

## REVIEW

# Acromioclavicular Joint Cyst Formation

ANDREW D. HILLER,<sup>1</sup> JOSHUA D. MILLER,<sup>2</sup> AND JOHN L. ZELLER<sup>3\*</sup>

<sup>1</sup>*Division of Anatomical Sciences, University of Michigan Medical Center,  
Ann Arbor, Michigan*

<sup>2</sup>*Department of Orthopaedic Surgery, University of Michigan Medical Center, VA Medical Center,  
Ann Arbor, Michigan*

<sup>3</sup>*Division of Anatomical Sciences, Department of Medical Education, University of Michigan Medical Center,  
Ann Arbor, Michigan*

Acromioclavicular joint (ACJ) cysts are an uncommon and unusual sequela associated with shoulder pathophysiology. The majority of literature on ACJ cysts consists of individual case reports with no definitive literature review currently available. In addition to a comprehensive literature review, four clinical cases are presented in this report. First described by Craig (1984), a total of 41 cases have been previously reported in the literature. Of these cases, five occurred with the rotator cuff musculature intact. The remaining 36 cases of ACJ cysts occurred in patients with a complete tear/avulsion of the rotator cuff. Previous attempts at compiling a complete record of all reported cases have combined several distinct conditions into a single category. This article presents two distinct etiologies for the pathogenesis of ACJ cyst formation. In the presence of an intact rotator cuff, a Type 1 cyst can form superficially and be limited to the ACJ. Following a massive or traumatic tear of the rotator cuff, mechanical instability of the humeral head can cause a deterioration of the inferior acromioclavicular capsule (cuff tear arthropathy) and an overproduction of synovial fluid. Overtime, a “geyser” of fluid can form between the glenohumeral and the ACJ, forming a Type 2 cyst. This differentiation and categorization is essential for appropriate classification and treatment. Clin. Anat. 23:145–152, 2010. © 2010 Wiley-Liss, Inc.

**Key words:** ACJ cyst; geyser sign; rotator cuff tear; cuff tear arthropathy

## INTRODUCTION

Acromioclavicular joint (ACJ) cysts can develop in either the subcutaneous tissue superficial and limited to the ACJ or result from ongoing degenerative changes related to the glenohumeral (GH) joint. First described by Craig (1984), in addition to the four clinical cases presented in this report, 41 cases (Fig. 1) have been previously reported in the literature (Burns and Zvirbulis, 1984; Craig, 1986; Rockwood and Burkhead, 1988; Rowe, 1988; Nardini, 1991; Groh et al., 1993; Postacchini et al., 1993; Lizaur Utrilla et al., 1995; Le Huec et al., 1996; Segmüller et al., 1997; Marino et al., 1998; Selvi et al., 1998; Cvitanic et al., 1999; Montet et al., 2004; Tshering et al., 2005; Moratalla and Gabarda, 2007; Kontakis et al., 2007; Mullett et al., 2007; Nowak et al., 2009). Initially, two cases of soft-tissue masses overlying the ACJ were excluded from classification. These cases were re-classified as Gout/DISH (Echols

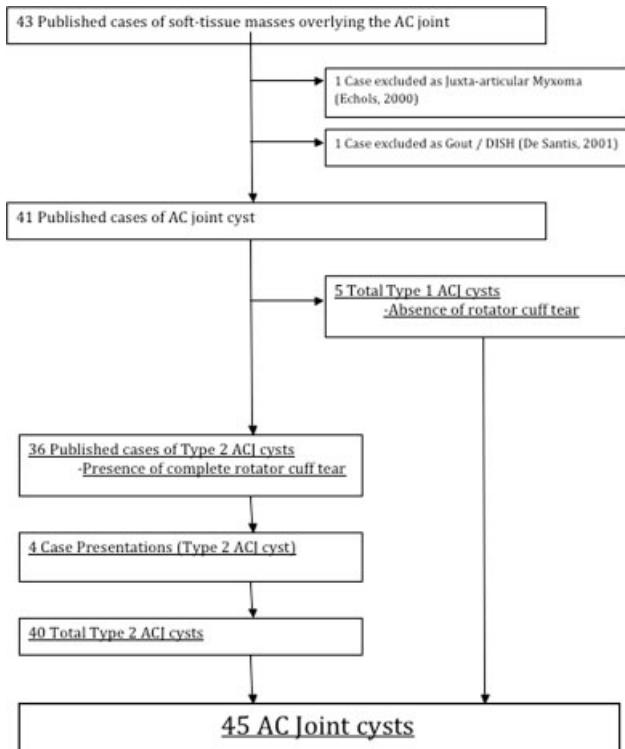
et al., 2000) and juxta-articular myxoma (DeSantis et al., 2001) (Fig. 1).

