J Shoulder Elbow Surg (2019) 28, e238–e244

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

Voluntary acromioclavicular joint dislocation: a case report and literature review

Stephen R. Barchick, AB[a], R. Stephen Otte, MD[b], Grant E. Garrigues, MD[b,*]

[a]Duke University School of Medicine, Duke University Health System, Durham, NC, USA
[b]Midwest Orthopaedics at Rush, Rush University Medical Center, Chicago, IL, USA

Voluntary glenohumeral dislocations have been reported in academic literature; however, voluntary dislocations of the acromioclavicular joint are rare, with four cases previously reported in published literature. We present a case of an adolescent female with bilateral, atraumatic acromioclavicular joint dislocation who ultimately was treated with arthroscopic reconstruction of the coracoclavicular ligament. The case is discussed in addition to a review of previously reported cases of voluntary acromioclavicular joint dislocations. Treatment methods in each of the four previously reported cases are discussed with recommendation for surgeons that may encounter this rare shoulder problem in future patients.

Level of evidence: Case Report; Review

Keywords: Acromioclavicular; coracoclavicular; acromion; dislocation; subluxation; sports medicine; shoulder; instability

Traumatic dislocation of the acromioclavicular (AC) joint has an estimated incidence of 1.8 per 10,000 people per year, with a male predominance of 8.5 to one.[2] Although volitional dislocation of the glenohumeral joint is a known clinical entity, first described in 1722 by Portal, voluntary dislocations of the AC joint are extremely rare, with only four previously reported cases in published literature (Table I).[3,9]

We report a case of an adolescent female athlete with bilateral, atraumatic, voluntary, recurrent AC dislocations. The right side was treated surgically, whereas the left side was treated nonoperatively. Both resulted in similarly poor outcomes. The results of treatment with an arthroscopic coracoclavicular (CC) ligament reconstruction are compared with other techniques and other previously reported cases of atraumatic, voluntary, and recurrent AC joint dislocation.

Case report

History/presentation

A 15-year-old right-hand-dominant female softball short-stop presented to a primary care clinic with complaints of instability and an aching pain in her shoulder. After evaluation, she was referred to an orthopedic surgeon. Her initial orthopedic visit yielded a diagnosis of shoulder impingement syndrome. She was prescribed physical therapy and followed up three weeks later.

At the follow-up visit, her symptoms had not dramatically changed, and she was referred for a magnetic resonance imaging (MRI) arthrogram, which showed only a

No IRB approval was required for this study.

*Reprint requests: Grant. E. Garrigues, MD, Midwest Orthopaedics at Rush, Rush University Medical Center, 1611 W Harrison Street, Suite 300, Chicago, IL 60612, USA.

E-mail address: grant.garrigues@rushortho.com (G.E. Garrigues).

1058-2746/$ - see front matter
https://doi.org/10.1016/j.jse.2019.03.039

Table I Reports of voluntary AC joint dislocations

Author	Year	Sex, age	Laterality, dislocation	Trauma history	Treatment	Outcome
Janecki[3]	1977	F, 19	Bilateral, anterior	None, possible Marfan syndrome	Patient advised to stop subluxation	After 1 mo without voluntary subluxation patient was pain free
Richards[8]	1986	M, 14	Bilateral, anterior	None	None—asymptomatic	No treatment provided
Sahara[11]	2005	M, 19	Right, posterior	Yes, weight-lighting	1 cm osteotomy of the clavicle Coracoid tip osteotomized 1.5 cm from tip, transferred to the clavicle	Improved pain control Clicking with arm elevation Posterior displacement reduced from 18to 8 mm at 5 mo after surgery but returned to 15 mm after 22 mo postoperatively
Sadeghi[10]	2017	F, 17	Right, anterior	None	Nonoperative	Nonoperative treatment, avoiding abduction and external rotation caused reduced pain
Current case		F, 16	Right, anterior	None	AC joint reconstruction with CC ligament reconstruction	Initially resolved pain and subluxation; subluxation and pain returned by 6-mo visit

AC, acromioclavicular; *CC*, coracoclavicular.

small labral irregularity. Notably, the CC ligaments were intact (Fig. 1). After obtaining the MRI arthrogram, she was referred to a second orthopedic surgeon for evaluation and management of her labral tear.

