

# The MRI Geyser Sign: Acromioclavicular Joint Cysts in the Setting of a Chronic Rotator Cuff Tear

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## Abstract

We present the case of a 71-year-old man with a large acromioclavicular (AC) joint cyst successfully managed with surgical excision. AC joint cysts are soft tissue masses generally signifying underlying rotator cuff pathology. Traditionally, these cysts were identified with shoulder arthrography as a “geyser” of fluid escaping through the AC joint. Magnetic resonance imaging (MRI) is today’s preferred imaging modality; we describe the MRI equivalent of the “geyser sign,” signifying synovial fluid escaping through the cuff defect, across the sub-acromial bursa, and decompressing superiorly through a degenerated AC joint. Surgical management is preferred for symptomatic cysts. Based on a review of limited retrospective case series, recommendations for management of these lesions are as follows. Repair of the rotator cuff is preferable whenever possible. In the case of an irreparable defect, good results can be achieved through excisional AC joint arthroplasty and resection of the cyst base. Aspiration of these cysts should not be attempted, due to the high recurrence rate and potential for a draining sinus. Hemiarthroplasty also may be effective in indirectly decompressing these cysts; but given the invasive nature of this procedure, it should be reserved for patients who are also symptomatic from cuff arthropathy.

The “geyser radiographic sign” was originally described by Craig in 1984 as leakage of dye from the glenohumeral joint into the subdeltoid bursa during a shoulder arthrogram.<sup>1</sup> Its significance was to document a tear in the articular capsule of the acromioclavicular (AC) joint in the set-

ting of a chronic full-thickness tear of the rotator cuff, which gave the appearance of a geyser arising from the subacromial bursa as dye tracked through the AC joint to project superiorly from the shoulder.<sup>1</sup>

As magnetic resonance imaging (MRI) has become the mainstay of orthopedic imaging for the shoulder, classic radiographic signs that were once used to document injury during arthrography have been translated into analogous findings on MRI. The purposes of this case report are threefold: (1) to reintroduce this radiographic finding into the orthopedic literature in the context of modern-day musculoskeletal imaging with MRI, (2) to remind the reader of this unusual clinical presentation through another case presentation, and (3) to comprehensively review the literature regarding management of this condition. Informed consent was obtained from the patient for print and electronic publication of this report, along with the accompanying images.

## CASE PRESENTATION

A 71-year-old, right-hand dominant man presented to the office of the senior author (G.S.D.) reporting a slowly enlarging mass on the superior aspect of his left shoulder, which had increased in size over the preceding several years. The patient noted a tight feeling associated with the mass and was bothered by its appearance. He reported no significant activity-related shoulder pain. His medical history was unremarkable, with no prior surgery on the affected shoulder. The patient reported no history of weight loss, fevers, or other constitutional symptoms.



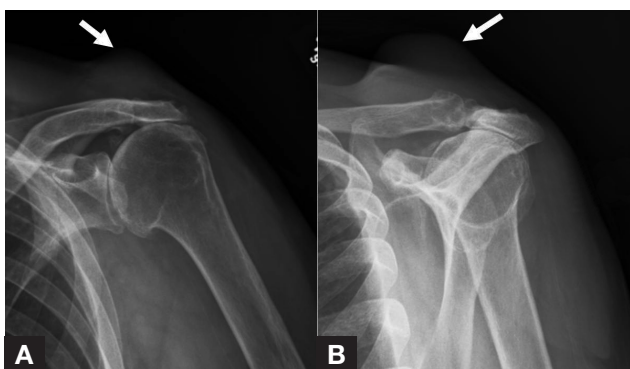
Figure 1. Soft tissue mass present on the left shoulder.

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**Figure 2.** Anteroposterior (A) and scapular-Y (B) radiographs of the left shoulder, demonstrating rotator cuff arthropathy and soft tissue swelling superior to the hypertrophic AC joint (arrow).

Physical examination was significant for a 3 cm x 4 cm x 3 cm mass on the superior aspect of his shoulder, located adjacent to the AC joint (Figure 1). The mass, which was somewhat mobile, demonstrated a firm, spongy consistency and was nontender to touch. There were no skin changes present over the mass, and it did not demonstrate any evidence of neovascularization. Visual inspection of the shoulder girdle also demonstrated marked wasting of the supraspinatus and infraspinatus fossae. Active range of motion (ROM) was 160° of forward flexion, 45° of external rotation with the arm at the side, and internal rotation to the sixth thoracic vertebrae. Rotator cuff assessment demonstrated 3+/5 strength in the supraspinatus and infraspinatus, and 5/5 strength in the subscapularis.