The exact etiology of the ACJ cyst has been a source of controversy. Accordingly, the research objective of this author is to define the degenerative stages giving rise to cyst development, to identify the varied anatomic etiologic factors and to provide treatment options based upon the underlying pathology. It is the position of this author that two distinct etiologies exist for the formation of an ACJ cyst (Fig. 2). The Type 1 cyst is isolated and limited to

\*Correspondence to: John L. Zeller, Division of Anatomical Sciences, 3767 Medical Science II Building, 1135 E. Catherine St., Ann Arbor, Michigan, USA. E-mail: jlzeller@med.umich.edu

Received 25 August 2009; Revised 7 November 2009; Accepted 9 November 2009

Published online 12 January 2010 in Wiley InterScience (www.interscience.wiley.com). DOI 10.1002/ca.20918



**Fig. 1.** Summary of article selection process.

the ACJ. The Type 2 cyst is dependant on the complete tear/rupture of the rotator cuff musculature—principally the avulsion of the supraspinatus tendon/muscle. Overtime, a complete avulsion of the supraspinatus muscle allows for the superior migration of the humeral head leading to irritation and deterioration of the inferior acromioclavicular (AC) capsule. This can be confirmed on various imaging modalities, specifically X-ray, CT, and MRI. This condition is commonly referred to as cuff tear arthropathy (CTA) (Neer et al., 1983). The disruption of the congruity of the GH joint results in an increase in synovial fluid production and, subsequently, permits a direct column of fluid to flow from the GH joint into the ACJ, referred to by Craig as a “geyser sign” (Craig, 1984). Diagnosis of the underlying pathology (i.e., massive rotator cuff tear) is essential for effective treatment of the ACJ cyst.

Several other possible etiologies exist for noncystic soft-tissue masses of the shoulder including ganglia, tumor, degenerative joint disease, rheumatoid arthritis, infection, juxta-articular myxoma, gout, ochronosis, diffuse idiopathic skeletal hyperostosis, synovial chondromatosis, avascular necrosis, and neuroarthropathy.

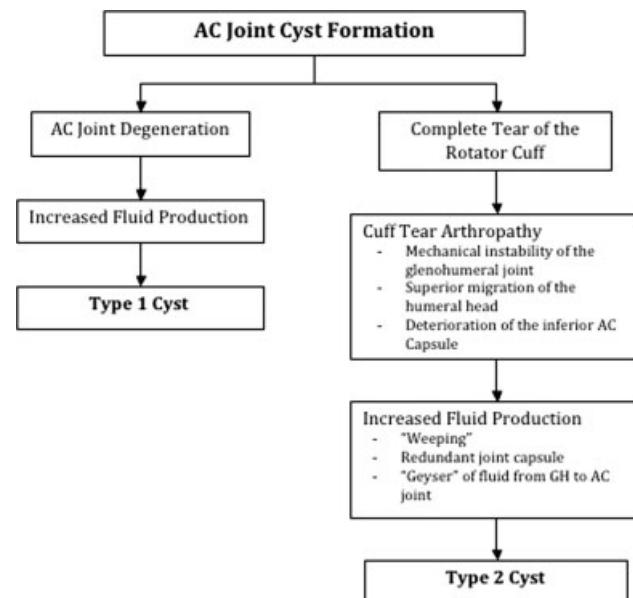
## METHODS

Several aspects pertaining to the exact etiology and pathogenesis of ACJ cysts are still disputed in the scientific literature. The majority of the literature

concerning ACJ cysts consists of individual case studies with no definitive literature review. In this study, we have performed a comprehensive review, exclusive to English language journals, of the literature regarding cyst pathogenesis. Previous attempts at compiling a complete record of all reported cases have combined several distinct conditions into a single category. It is the position of this author that several possible etiologies exist for cystic soft-tissue masses overlying the ACJ, and they must be differentiated for appropriate classification. In addition to the literature review, we present four case studies that further illustrate the proposed classification. Finally, this article presents treatment options that address the underlying pathology specific to each type of ACJ cyst.

