shows the positioning of the 2 wires percutaneously from posterior to anterior. (B) Arthroscopic view confirms the central positioning of the wires in the acromion and os fragment.

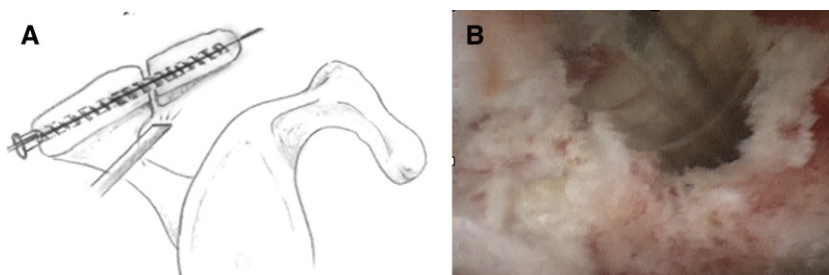


Figure 3 (A) Schematic drawing shows the absorbable screws being inserted under arthroscopic control. (B) Arthroscopic view shows the insertion of the absorbable screws under arthroscopic control.

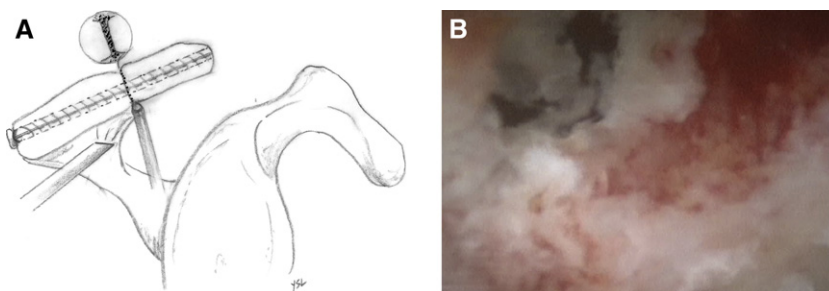


Figure 4 (A) Schematic drawing shows compression of the acromion and the os fragment. (B) Arthroscopic view shows compression of the acromion and the os fragment.

Once a satisfactory position of the guidewires is confirmed, a 3.2-mm cannulated drill is used to drill over the guidewires. The lengths of the drilled holes are measured, followed by their tapping. Two biodegradable 4.5-mm screws (Inion, Tampere, Finland) are passed over the guidewires (Fig. 3) and tightened to achieve good compression of the mesoacromion and meta-acromion fragments (Fig. 4). The Inion implants are made of biodegradable copolymers composed of L-Lactide, D-Lactide, and trimethylene carbonate that are metabolized by the body into carbon dioxide and water. Tricalcium phosphate bone substitute granules are then introduced using the empty shaver blade barrel to the area between the fragments. This last step is performed after the fluid inflow is stopped.

Results

Diagnostic arthroscopy and bursoscopy revealed positive outlet impingement signs in all of the patients. Full-

thickness rotator cuff tear was found in 3 patients and a partial tear in 2 patients, and all were treated with arthroscopic rotator cuff repair in the same procedure.

The average length of follow-up was 22 months (range, 12-36 months). The average Constant score improved from 49 points (range, 35-57 points) to 81 points (range, 75-86 points). The average satisfaction score improved from 4.5 of 10 (range, 2-6) to 8.5 of 10 (range 7-9).

All patients made good clinical recovery at 3 to 6 months after surgery. Two patients complained of persistent discomfort at the anterior aspect of the shoulder. Examination revealed a subcutaneous, bulging, screw end. The screws in both patients were trimmed with cutters through a stab skin incision, 6 months after the first procedure.

In one case during the introduction of the second screw, a crack in the undersurface of the os was observed. The