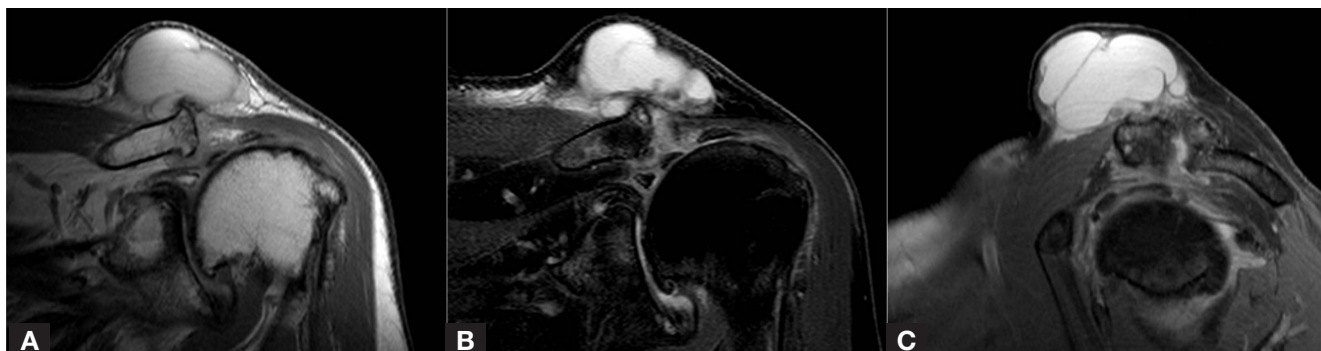
Radiographs taken in the office demonstrated a high-riding humeral head with obliteration of the acromiohumeral interval, as well as glenohumeral joint space narrowing with osteophyte formation, consistent with chronic rotator cuff arthropathy (Figure 2). In addition, soft tissue swelling adjacent to the hypertrophic AC joint was appreciated. To confirm suspicion of a degenerative AC joint cyst in the setting of a chronic rotator cuff tear, an MRI was ordered. The MRI (Figure 3), performed with and without contrast, demonstrated full-thickness tears of the supraspinatus and infraspinatus tendons, with retraction of both tendons to the level of the glenoid.

Both muscles had associated fatty atrophy. Furthermore, there was attenuation of the subscapularis tendon with a partial tear of the superior fibers. A small glenohumeral effusion was visualized in communication with the subacromial bursa. Hypertrophic and cystic changes were present at the AC joint; extending superiorly from the joint was a septated and lobular cystic mass measuring 3.8 cm x 4.1 cm x 2.6 cm. Post-contrast imaging demonstrated peripheral enhancement but no nodular or thickened septal enhancement. These findings were consistent with a massive rotator cuff tear with resultant cuff tear arthropathy, with an associated severe AC arthropathy and large AC joint cyst extending superiorly and representing the MRI equivalent of a geyser sign.

Given the cosmetic appearance and deformity secondary to the enlarging mass, the patient elected for open surgical excision of the AC joint cyst, along with open resection of the AC joint. He understood that removal of this cyst would not address the underlying rotator cuff pathology or degenerative nature of the glenohumeral joint, which were likely the larger source of his chronic pain.

At surgery, a vertical incision was made over the prominence of the mass. Careful dissection was performed around the entirety of the mass, revealing a stalk at its base. The stalk was transected and the mass was removed and sent for pathologic analysis. It was multiloculated and filled with gelatinous contents with an appearance consistent with a ganglion. An open AC joint resection arthroplasty was performed, removing the lateral border of the clavicle. The stalk of the mass was oversewn with a heavy absorbable suture. A complex wound closure was performed in layers with a combination of braided and monofilament absorbable suture.