## RESULTS

The current review of the literature in this article presents a total of 45 cases of ACJ cysts (41 previously published reports plus four new case presentations) (Tables 1 and 2). Of the previously reported cases, five presented in the absence of a complete rotator cuff tear (Burns and Zvirbulis, 1984; Nardini, 1991; Segmuller et al., 1997; Kontakis et al., 2007). For the Type 1 cyst (occurring in the absence of a rotator cuff tear), the average age was 64.3 ( $\pm 2.3$ ) year, and cysts occurred in males 67% (2/3 cases) of the time. Three of these cases had confirmation of an intact rotator cuff by MRI, ultrasound, or arthroscopy (Burns and Zvirbulis, 1984; Segmuller et al.,



**Fig. 2.** Anatomic pathophysiology of ACJ cyst formation. ACJ degeneration has been documented in acute, chronic, and acute-on-chronic conditions. Complete rotator cuff tear can be identified in an acute stage, whereas CTA has been relegated to a chronic stage of joint degeneration and rotator cuff pathology.

**TABLE 1. Summary of Reported Type 2 AC Joint Cyst Cases**

Study (first author)	Test	# of cases	Age	Rotator cuff tear	"Geyser sign"	Gender	RH/LH cyst	RH/LH dominant	Cyst on dominant side	History
Craig, 1986	AG	2	86	Y	Y	M	LH	RH	N	AC/GH DJD
	AG		67	Y	Y	M	RH	RH	Y	AC DJD
Rowe, 1988		2		Y	N					
				Y	N					
Nardini, 1991		4		Y	N					
				Y	N					
Groh et al., 1993	AG	4	65	Y	N	F			Y	GH RA
	AG		67	Y	Y	M			Y	GH DJD
	AG		71	Y	N	M			Y	GH DJD
	AG		60	Y	N	M			N	GH DJD
Postacchini et al., 1993	AG	3	73	Y	Y	F	RH	RH	Y	
	Echo		75	Y	N	M	RH	RH	Y	
	AG		76	Y	N	F	RH	RH	Y	
Lizaur Utrilla et al., 1995	MRI	1	58	Y	Y	M	RH	RH	Y	Trauma
Le Huec et al., 1996	MRI	3	72	Y	N	M				
	MRI		68	Y	N	M				
	MRI		61	Y	N	F				
Marino et al., 1998	MRI	1	66	Y	N	M	RH	RH	Y	NIDDM
Selvi et al., 1998	US	2	62	Y	N	F	RH	RH	Y	AC/GH RA
	MRI		53	Y	N	M	RH	RH	Y	AC/GH RA
Cvitanic et al., 1999	MRI	1	69	Y	Y	M	RH	RH	Y	Trauma
Montet et al., 2004	US	1	80	Y	N	F	RH	RH	Y	chronic pain
Tshering	MRI	9	57	Y	Y	M				GH DJD
Vogel et al., 2005	MRI		60	Y	N	M				GH DJD
	MRI		68	Y	N	F				
	MRI		64	Y	Y	F				
	MRI		71	Y	N	M				GH DJD
	MRI		68	Y	N	M				GH DJD
	AG		68	Y	Y	M				GH DJD, CPPD
	AG		68	Y	N	M				GH DJD, CPPD
	AG		86	Y	N	M				
Moratalla and Gabarda, 2007	US	1	66	Y	N	F	RH			AC DJD
Mullett et al., 2007	MRI	1	75	Y	N	M	RH			
Nowak et al., 2009	MRI	1	77	Y	Y	F	RH			AC/GH DJD
Hiller et al., 2009	MRI	4	73	Y	N	M	LH	RH	N	AC DJD
	MRI		90	Y	Y	M	RH			
	MRI		76	Y	N	M	LH	LH	Y	AC DJD
	MRI		76	Y	N	M	RH	RH	Y	AC DJD
Total cases in presence of rotator cuff tear = 40										

Test refers to diagnostic imaging, AC, acromioclavicular; AG, arthrogram; CPPO, calcium pyrophosphate dehydrate deposition diseases; DJD, degenerative joint diseases; GH, glenohumeral; RA, rheumatoid arthritis; MRI, magnetic resonance imaging; NIDDM, noninsulin-dependant diabetes mellitus; US, ultrasound.