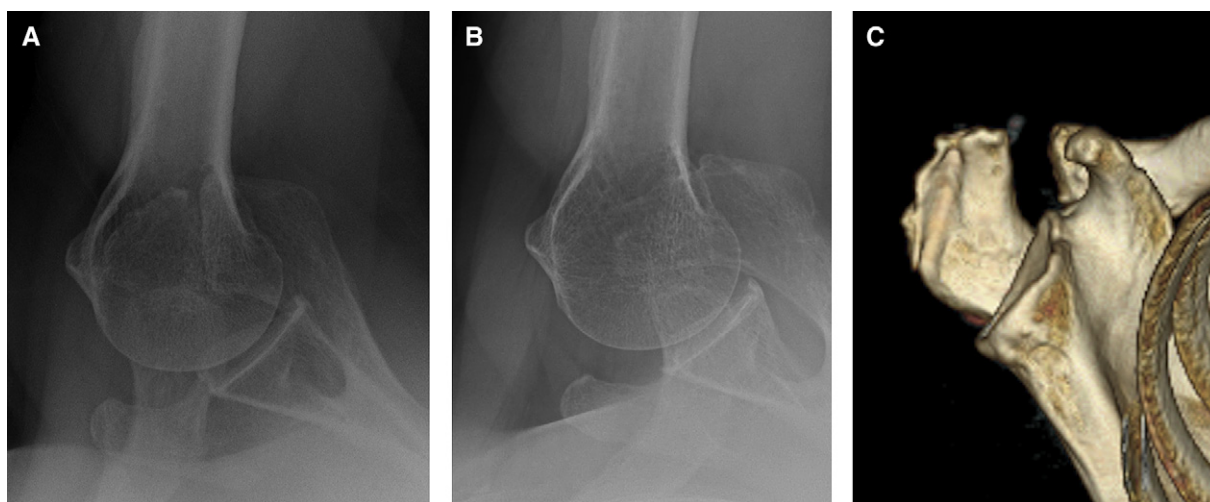


Figure 5 (A) Preoperative axillary radiograph shows meso type os acromiale. (B) Follow-up axillary radiograph shows full union of the os to the acromion. (C) Follow-up 3-dimensional reconstruction computed tomography image of the scapula in a patient with fracture of the undersurface of the acromion shows complete union of the os to the acromion.

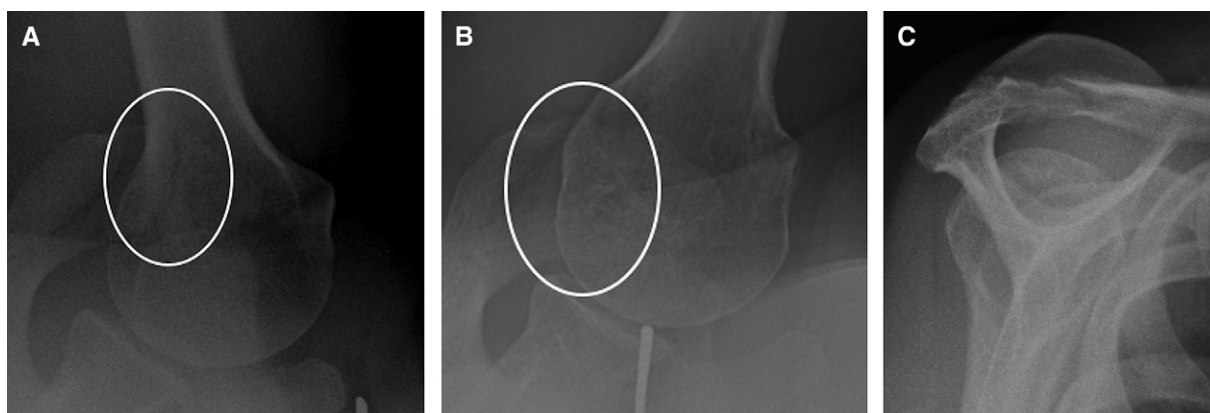


Figure 6 (A) A Preoperative axillary radiograph shows a meso type os acromiale (circled area). (B) A follow-up axillary radiograph shows full union of the os to the acromion (circled area). (C) A follow-up Y radiograph shows full union of the os to the acromion.

screw was left in place, and full radiologic union was observed 3 months after surgery. A computed tomography scan at 13 months after the initial surgery revealed complete union of the os fragment to the acromion (Fig. 5).

At the last follow-up, full radiographic union was observed in 6 patients (Fig. 6), partial union in 1 patient (Fig. 7), and persistent radiologic nonunion in 1 patient. One of the patients began complaining of pain in the acromioclavicular joint 1 year after the procedure. She was treated with arthroscopic acromioclavicular joint resection arthroplasty, which provided an opportunity to arthroscopically assess the state of the fusion. During the arthroscopic procedure, 19 months after the fixation, full union at the previous nonunion site was observed (Fig. 8).

The arthroscopic portals and stab wound for insertion of the screws have healed nicely, with good cosmetic results, in all patients (Fig. 9).

Discussion

The optimal surgical treatment for symptomatic os acromiale remains controversial. A number of surgical treatments have been described, including fragment excision, acromioplasty, and various techniques of ORIF to fuse the os.

Excision of a meso os acromiale has had mixed results. Edelson et al⁵ reported patient satisfaction in 4 of 5 patients (80%). Mudge et al¹⁴ reported excellent results in 4 of 6 patients (75%) after open excision, the results in the remaining 2 were poor. They advocated ORIF and bone grafting for larger fragments. Wright et al²⁵ reported good results in 11 of 13 patients (85%) after arthroscopic resection. In contrast, several studies have reported that if the excised fragment is too large, it may lead to deltoid dysfunction and weakness.^{3,15,21,22,24}

Armengol et al² recommended an acromioplasty as the treatment of choice of an unfused apophysis and reported