The surgical specimen (Figure 4) was sent for histopathologic analysis. It consisted of a tan-pink, roughly circular cyst, along with tan-yellow mucoid lobulated material, measuring 4.0 cm x 3.5 cm x 2.0 cm. Upon opening the specimen, the cavity was multilocular and filled with tan-yellow translucent gelatinous material. The inner lining of the cyst was tan-pink and smooth without any projections; the cyst wall varied in thickness from 0.3 cm to 1.0 cm. On serial sectioning and microscopic analysis, a diagnosis of a



**Figure 3.** Coronal proton density (A), coronal fat-suppressed T2 (B), and sagittal proton density (C) magnetic resonance images (MRIs), demonstrating the MRI equivalent of a "geyser" sign.



**Figure 4.** Surgical specimen confirming diagnosis of a ganglion cyst.

ganglion cyst was confirmed, with fibrin, granulation tissue, and myxoid degeneration.

At latest follow-up of 8 months post-mass excision, the patient was doing well without any evidence of recurrence. The surgical wound healed without event. His ROM was unchanged by the operation, and he was able to perform daily activities without limitation.

### DISCUSSION

Although large AC joint cysts can be seen in the absence of rotator cuff pathology, they typically represent an unusual presentation of full-thickness rotator cuff tears in patients with a degenerative AC joint.<sup>1-9</sup> These cysts typically are obvious on physical examination; when seen clinically, an underlying full-thickness rotator cuff tear must be strongly considered if it is not already obvious to the examiner.

Shoulder arthrography was once the test of choice to make a radiographic diagnosis of tears of the rotator cuff.<sup>10</sup> Using aseptic technique, a needle is placed into the glenohumeral joint, contrast is injected, and the internal architecture of the shoulder can be evaluated with magnified fluoroscopy.<sup>11</sup> With this test, Craig<sup>1</sup> described a geysers sign as dye leaked from the glenohumeral joint into the subacromial bursa and decompressed superiorly through the AC joint. In recent years, as MRI has

become an effective and accessible technology in nearly every practice setting in the United States, rotator cuff tears and other shoulder pathology are being diagnosed noninvasively in this manner. It is within this context that Craig's description of an arthrographic geysers sign has come to represent what is now more commonly recognized as an MRI geysers sign of synovial fluid extravasation (which is bright on T2 or proton-density weighted sequences) across the subacromial space and through the AC joint, giving the appearance of a geysers, as demonstrated in Figure 3. Although contrast-enhanced images were obtained in this case, noncontrast MRI may be sufficient to make the diagnosis because the cyst fluid acts as a contrast medium.<sup>5,9</sup>

The pathogenesis of this type of cyst formation has been well-described in the literature. AC joint cysts are uniloculated or multiloculated fluid-filled masses that are thought to form when synovial fluid produced in the glenohumeral joint escapes through the full-thickness rotator cuff tear into the subacromial bursa, then decompresses across a degenerated AC joint. With time, this fluid pressure eventually causes distension of the superior capsule of the AC joint, leading to the formation of a cystic mass, as was seen in this case.<sup>1-3</sup> In order for the fluid to escape superiorly through the AC joint, a defect must be present in the inferior articular portion of the AC joint capsule. This defect is thought to occur either from a gradually enlarging osteophyte at the degenerative AC joint,<sup>1</sup> secondary to chronic friction and mechanical wear from a high-riding humeral head,<sup>8</sup> or a combination of both. A postoperative geysers sign also has been described as a common finding secondary to iatrogenic injury of the acromial undersurface during subacromial decompression.<sup>12</sup>

Although this characteristic lesion was originally described in 1984,<sup>1</sup> studies on this entity to date consist of individual case reports, and there has yet to be a comprehensive review of the management of these lesions published in the orthopedic literature. Our review of the English literature found 28 cases in 12 published reports (Table).