1997; Kontakis et al., 2007). The remaining two cases established continuity of the rotator cuff by X-ray and physical exam (no pain on full range of motion). Surgical excision confirmed the original

diagnosis (Nardini, 1991). One case of Type 1 cyst occurred with a concomitant history of noninsulin-dependant diabetes mellitus (NIDDM) (Segmüller et al., 1997). Thirty-six previously reported cases

**TABLE 2. Summary of Reported Type 1 AC Joint Cyst Cases**

Author	# of Cases	Age	Rotator cuff tear	"Geyser sign"	Gender	RH/LH cyst	RH/LH dominant	Cyst dominant side	History
Burns and Zvirbulis, 1984	1	63	N	N	F				
Nardini, 1991	2		N	N					
			N	N					
Segmüller et al., 1997	1	63	N	N	M	LH			NIDDM
Kontakis et al., 2007	1	67	N	N	M	RH			
Total cases in absence of rotator cuff tear = 5									

NIDDM, noninsulin-dependant diabetes mellitus.



**Fig. 3.** AP X-ray of left shoulder joint demonstrating uncalcified mass and significant impingement.

occurred in individuals with complete tears of the rotator cuff (Craig, 1986; Rowe, 1988; Nardini, 1991; Groh et al., 1993; Postacchini et al., 1993; Lizaur Utrilla et al., 1995; Le Huec, 1996; Marino et al., 1998; Selvi et al., 1998; Cvitanic et al., 1999; Montet et al., 2004; Tshering Vogel et al., 2005; Moratella and Gabarda, 2007; Mullett et al., 2007; Nowak et al., 2009). For the Type 2 cyst (occurring in the presence of a complete rotator cuff tear), the average age was 68.5 ( $\pm 7.8$ ) year. Type 2 cysts occurred in males 67% (20/30 cases) of the time and occurred on the dominant-handed side 81% (13/16 cases) of the time. Concomitant medical histories for patients with a Type 2 cyst included nine cases with degenerative joint disease (DJD) of the GH joint, two cases with DJD of the AC and GH joints, two cases with DJD of the ACJ, two cases with rheumatoid arthritis (RA) of the AC and GH joint, one case with RA of the GH joint, two cases with prior trauma, two cases with CPPD deposition disease, one case with chronic pain, and one case with NIDDM.

As a complement to the literature review, we report four additional case studies. The first, W.W., is a right-hand dominant (RHD) 73 year-old-male with a 7 month history of a painless  $10 \times 6$  cm mass over the left ACJ. Patient had a history of AC, DJD, and CTA but no pain or shoulder dysfunction (Fig. 3). Treatment included aspiration of the cyst.

The second case, R.P., is a 90 year-old-male with a large right ACJ cyst preceded by a full-thickness rotator cuff tear (Figs. 4 and 5). MRI demonstrates a large cystic lesion overlying the ACJ with a well-formed "stalk" communicating between the GH and ACJs (Fig. 6). The MRI likewise demonstrates a cranial displacement of the humeral head because of a complete avulsion of the right rotator cuff musculature, enlargement of the shoulder joint capsule, and a pathological increase in the volume of intra-

articular joint fluid. Upon histological sectioning, the cyst was found to communicate with the subacromial bursa and displayed the standard pathology of a fluid filled cavity with a simple synovial lining. Treatment included ACJ resection, subacromial bursectomy, resection of the rotator cuff, and reformation of the shoulder joint capsule.

The third case, H.L., is a left-hand dominant 76 year-old-male with a 1 year history of a painful  $8 \times 7$  cm mass over the left ACJ. Patient had a failed left rotator cuff repair 10 year previously and a history of left AC DJD and CTA. Multiple cyst aspirations and steroid injections into the subacromial space failed to resolve the cyst. Treatment included cyst excision, distal clavicle excision (DCE), and arthroscopic debridement.

The fourth case, C.W., is a RHD 76 year-old-male with chronic ACJ pain and a cyst overlying the right ACJ. Patient had a history of right rotator cuff repair 25 years previously, right AC DJD and CTA. Treatment included cyst excision, DCE, and hemiarthroplasty.