During follow-up with the second orthopedic surgeon, a new diagnosis of glenohumeral internal rotation deficit was made. She was referred for more physical therapy and advised to follow up in two months. At this subsequent visit, glenohumeral internal rotation deficit was no longer the suspected pathology and saltatory motion of the clavicle was found and felt to represent sternoclavicular (SC) instability. The patient was referred to the senior author (G.E.G.) at a tertiary referral center for management of her shoulder pain and evaluation for possible SC joint reconstruction.

The now 16-year-old female was evaluated, with her chief complaint of moderate-to-severe, sharp, stabbing pain in both shoulders localized to the area of the AC joint. She denied any history of shoulder trauma. The pain was aggravated with overhead activity and, in particular, gave her subjective instability of the right AC joint while throwing a softball. Her feelings of instability were bilateral and symmetric, but the pain was more significant in her right, throwing shoulder. The symptoms were jeopardizing her plan to play collegiate softball.

Physical examination

On examination, the patient had tenderness to palpation at the AC joint bilaterally, right greater than left, with increased bilateral anterior/posterior (AP) and inferior/superior translation but with solid end point. The AC joints were reducible, which resulted in decreased AP translation. There was no pain noted at either of the SC joints. The patient demonstrated full strength with external rotation, empty can and full can tests bilaterally. No pain was elicited with rotator cuff testing, impingement tests (Hawkins and Neer), or biceps testing (Speed's and Yergason's). The patient exhibited pain with the right arm in cross-body adduction. Range of motion was full and symmetric bilaterally.

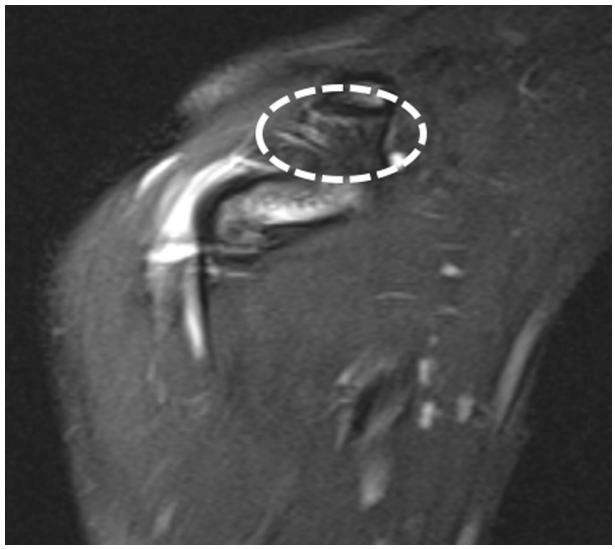

Figure 1 Preoperative right shoulder coronal T2-weighted MRI arthrogram showing intact CC ligaments (dotted oval). Preoperative radiographs are no longer available, but they showed no bony abnormality and a reduced AC joint.

The patient demonstrated voluntary AC joint instability both actively and passively, which could be elicited with differential firing of her shoulder girdle muscles (Video 1). The lateral aspect of the clavicle would become prominent and she could volitionally dislocate and reduce the AC joint bilaterally. She reported 6/10 pain and that her function was 25% of normal (see Table II for patient-reported outcome information). The initial MRI was re-reviewed and showed intact CC ligaments without evidence of injury.

Treatment

The attending surgeon contacted numerous shoulder specialists at other centers to discuss the patient's case given the rarity of the physical examination findings and paucity of literature on the topic. Options ranging from watchful waiting, distal clavicle excision, complete open excision of the existing, intact CC ligaments with allograft tendon reconstruction, and arthroscopic augmentation of the CC ligaments were considered; the last option was the selected treatment.

Given that all of the stabilizing structures of the AC joint—the CC ligaments, the AC joint capsule, the deltotrapezial fascia, and the bony articulation—were intact, the senior author (G.E.G.) did not want to disrupt these structures, and selected to augment the intact ligaments with an arthroscopic AC joint reconstruction/augmentation technique as described by Millet et al.[5,7]

A 3-cm incision was made just medial to the right AC joint. From here, a full thickness flap above the deltoid fascia was elevated. The deltoid fascia was incised in line with the clavicle, and a small portion of the anterior and posterior deltoid was stripped to pass a small Crego elevator at the location of the future tendon graft passage around the clavicle.