**Table. Other Case Reports Describing Acromioclavicular Joint Cysts**

Study	No. of Patients Described	Treatment	Recurrence
Craig, 1986 <sup>2</sup>	2	Surgical excision	Mixed
Postarcchini, 1993 <sup>13</sup>	3	Conservative treatment (1 patient) Surgical excision (1 patient) Surgical excision + RC repair (1 patient)	Mixed
Groh, 1993 <sup>3</sup>	4	Hemiarthroplasty	No
Utrilla, 1995 <sup>16</sup>	1	Surgical excision + allograft RC augmentation	No
Le Heuc, 1996 <sup>15</sup>	3	Surgical excision	No
Marino, 1998 <sup>4</sup>	1	Surgical excision + RC repair	No
Cvitanic, 1999 <sup>14</sup>	1	Aspiration	Yes
Tshering Vogel, 2005 <sup>9</sup>	9	Aspiration (2 patients) Surgical excision (7 patients)	Incomplete follow-up
Mullett, 2007 <sup>5</sup>	1	Arthroscopic excision	No
Nowak, 2009 <sup>7</sup>	1	Surgical excision + RC repair	No
Murena, 2009 <sup>6</sup>	1	Surgical excision	No

Treatment options that have been discussed in the literature include conservative management (observation), needle aspiration, surgical excision with or without rotator cuff repair, and glenohumeral joint hemiarthroplasty. Observation may be appropriate in cases in which the mass is asymptomatic and the patient is not bothered by pain or appearance of the mass.<sup>13</sup> Generally, repeated aspirations of these masses is not advised, as they often recur,<sup>14,3,7</sup> and repeated attempts at aspiration may lead to formation of a draining fistula that then mandates surgical attention.<sup>6</sup>

Keeping in mind the potential for publication bias when reviewing the literature, surgical excision generally has produced good results with respect to cyst recurrence. Although there have been isolated reports of recurrence of the AC joint cyst after surgical excision,<sup>2,3</sup> most have documented good results.<sup>6,15</sup> This heterogeneous picture may relate to several factors, including the quality and extent of surgical excision of the mass, the degree of resection of the AC joint or lateral border of the clavicle,<sup>13</sup> the type of surgical closure performed, as well as patient-related factors that may be independent of the quality of surgery performed. Several authors have recommended that when the rotator cuff defect is irreparable, an excisional AC joint arthroplasty should be performed with adequate resection of the base of the cyst, which removes the one-way “pinch-valve effect” and prevents future recurrence.<sup>5,13</sup> The base of the stalk also should be cauterized to further decrease the chance of recurrence. The case reports in which this is explicitly described have uniformly demonstrated good results with respect to cyst recurrence. Although arthroscopic management was reported successful in one case report,<sup>5</sup> concerns regarding surgical management of the excess skin and soft tissues associated with the enlarging cyst may direct the surgeon to favor an open approach as described by Nowak and colleagues.<sup>7</sup>

Rotator cuff repair is generally advisable whenever possible,<sup>7,13</sup> as achieving a watertight closure of the glenohumeral joint potentially would stop the egress of synovial fluid across the subacromial bursa and into the AC joint. In chronic, retracted tears or in the setting of cuff arthropathy, however, this may not be possible often—as seen in this case presentation. In these cases, allograft augmentation of the rotator cuff may help prevent cyst recurrence even if it doesn’t substantially improve function,<sup>16</sup> although there is very limited experience with this technique published in the literature. Finally, humeral head replacement, or hemiarthroplasty, may have a role in management of these cysts, and is certainly a well-accepted surgical treatment for cuff tear arthropathy, which may be of a greater clinical concern in some of these patients.<sup>3</sup> Interestingly, in this case series by Groh and colleagues,<sup>3</sup> no treatment was directed at the AC joint or at the cyst itself, yet in each case the cyst resolved spontaneously,

suggesting that treatment aimed at the underlying pathology is sufficient even without a direct surgical decompression of the AC joint or cystic mass.

Two final points are worthy of emphasis. First, although AC joint cysts generally occur in the setting of a chronic full-thickness rotator cuff tear, they have been described to occur in isolation in patients with an intact cuff; and this likely represents a different pathomechanical model, as discussed by Kontakis and colleagues.<sup>17</sup> Second, an important reminder is that the treating physician always must be concerned of neoplasm.<sup>18</sup> Frequently, the patient with a large AC joint cyst already may have been evaluated for a neoplastic process before presenting to an orthopedic surgeon;<sup>5,9</sup> however, the orthopedist may be the first physician to evaluate these patients. In these cases, the MRI geysier sign is highly suggestive of a benign process, which suggests underlying rotator cuff pathology.

### AUTHORS’ DISCLOSURE STATEMENT

The authors report no actual or potential conflict of interest in relation to this article.

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*This paper will be judged for the Resident Writer’s Award.*

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