## DISCUSSION

Two distinct etiologies exist for a cyst overlying the ACJ (Fig. 2). In the presence of an intact rotator cuff, an ACJ cyst can form superficially and be limited only to the ACJ. This type of cyst, Type 1, has no fluid communication with the GH joint. The pathogenesis of the Type 1 ACJ cyst is dependant on degenerative changes of the ACJ due to trauma (including dislocation), infection, metabolic disease, or repetitive overuse (Nardini, 1991; Kontakis et al., 2007). Overtime, degenerative changes of the ACJ can cause irritation of the synovium leading to an overproduction of fluid resulting in cyst formation superficial to the joint.

Alternatively, following a massive tear of the rotator cuff, another distinct condition can occur. A massive rotator cuff tear can lead to CTA, a disease with clearly discernible morphologic characteristics including increased production of intra-articular synovial fluid and the upward displacement of the humeral head, which in time can erode the ACJ and permit a geyser of fluid to flow from the GH joint into the ACJ. This type of cyst, Type 2, is dependant on a complete rotator cuff tear accompanied by subsequent degenerative changes of both the GH and ACJs.

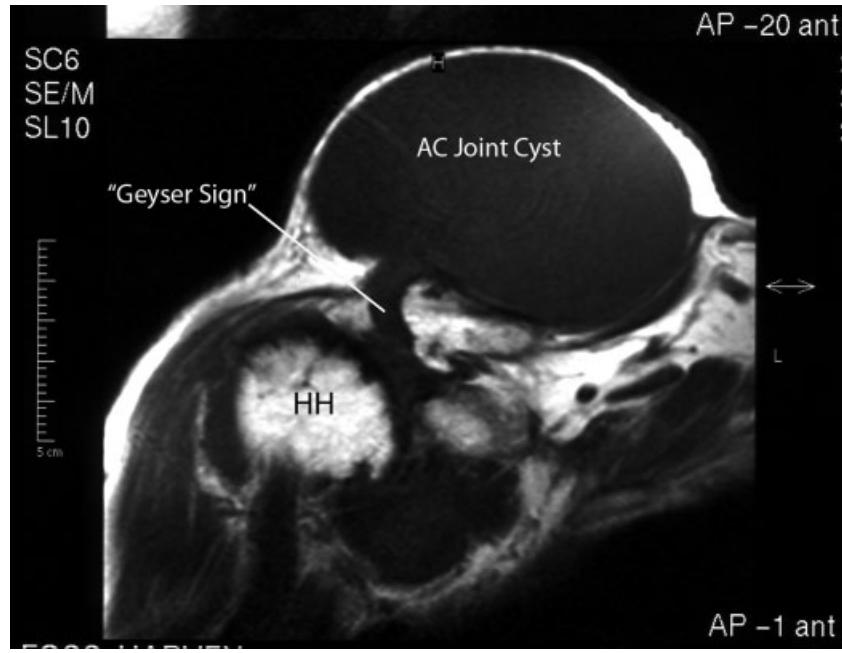
By differentiating ACJ cysts into distinct categories, treatment options can be directed at the appropriate underlying pathology (Figs. 7 and 8). Treatment for the Type 1 ACJ cyst can include resection of the distal clavicle and subacromial bursectomy (Kontakis et al., 2007). Treatment for the Type 2 ACJ cyst remains a topic of controversy. Treatment options for the underlying CTA include resection of the distal clavicle, arthroscopic irrigation and debridement, ACJ arthrodesis, total shoulder arthroplasty, hemiarthroplasty, and reverse total shoulder arthroplasty (Feeley et al., 2009). Although the underlying rotator cuff pathology must be addressed, repair is not always possible due to the extent of the cuff tear. Concomitant conditions and functional