After this, the surgeon conducted a diagnostic arthroscopy, which revealed no intra-articular pathology. In contrast with the MRI report, there was no labral tear. Attention was then turned to the arthroscopic augmentation of the AC joint (Fig. 2).

The middle glenohumeral ligament was left intact. The rotator interval tissue superior to the subscapularis and anterosuperior to the middle glenohumeral ligament was excised with the aid of a 70° arthroscope, a radiofrequency ablation device, and a 4.0-mm shaver, leaving the lateral-most confluence of the superior glenohumeral ligament and coracohumeral ligament (comma sign) intact in order not to disrupt long head biceps tendon stability. The inferior portion of the coracoid was lightly roughed with a 4.0-mm round burr to promote healing without weakening the bone.

An AC joint reconstruction guide was placed through the anterior portal and guided with both arthroscopic visualization and confirmed with fluoroscopy. After appropriate alignment was achieved between the distal clavicle and the coracoid, a hole was drilled vertically through the clavicle and exiting through the coracoid base. Through this hole, a suture-button device was then shuttled through the coracoid and clavicle (Dog Bone; Arthrex, Naples, FL, USA).

Switching sticks were used to target and aid in suture passage posterior to the clavicle and medial to the coracoid as well as anterior to the clavicle and lateral to the coracoid. These sutures were used to shuttle an allograft semitendinosus, whip stitched on each end with No.2 FiberWire (Arthrex) around the coracoid and the clavicle. After lightly abrading the superior surface of the clavicle where the graft would lay down, the AC joint was reduced, confirmed fluoroscopically, and the Dog Bone was tied down tightly. A Zanca view confirmed appropriate reduction of the AC joint (Fig. 3). The second Dog Bone suture was tied down, followed by tying the allograft around the clavicle and oversewing the knot in the graft (Figs. 4 and 5). The AC joint was stable in both AP and superior-inferior planes on evaluation.

The deltoid fascia was closed and imbricated (Fig. 6). The wound was irrigated copiously and closed (Fig. 7). The patient was placed in a sling with a small abduction pillow.

Follow-up

One week after surgery, the patient was seen for her first postoperative appointment. She reported a sense of subluxation in the right shoulder with unresolved pain that began after dancing at her high school prom in the immediate postoperative period. It was unclear whether she

Table II Patient-reported outcomes

	ASES score	Maximum pain experience (0-15)	Pain today (0-10)	Shoulder % rating (SANE score)
Preoperative	43.34		6	25
Postoperative				
1 wk	0	15	10	0
2 wk	50	0	0	0
6 wk	71.66	0	0	50
3 mo	78.32	3	0	70
6 mo	75.01	10	0 (unless activity)	50

ASES, American Shoulder and Elbow Surgeons; *SANE*, single assessment numeric evaluation.

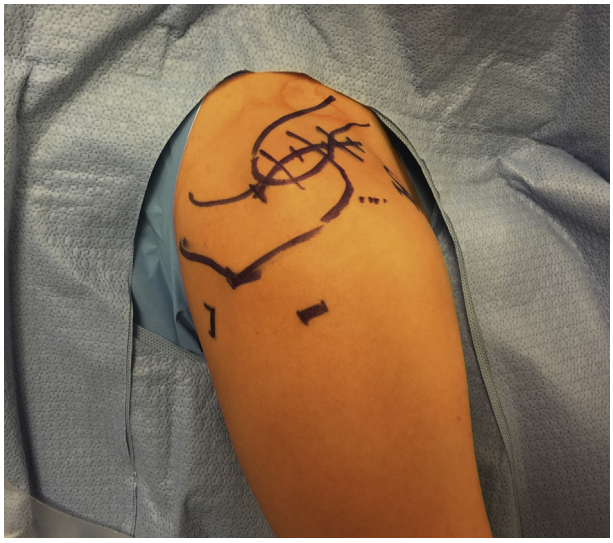

Figure 2 Intraoperative photo of the right shoulder, showing portals used for the procedure. The lateral portal was not used and the anterosuperolateral portal (dotted line) was made with spinal needle targeting to ensure the correct trajectory with respect to the coracoid.

was compliant with her instructions for sling use and refrained from active shoulder range of motion. A Zanca radiograph of the right shoulder was evaluated and demonstrated a maintained reduction of the AC joint with intact anchors (Fig. 8).