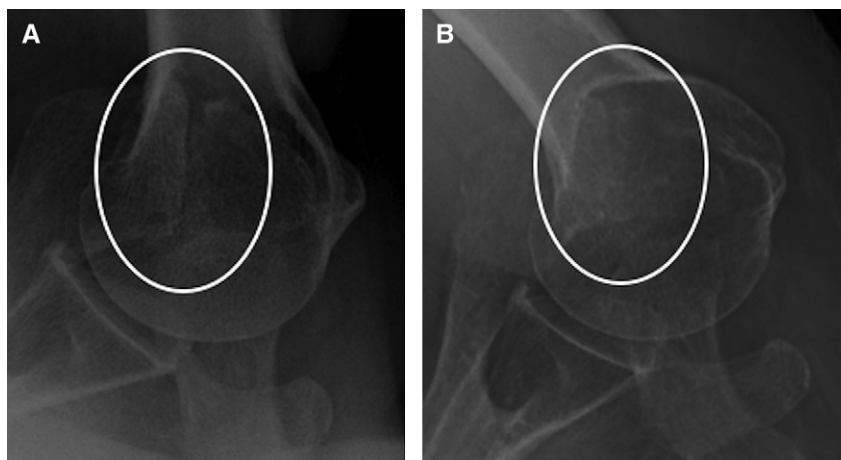


Figure 7 (A) A preoperative axillary radiograph shows a meso type os acromiale (*circled area*). (B) A follow-up axillary radiograph shows partial bony union of the os acromiale (*circled area*).

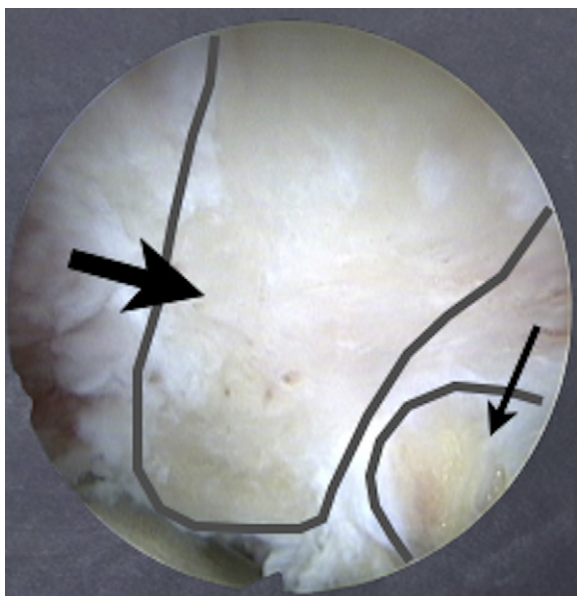


Figure 8 Arthroscopic view of the under surface of the acromion 19 months after arthroscopic fusion shows full union of the acromion (*thick arrow*) and the clavicle (*thin arrow*).



Figure 9 Cosmetic results 3 months after arthroscopic fusion of os acromiale.

good results in 19 of 22 patients (86%) treated in this manner. However, Jerosch et al¹¹ reported excellent and good results only in 7 of 12 patients (58%) after acromioplasty. Abboud et al¹ reported satisfactory results for acromioplasty only in 7 of 11 patients (64%) with stable os acromiale, and Hutchinson et al⁹ reported 3 of 3 patients with recurrent pain and impingement 1 year after acromioplasty.

Numerous techniques have been described for ORIF of a symptomatic os acromiale. Screw fixation and preservation of the blood supply to the acromion (acromial artery) resulted in higher union rates compared with Kirschner wire fixation and approaches that involve detachment of the deltoid.^{7,8,18,19,21,24} Hardware complication and necessary

hardware removal are common after ORIF, even when radiographic union has occurred.^{1,5,18,24}

This study describes a new technique for arthroscopic fixation of os acromiale with absorbable screws. This technique was developed to avoid some of the complications reported in previous techniques. The arthroscopic technique is intended to preserve the blood supply to the os acromiale, minimize deltoid muscle injury by avoiding its detachment, and improve the cosmetic results. Minimal acromial resection is done to leave a stable anchor for the pull of the deltoid. Screw fixation had a union rate better than Kirschner wire fixation. Absorbable screws are used to avoid the need for their removal.

At an average follow-up of 22 months, we have found marked improvement in the Constant score (49 to 81 points), in patient satisfaction (4.5 to 8.5 of 10), and good cosmetic results in all patients (100%). Radiologic assessment showed 6 of 8 patients had full union of the os, 1 had partial bony

union, and 1 had radiologic nonunion. A CT scan at 13 months after the surgery in 1 patient and arthroscopic inspection 19 months after fixation in another patient during acromioclavicular joint excision revealed a complete union of the os to the acromion (Fig. 5c and Fig. 8). Two patients complained of discomfort at the anterior aspect of the shoulder, due to a prominent screw end, and they had a second procedure to trim the screw. To avoid this complication, we strongly recommend meticulous preoperative planning by estimating the correct length of the screws and use of a 3.5-mm screws in patients with a small os acromiale.

Conclusion

We have found that this new arthroscopic technique of fixation of os acromiale with absorbable screws provides promising clinical, cosmetic, and radiologic results with high patient satisfaction.

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Supplementary data

Supplementary data related to this article can be found online at doi:10.1016/j.jse.2011.12.011.

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