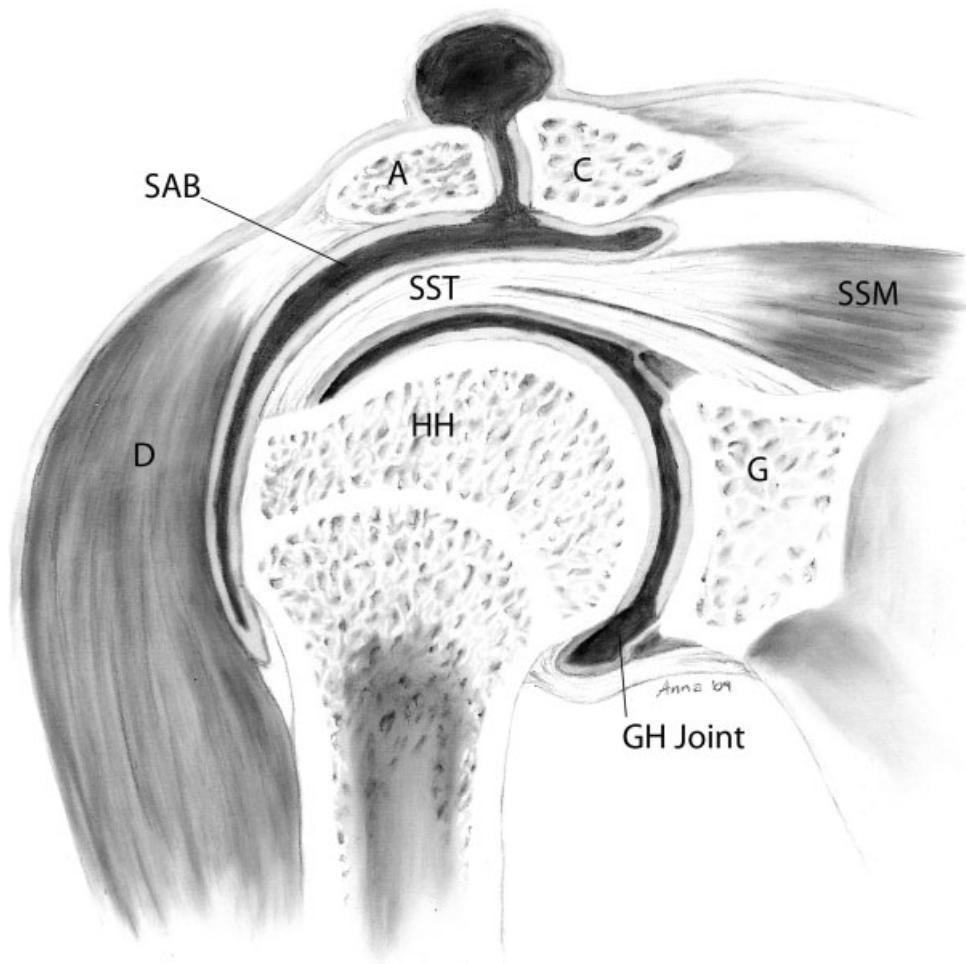
**Fig. 4.** Preoperative photographs demonstrating large right type 2 ACJ cyst.