Two weeks postoperatively the patient was re-evaluated and reported no pain (0/10 at rest and 0/15 with movement). She reported compliance with the use of her right arm sling and was instructed to maintain sling use until the 6-week postoperative visit.

The patient returned to clinic for her 6-week postoperative appointment compliant with her sling use, without pain (0/10 at rest, 0/15 with movement) and

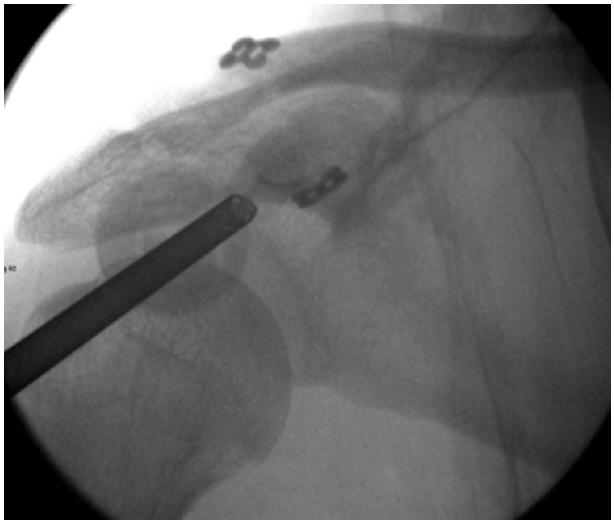

Figure 3 Intraoperative fluoroscopy showing targeting for the Dog Bone and reduction of the AC joint.

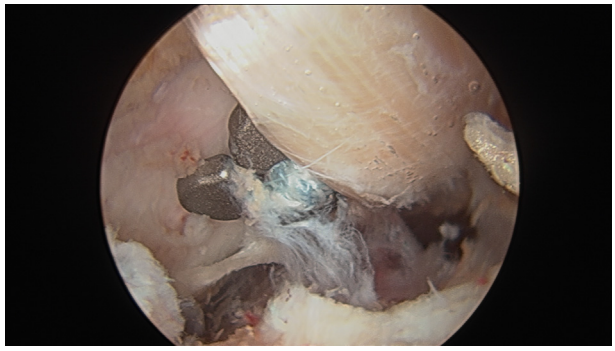

Figure 4 Intraoperative arthroscopic photo of the right shoulder from superolateral portal showing Dog Bone in place on the underside of the coracoid base and allograft wrapped around the coracoid.

attending physical therapy twice weekly. She was cleared to remove her sling during light daily activities and progress to pool exercises. Radiographs from this visit showed no abnormalities (Fig. 9). She was scheduled for repeat examination at the 3-month postoperative visit.

At the 3-month visit, she reported no pain (0/10) at rest and mild pain (3/15) with movement primarily at the AC joint, though significantly less than before surgery. Subjectively, she began to experience subtle AC joint subluxation when reaching above her head or when rolling over in her sleep. She complained that the AC joint subluxation was returning. The radiograph showed the expected soft tissue prominence overlying the superior aspect of the AC joint, and the AC joint alignment and hardware were maintained. She was discharged from clinic with continued physical therapy and follow-up in 3 months, or sooner if new issues presented.

At the 6-month visit, the patient reported no (0/10) pain at rest but severe pain (10/15) with overhead activities in the right AC joint accompanied with joint subluxation. The

Figure 5 Intraoperative photo showing graft tied and then oversewn.

Figure 6 Intraoperative photo showing closure and imbrication of the deltotrapezial fascia.

pain and the level of displacement were now comparable with what she experienced before surgery and to her contralateral side. The imaging showed subtle potential CC interspace widening and clavicular tunnel widening but no gross failure of the construct (Fig. 10). The initial over-reduction had returned to a radiographically normal alignment. Range of motion was comparable with preoperative scores (Table III). After shared decision making with the senior author (G.E.G.), she and her family chose no further treatment for either shoulder.

Discussion

AC joint anatomy/demographics

This patient is one of five reported cases of voluntary, atraumatic AC joint subluxation and, to our knowledge, the first treated with an arthroscopic AC joint augmentation.

