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Functional and radiographic outcomes after allograft anatomic coracoclavicular ligament reconstruction

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Abstract
Introduction: Acromioclavicular joint dislocation is a commonly encountered shoulder injury. Various surgical methods are available for the treatment of complete AC Joint dislocation, however, optimal surgical treatment is still controversial. The purpose of this study was to evaluate the functional and radiographic outcomes after allograft anatomic coracoclavicular ligament reconstruction.
Materials and Methods: 18 patients with grade III to V AC joint disruptions underwent allograft anatomic coracoclavicular ligament reconstruction. Functional and radiographic outcomes were assessed using DASH score and Constant score.
Results: The mean coracoclavicular (CC) distance decreased from 16.98±3.20 mm (pre-operative) to 8.93±1.25 mm (at final follow-up). Based on Constant Scores there were 10 (50.56%) excellent outcomes, 4(22.22%) good outcomes, 2(11.11%) fair outcomes, and 2(11.11%) poor outcomes.
Conclusion: Allograft anatomic coracoclavicular ligament reconstruction results in generally good-toexcellent outcomes at the final follow-up.

Keywords: Acromioclavicular joint dislocation, anatomic reconstruction, allograft, dash score, constant score, outcomes

Introduction
Acromioclavicular joint (ACJ) dislocations are commonly encountered shoulder injuries. Injury to the acromioclavicular (AC) joint accounts for nearly half of all sports related shoulder injuries [1]. These injuries are higher among a young athletic population with an incidence of 9.2 injuries per 1000 person-years [1, 2-5]. The AC joint is a diarthroidal joint, with stability maintained by the coracoacromial (CA) and coracoclavicular (CC) ligaments, shoulder capsule, and deltoid and trapezius muscles and fascia. AC joint injuries are most commonly caused by a direct lateral impact at the acromion with the arm in an adducted position.

Treatment of AC joint injuries depends on the extent of ligament injury, displacement observed, position of clavicle relative to the coracoid, and whether the AC joint can be reduced as classified according to the Rockwood criteria. Low grade injuries (Type I and II) often can be conservatively managed, as the coracoclavicular ligaments remain intact and keep the clavicle in close proximity to the scapula. However, higher grade injuries result in the complete disruption of these ligaments and often result in both infer superior and anteroposterior instability. Operative stabilization often is indicated and can minimize the discomfort and disability associated with this instability.

Early techniques of AC joint reconstruction for AC joint separations were associated with poor outcomes and significant complications. However, recent anatomic work has better defined the ligamentous and bony anatomy of this region [6]. This has led to the development of the anatomic-based coracoclavicular (CC) ligament reconstruction technique, which has been shown to be superior to the other techniques with a biomechanical evaluation [7]. Anatomic coracoclavicular ligament reconstruction (ACCR) was initially described by Mazzocca *et al.* [7] using clavicle bone tunnels and interference screws for clavicle graft fixation. As for this technique, despite short-term clinical follow-up showing generally good to excellent outcomes, the complication rate remains high with an overall rate of 39.8%.

16 An alternative method of fixation of the graft is to tie the ends of the graft together in a square knot after passage through the clavicle bone tunnels. Advantages of a knotted technique without screws include lower costs and potentially less graft injury from the screws. If the clinical and radiographic outcomes of a knotted graft were equivalent to an ACCR using interference screws for fixation, there might ultimately be a cost savings using the knotted graft technique.
The aim of this study was to evaluate the functional and radiographic outcomes after allograft anatomic coracoclavicular ligament reconstruction.

Materials and Methods

Eighteen patients with grade III to V AC joint disruptions underwent allograft anatomic coracoclavicular ligament reconstruction in Govt. Bone and Joint Hospital, an associated hospital of Govt. Medical College Srinagar from January 2021 December were included in this study. Patients < 18 years, ipsilateral shoulder injury, patients with revision surgery and patients with type I, II injuries were excluded from the study.

Surgical technique

Patients received a general anesthetic and were placed in the beach chair position. All patients received one dose of standard preoperative antibiotics (cefazolin or clindamycin). A superior strap incision was made starting 1 cm medial to the AC joint running from just posterior to the clavicle to the level of the coracoid. Skin and subcutaneous tissues were dissected down to the deltotrapezial fascia that was incised longitudinally in line with the clavicle and then released to its undersurface. Tunnel positions for the trapezoid and conoid ligaments were planned and marked by measuring 2.5 and 4.5 cm, respectively, from the distal clavicle. Tunnels were positioned centrally in the clavicle in an anteroposterior (AP) direction to maximize bone bridges on the anterior and posterior aspects of the tunnels. A distal clavicle resection of 7 mm was performed using a sagittal saw. The tunnels were drilled sequentially with a 5.0 mm drill bit, and a passing suture was placed through each tunnel.
Blunt dissection was carried down toward the coracoid, and a suture was passed from medial to lateral around the coracoid using a right angle clamp. A hamstring allograft between 6 and 7 mm in folded diameter was used. The allograft was not pre-tensioned. The allograft was whip-stitched at each end with 2 high-strength non-absorbable suture in a Krackow fashion, and the graft, in addition to two 5 high-strength non-absorbable strands of suture was passed beneath the coracoid using the passing suture. All tails were then passed through the tunnels in the clavicle using passing sutures. The clavicle was reduced with the intention to over reduce the clavicle as much as possible by pushing down on the clavicle and up on the elbow, and the two 5 non-absorbable high-strength cerclage sutures were tied to hold the reduction. The graft was then tied on itself in a square knot. Each hitch was oversewn with two 2 high-strength non-absorbable sutures using figure-of eight stitches. The deltotrapezial fascia and AC joint capsule were repaired in a pants-over-vest fashion and imbricated.