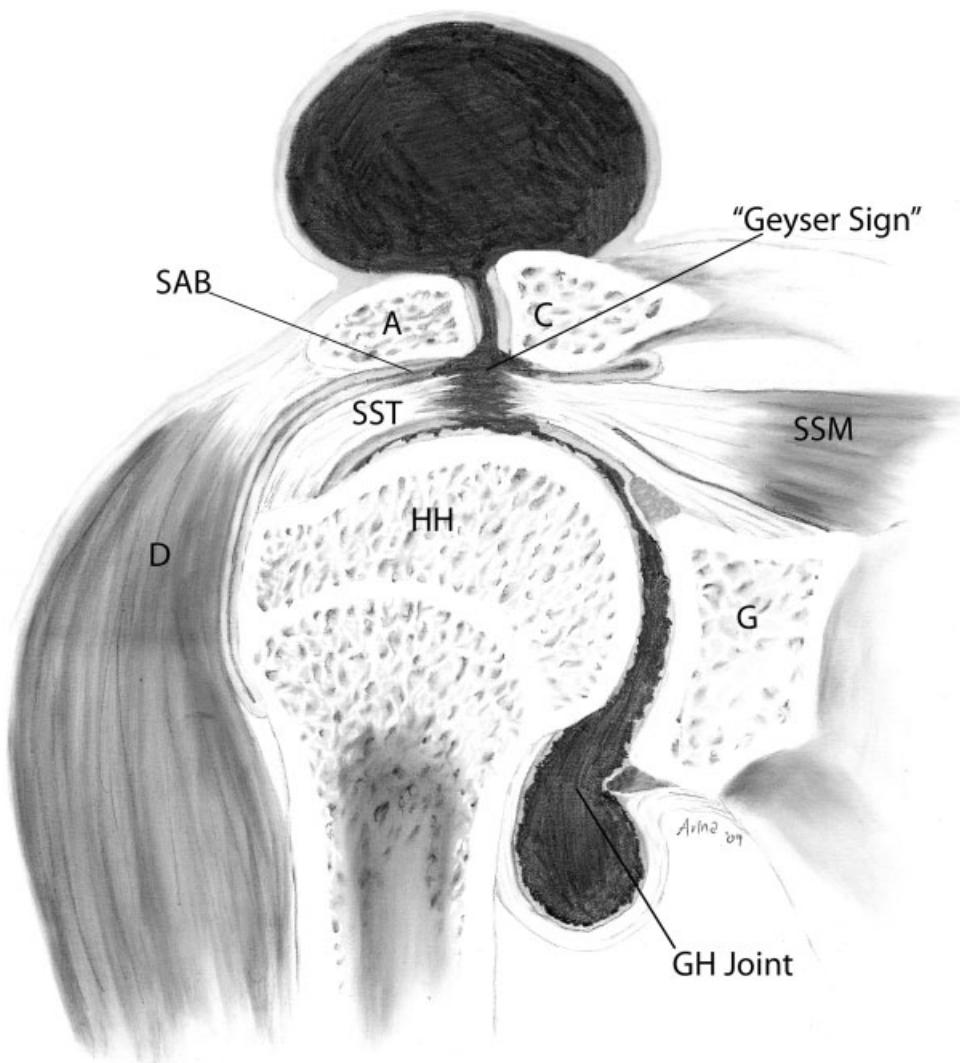
**Fig. 5.** Intraoperative photograph demonstrating  $10 \times 8$  cm cystic mass.



**Fig. 6.** T1-weighted coronal oblique MRI identifying degenerative changes of the humeral head, large cystic mass, "geyser sign," enlarged shoulder joint capsule, and a pathological increase in intra-articular fluid.



**Fig. 7.** Illustration of Type 1 ACJ cyst: deterioration/disruption of SAB and ACJ, accumulation of synovial fluid, intact rotator cuff, ACJ cyst. A, acromion; C, clavicle; D, deltoid muscle; G, glenoid; GH joint, glenohumeral joint; HH, humeral head; SAB, subacromial bursa; SSM, supraspinatus muscle; SST, supraspinatus tendon.



**Fig. 8.** Illustration of Type 2 ACJ cyst: complete tear of SST/SSM, instability of GH joint with superior migration of HH, accumulation of synovial fluid, "geyser sign," ACJ cyst. A, acromion; C, clavicle; D, deltoid

muscle; G, glenoid; GH joint, glenohumeral joint; HH, humeral head; SAB, subacromial bursa; SSM, supraspinatus muscle; SST, supraspinatus tendon.

deficiencies determine the appropriate treatment paradigm. Current treatment guidelines (Feeley et al., 2009) include resection of the distal clavicle and also:

1. Shoulder arthrodesis: patients with significant anterior deltoid deficiency or multiple previous surgeries.
2. Arthroscopy and debridement: high-risk patients with multiple medical comorbidities.
3. Total shoulder arthroplasty: patients with a repairable rotator cuff.
4. Hemiarthroplasty: patients with an intact deltoid, intact coracoacromial ligament, forward flexion  $>90^\circ$ , and external rotation  $>30^\circ$ .
5. Reverse total shoulder arthroplasty: patients with an intact deltoid and incompetent cora-

coacromial ligament, particularly elderly patients with low demand.

## REFERENCES

- Burns J, Zvirbulis R. 1984. A ganglion arising over the acromioclavicular joint: A case report. *Orthopedics* 7:1002–1004.  
 Craig EV. 1984. The geyser sign and torn rotator cuff: Clinical significance and pathomechanics. *Clin Orthop Relat Res* 191:213–215.  
 Craig EV. 1986. The acromioclavicular joint cyst: An unusual presentation of a rotator cuff tear. *Clin Orthop Relat Res* 202: 189–192.  
 Cvitanic O, Schimandle J, Cruse A, Minter J. 1999. The acromioclavicular joint cyst: Glenohumeral joint communication revealed by MR arthrography. *J Comput Assist Tomogr* 23:141–143.  
 De Santis D, Palazzi C, D'Amico E, Di Mascio DE, Pace-Palitti V, Petricca A. 2001. Acromioclavicular cyst and 'porcupine shoulder' in gout. *Rheumatology* 11:1320–1321.