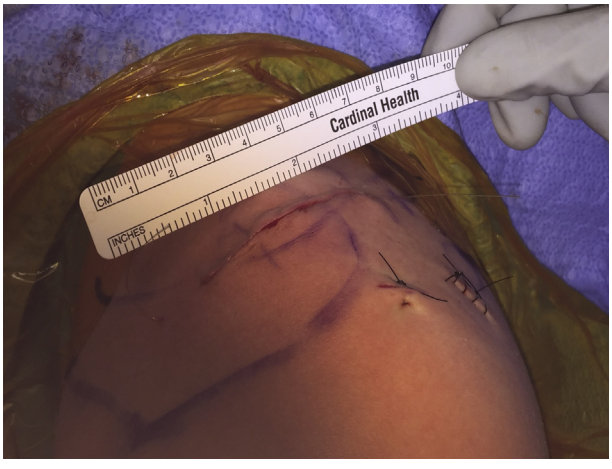

Figure 7 Intraoperative photo showing closure final wound closure.

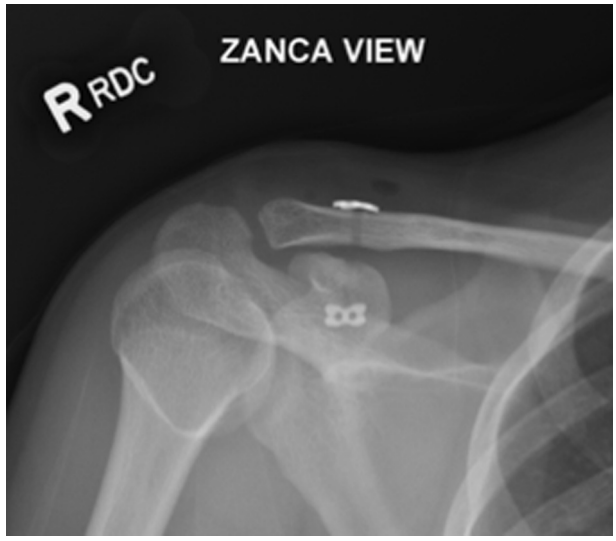

Figure 8 Zanca view radiograph, one week postoperatively. Note proper position of the Dog Bone and reduction of the AC joint and CC interspace.

We present our sobering results as a cautionary tale to future treating surgeons as this condition does not have a clear and reliable answer at this time.

Previous reports of voluntary AC joint dislocation

In 1977, Janecki[3] first reported a 19-year-old woman who could voluntarily subluxate both AC joints anteriorly causing pain. There were no confirmed connective tissue disorders, but the author suggested marfanoid features due to height more than 6 feet and dolichocephaly. After 1 month refraining from voluntary subluxation, the patient was without pain. The patient was able to subluxate both shoulders anteriorly through retraction of the scapulae with

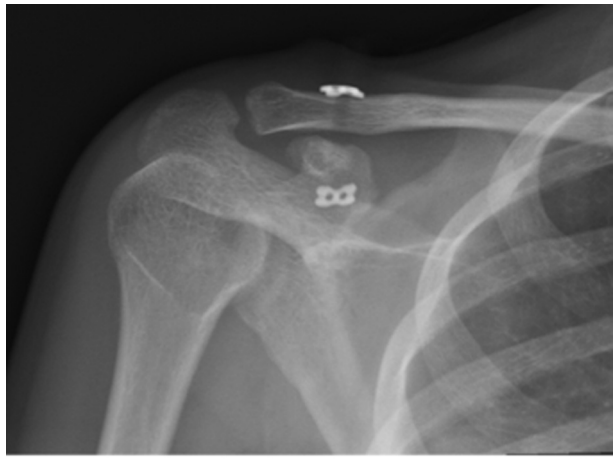

Figure 9 Zanca view radiograph, six weeks postoperatively. Note unchanged, proper position of the Dog Bone and reduction of the AC joint and CC interspace.