Post-operative protocol and follow-up

Patients were placed in an abduction sling for 6 weeks postoperatively allowing pendulums and elbow, wrist, and hand range of motion. At 6 weeks, the abduction sling was discontinued, and patients were allowed passive and active external rotation with the arm at the side and forward elevation limited to 90 degrees. At 9 weeks postoperatively, patients were progressed to full passive and active range of motion with a 5 pound lifting restriction. Gentle strengthening was begun at 3 months after surgery with a 20 pound lifting restriction. At 4.5 months, the lifting limit was increased to 40 pounds, and patients were released to full activities at 6 months postoperatively.
Patients were evaluated using x-ray, both true AP view and axillary lateral view of shoulder. Coracoclavicular (CC) distance was calculated in AP view, as the perpendicular distance between the uppermost point of superior cortex of coracoid and undersurface of clavicle and CC difference was calculated by measuring CC distance of normal side. The finding of CC distance on the affected side greater than 25% as compared to the normal side was considered radiological failure. Clinically, patients were evaluated using DASH score and Constant score at final follow up. Functional outcome was graded according to Constant score.

Results

The mean age of the study population was 37.6 (range 19-58) years. Among 18 included patients there were 11(61.11%) males and 7 (38.89%) females. Of the 18 patients operated, 6 (33.33%) had a Rockwood III type lesion, 3(16.67%) had a Rockwood IV type lesion, and 9(50%) had a Rockwood V type lesion (Table 1).

Table 1: Demographic characteristics of patients (N=18)

Demographic characteristics	No. of patients	Percentage
Gender		
Male	11	61.11
Female	7	38.89
Injured Side		
Right	6	33.33
Left	12	66.67
Type of dislocation		
Type III	6	33.33
Type IV	3	16.67
Type V	9	50.00

The mean coracoclavicular (CC) distance decreased from 16.98±3.20 mm (pre-operative) to 8.93±1.25 mm (at final follow-up) which was statistically significant (Table 2).

Table 2: Comparison of Coracoclavicular (CC) distance between pre-operative versus final follow up

Parameters	Coracoclavicular (CC) distance	P-value
Pre-operative	16.98±3.20 mm	0.0001
At final follow-up	8.93±1.25 mm	

There was more than 25% loss of reduction as compared to normal shoulder in 2(11.11%) cases suggesting radiological failure. Superficial wound infection occurred in 2(11.11%) patients, subsided with oral antibiotics and regular dressing.
At the final follow up, mean DASH score was 5.20±3.22 and the constant score was 86.98±9.90.
Based on Constant Scores there were 10 (50.56%) excellent outcomes, 4(22.22%) good outcomes, 2(11.11%) fair outcomes, and 2(11.11%) poor outcomes (Table 3).

Table 3: Constant Score grading

Grade	Score	No. of patients	Percentage
Excellent	< 11	10	50.56
Good	11-20	4	22.22
Fair	21-30	2	11.11
Poor	> 30	2	11.11

Discussion

The ligamentous structures around the AC joint have been described as well as their individual contributions to joint stability [6, 8-10] Fukuda *et al.* [9] demonstrated that each of the ligamentous structures surrounding the AC joint play a pivotal role in its stability. In their study they determined that the AC ligaments act as the primary constraint for posterior translation especially at smaller degrees of displacement. CC ligaments, primarily the conoid ligament, are responsible for constraining motion in the anterior and superior directions especially at greater degrees of displacement. They also determined that the primary role of the trapezoid ligament is stability of the AC joint during axial compression toward the acromial process. From their study, Fukuda *et al.* [9] concluded that each of the ligamentous structures surrounding the AC joint provides stability depending on the force and direction of the load. Therefore, operative procedures that allow the greatest number of structures to remain intact will provide superior strength after healing. The authors also noted that some procedures, such as distal clavicular resection, may not allow this to occur.

Many techniques for surgical treatment of AC joint dislocation have been evolved. There have been more than 150 different techniques described in the literature which have evolved. This suggests that there is no consensus regarding optimal management. Various methods of fixation such as trans-articular Kirschner wire, TBW, Bosworth screw, Hook plate were used historically, however, due to complications like hardware migration, loss of reduction, hardware failure and low functional outcomes, these techniques are rarely used these days. Subsequently, various soft tissue procedures replicating the function of CC and/or AC ligaments were described. The first reported ligament reconstruction procedure was by Weaver and Dunn in 1972 [11]. The non-anatomic reconstruction, Weaver and Dunn, was the most frequently used procedure to treat AC joint dislocation. However, due to the high rate of re-dislocation and inferior results these procedures have been abandoned nowadays.