- Echols PG, Omer GE Jr, Crawford MK. 2000. Juxta-articular myxoma of the shoulder presenting as a cyst of the acromioclavicular joint: A case report. *J Shoulder Elbow Surg* 9:157–159.
- Feeley BT, Gallo RA, Craig EV. 2009. Cuff tear arthropathy: Current trends in diagnosis and surgical management. *J Shoulder Elbow Surg* 18:484–494.
- Groh G, Badwey T, Rockwood CA Jr. 1993. Treatment of cysts of the acromioclavicular joint with shoulder hemiarthroplasty. *J Bone Joint Surg Am* 75:1790–1794.
- Hiller et al. 2009. "Acromioclavicular joint cyst formation." Poster presentation. SBRP Research Forum. Ann Arbor, Michigan. 5 November 2009.
- Kontakis GM, Tosounidis TH, Karantanas A. 2007. Isolated synovial cyst of the acromio-clavicular joint associated with joint degeneration and an intact rotator cuff. *Acta Orthop Belg* 73:515–520.
- Le Huec JC, Zipoli B, Schaeverbeke T, Moinard M, Chauveaux D, Le Rebeller A. 1996. Acromio-clavicular joint cyst. Surgical treatment. *Acta Orthop Belg* 62:107–112.
- Lizaur Utrilla A, Marco Gomez L, Perez Aznar A, Cebrian Gomez R. 1995. Rotator cuff tear and acromioclavicular joint cyst. *Acta Orthop Belg* 61:144–146.
- Marino AJ, Tyrrell PN, El-Houdiri YA, Kelly CP. 1998. Acromioclavicular joint cyst and rotator cuff tear. *J Shoulder Elbow Surg* 7: 435–437.
- Montet X, Zamorani-Bianchi MP, Mehdizade A, Martinoli C, Bianchi S. 2004. Intramuscular ganglion arising from the acromioclavicular joint. *Clin Imaging* 28:109–112.
- Moratalla MB, Gabarda RF. 2007. Acromioclavicular joint ganglion. *Eur J Radiol Extra* 63:21–23.
- Mullett H, Benson R, Levy O. 2007. Arthroscopic treatment of a massive acromioclavicular joint cyst. *Arthroscopy* 23:446.e1–446.e4.
- Nardini C. 1991. Sul significato delle cisti acromio-clavicolari. Loro associazione con la rottura della cuffia dei rotatori. *Minerva Orthop* 42:211–216.
- Neer CS II, Craig EV, Fukuda H. 1983. Cuff-tear arthropathy. *J Bone Joint Surg Am* 65:1232–1244.
- Nowak DD, Covey AS, Grant RT, Bigliani LU. 2009. Massive acromioclavicular joint cyst. *J Shoulder Elbow Surg* 18:e12–e14.
- Postacchini F, Perugia D, Gumina S. 1993. Acromioclavicular joint cyst associated with rotator cuff tear: A report of three cases. *Clin Orthop Relat Res* 294:111–113.
- Rockwood C, Burkhead WZ. 1988. Management of patients with massive rotator cuff defects by acromioplasty and rotator cuff debridement. *Orthop Trans* 12:190–193.
- Rowe CR. 1988. Symptomatic Cysts of the Acromioclavicular Joint. *The Shoulder*. New York: Churchill Livingstone. p 644–645.
- Segmüller HE, Saies AD, Hayes MG. 1997. Ganglion of the acromioclavicular joint. *J Shoulder Elbow Surg* 6:410–412.
- Selvi E, De Stefano R, Frati E, Manganelli S, Manca S, Marcolongo R. 1998. Rotator cuff tear associated with an acromioclavicular cyst in rheumatoid arthritis. *Clin Rheumatol* 17:170–171.
- Tshering Vogel DW, Steinbach LS, Hertel R, Bernhard J, Stauffer E, Anderson SE. 2005. Acromioclavicular joint cyst: Nine cases of a pseudotumor of the shoulder. *Skeletal Radiol* 34:260–265.