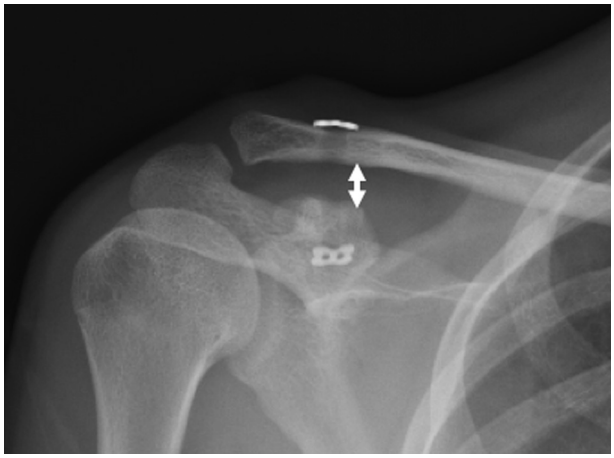

Figure 10 Radiograph six months postoperatively. There is a question of slight CC interspace widening (double arrow) slightly and possible clavicular tunnel widening.

arms adjacent to torso. Janecki[3] suggested that the likely mechanism of action was due to narrowing of the costoclavicular space during scapular adduction, which caused decreased distance between the clavicle and first rib causing the distal clavicle to sublux.

In 1986, Richards et al[8] reported a 14-year-old boy with right-sided spastic hemiparesis from cerebral palsy with bilateral atraumatic anterior AC joint dislocation. Similar to the case reported by Janecki, global ligamentous laxity was noted. Given the patient was asymptomatic, no treatment was offered.

In 2005, Sahara et al[11] reported a 19-year-old man with atraumatic posterior dislocation of the AC joint with voluntary reduction. The patient first noted shoulder discomfort and pain with arm abduction after weight lifting at 17 years of age. The patient was treated surgically with an excision of AC joint capsule and the distal 1 cm of the clavicle. The distal 1.5 cm of the coracoid tip with the conjoined tendon attached was osteotomized and transferred to the anterior aspect of the clavicle near the trapezoid ligament. The patient's preoperative AC joint posterior displacement was 18 mm, which improved to 5 mm at 5 months postoperatively. However, at 22 months' follow-up, the patient was without pain but still demonstrated 15 mm posterior displacement of the acromion.

In 2017, Sadeghi et al[10] reported a 17-year-old girl with voluntary atraumatic right AC joint dislocation. Dislocation of the AC joint was caused via abduction and external rotation of the right shoulder. The patient was treated nonoperatively with postural therapy and avoiding combined active abduction with external rotation. One year after her initial appointment she experienced fewer symptoms and was able to complete daily activities.

Table III Six-month postoperative range of motion (PROM)

PROM	Left	Right
ER @ 0	50 (was 60 preoperative)	70 (was 60 preoperative)
FF	170 (was 180 preoperative)	170 (was 180 preoperative)
IR @ 0	T7 (T6 preoperative)	T4 (T3 preoperative)

ER, external rotation; *FF*, forward flexion; *IR*, internal rotation.

Current case

This case is unique in that the patient had no neuromuscular abnormalities and was a high-level athlete. Furthermore, this case was bilateral and the dislocation could be provoked with differential firing of muscles of the shoulder. Lastly, this is the first such case treated with arthroscopic CC ligament augmentation.

The patient showed initial improvement in reduction of pain and complete reduction of the AC joint. However, this initial success was followed closely by loss of reduction and recurrence of pain and instability. As with the one other surgically treated case of voluntary AC joint dislocation (distal clavicle osteotomy, coracoid tip transfer),[11] the arthroscopic augmentation approach described for traumatic AC joint dislocation was not successful.[7]

Patients with arthroscopic anatomic reconstruction of the AC joint for the treatment of chronic post-traumatic dislocation have complications ranging from 27% to 52% and have lower overall satisfaction with surgery.[4,6,14] Loss of fixation and/or graft failure is the most likely reason for radiographic failure seen in patients postoperatively.[14] One systematic review of complications after arthroscopic AC joint reconstruction showed a loss of reduction in 26.8% of cases.[13] Milewski et al[6] reported that 8 of 27 patients (30%) with AC joint reconstruction showed loss of reduction. Although we must caution extrapolation from a single case, the voluntary nature of this patient's AC pathology may portend the same poor outcome as that of stabilization of voluntary glenohumeral joint dislocations, where recurrence rates range from 17% to 96% with a historical average of 67%.[1,12]

Conclusion

We present a case of a recurrent, atraumatic AC joint dislocation in a 16-year-old female athlete who did not respond well to nonoperative physical therapy and is the first reported arthroscopic augmentation of the CC ligaments to treat voluntary AC joint dislocation (see Table I).

Arthroscopic reconstruction for the treatment of traumatic AC joint dislocation has yielded good results,

but we recommend exercising caution when considering this or any other surgical attempt at stabilizing a voluntary AC joint dislocation as the surgical results in our hands and the other cases in the literature are sobering.

Disclaimer

Grant E. Garrigues is a consultant for DJO, Wright/Tornier, and Mitek; receives educational support from Arthrex (the devices used for the surgery described herein were manufactured by Arthrex) and Smith & Nephew. All the other authors, their immediate family, and any research foundation, with which they are affiliated, did not receive any financial payments or other benefits from any commercial entity related to the subject of this article.

Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jse.2019.03.039

References

1. Bey MJ, Song HK, Wehrli FW, Soslowsky LJ. Intratendinous strain fields of the intact supraspinatus tendon: the effect of glenohumeral joint position and tendon region. J Orthop Res 2002;20:869-74. https://doi.org/10.1016/s0736-0266(01)00177-2
2. Chillemi C, Franceschini V, Dei Giudici L, Alibardi A, Salate Santone F, Ramos Alday LJ, et al. Epidemiology of isolated acromioclavicular joint dislocation. Emerg Med Int 2013;2013:171609. https://doi.org/10.1155/2013/171609
3. Janecki CJ Jr. Voluntary subluxation of the acromioclavicular joint. A case report. Clin Orthop Relat Res 1977;125:29-31.
4. Martetschläger F, Horan MP, Warth RJ, Millett PJ. Complications after anatomic fixation and reconstruction of the coracoclavicular ligaments. Am J Sports Med 2013;41:2896-903. https://doi.org/10.1177/0363546513502459
5. Menge TJ, Tahal DS, Katthagen JC, Millett PJ. Arthroscopic acromioclavicular joint reconstruction using knotless coracoclavicular fixation and soft-tissue anatomic coracoclavicular ligament reconstruction. Arthrosc Tech 2017;6:e37-42. https://doi.org/10.1016/j.eats.2016.08.035
6. Milewski MD, Tompkins M, Giugale JM, Carson EW, Miller MD, Diduch DR. Complications related to anatomic reconstruction of the coracoclavicular ligaments. Am J Sports Med 2012;40:1628-34. https://doi.org/10.1177/0363546512445273
7. Millett PJ, Warth RJ, Greenspoon JA, Horan MP. Arthroscopically assisted anatomic coracoclavicular ligament reconstruction technique using coracoclavicular fixation and soft-tissue grafts. Arthrosc Tech 2015;4:e583-7. https://doi.org/10.1016/j.eats.2015.06.007
8. Richards RR, Herzenberg JE, Goldner JL. Bilateral nontraumatic anterior acromioclavicular joint dislocation. A case report. Clin Orthop Relat Res 1986:255-8.
9. Rowe CR, Pierce DS, Clark JG. Voluntary dislocation of the shoulder: a preliminary report on a clinical, electromyographic, and psychiatric study of twenty-six patients. J Bone Joint Surg Am 1973;55:445-60.
10. Sadeghi N, Haen PS, Onstenk R. Atraumatic acromioclavicular dislocation: a case report and review of the literature. Case Rep Orthop 2017;2017:8450538. https://doi.org/10.1155/2017/8450538
11. Sahara W, Sugamoto K, Miwa T, Tanaka H, Yoshikawa H. Atraumatic posterior dislocation of the acromioclavicular joint with voluntary reduction. Clin J Sport Med 2005;15:104-6.
12. te Slaa RL, Wijffels MPJM, Brand R, Marti RK. The prognosis following acute primary glenohumeral dislocation. J Bone Joint Surg Br 2004;86-B:58-64. https://doi.org/10.1302/0301-620x.86b1.13695
13. Woodmass JM, Esposito JG, Ono Y, Nelson AA, Boorman RS, Thornton GM, et al. Complications following arthroscopic fixation of acromioclavicular separations: a systematic review of the literature. Open Access J Sports Med 2015;6:97-107. https://doi.org/10.2147/oajsm.s73211
14. Wylie JD, Johnson JD, DiVenere J, Mazzocca AD. Shoulder acromioclavicular and coracoclavicular ligament injuries: common problems and solutions. Clin Sports Med 2018;37:197-207. https://doi.org/10.1016/j.csm.2017.12.002