In this study we used allograft anatomic ligament reconstruction technique, biomechanically more superior and has more favorable clinical and radiological outcomes than other non-anatomic techniques. And there is biomechanical evidence to support the surgical technique used. Tashjian *et al.* [12] examined AC joint reconstruction using hamstring allograft looped beneath the coracoid in cadaveric shoulders and compared clavicularside fixation with polyethyl ethyl ketone (PEEK) interference screws, square-knot in the graft, and side-to-side repair of the graft. The authors found superior ultimate strength with the square-knot technique. CA ligament transfer was purposefully abandoned part way through the study period, given evidence from Clevenger *et al.* [13] that CA ligament transfer does not improve time-zero biomechanical strength over tendon reconstruction with high-strength suture augmentation.

Clinical outcomes after ACCR have been reported in multiple studies with various techniques. These results have been generally good to excellent.

In our study, there was a statistically significant increment of coracoclavicular (CC) distance at final follow-up as compared to pre-operative coracoclavicular (CC) distance. This may be due to graft stretch over a while. However, radiological failure occurred in only 2 (11.11%) patients, similar to previous studies of ACCR. We did not observe a significant correlation between maintenance of reduction and functional outcome inferred from the side to side difference of coracoclavicular distance at final follow up suggesting anatomic reduction is not required for the functional outcome as reported in other literatures. Bostrom Windhamare suggested that even elongated reconstructed ligament improves the stability of the clavicle sufficient to improve shoulder function [14].

Clinical outcomes after ACCR have been reported in multiple studies with various techniques. These results have been generally good to excellent. In our study at the final follow up, mean DASH score was 5.20±3.22 and the constant score was 86.98±9.90. Based on Constant Scores there were 10 (50.56%) excellent outcomes, 4(22.22%) good outcomes, 2(11.11%) fair outcomes, and 2(11.11%) poor outcomes

This was a retrospective study with a small sample size. All these factors may bias our findings. Various techniques and different outcome measures reported in the literature for AC joint injuries makes it difficult to compare with other studies. Also small sample size limits statistical comparison. Studies with large sample size and longer duration of follow-up are needed to determine to what extent loss of reduction may impair functional outcomes.

Conclusion

Allograft anatomic coracoclavicular ligament reconstruction results in generally good-toexcellent outcomes at the final follow-up. Complication rates, both major and minor, are significant but consistent with previous studies evaluating ACCR. Larger prospective, randomized studies, will be needed to determine the validity of this statement.

Conflict of Interest

Not available

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Not available

References

1. Kaplan LD, Flanigan DC, Norwig J, *et al*. Prevalence and variance of shoulder injuries in elite collegiate football players. Am J Sports Med. 2005;33:1142-1146.
2. Agel J, Dompier TP, Dick R, *et al*. Descriptive epidemiology of collegiate men's ice hockey injuries: National Collegiate Athletic Association Injury Surveillance System, 1988-1989 through 2003-2004. J Athl Train. 2007;42:241-248.
3. Dick R, Agel J, Marshall SW. National collegiate athletic association injury Surveillance system commentaries: introduction and methods. J Athl Train. 2007;42:173-182.
4. Lynch TS, Saltzman MD, Ghodasra JH, *et al*. Acromioclavicular joint injuries in the National Football League: epidemiology and management. Am J Sports Med. 2013;41:2904-2908.
5. Pallis M, Cameron KL, Svoboda SJ, *et al*. Epidemiology of acromioclavicular joint injury in young athletes. Am J Sports Med. 2012;40: 2072-2077.
6. Rios CG, Arciero RA, Mazzocca AD. Anatomy of the clavicle and coracoid process for reconstruction of the coracoclavicular ligaments. Am J Sports Med. 2007;35:811-817.
7. Mazzocca AD, Santangelo SA, Johnson ST, *et al*. A biomechanical evaluation of an anatomical coracoclavicular ligament reconstruction. Am J Sports Med. 2006;34:236-246.
8. Renfree KJ, Wright TW. Anatomy and biomechanics of the acromioclavicular and sternoclavicular joints. Clin

Sports Med. 2003;22:219-237.
9. Fukuda K, Craig EV, An KN, *et al*. Biomechanical study of the ligamentous system of the acromioclavicular joint. J Bone Joint Surg. 1986;68:434-440.
10. Klimkiewicz JJ, Williams GR, Sher JS, *et al*. The acromioclavicular capsule as a restraint to posterior translation of the clavicle: a biomechanical analysis. J Shoulder Elbow Surg. 1999;8:119-124.
11. Weaver JK DH. Treatment of acromioclavicular injuries, especially complete acromioclavicular separation. J Bone Jt Surg Am. 1972;54:1187-94.
12. Tashjian RZ, Southam JD, Clevenger T, *et al*. Biomechanical evaluation of graft fixation techniques for acromioclavicular joint reconstructions using coracoclavicular tendon grafts. J Shoulder Elbow Surg. 2012;21:1573-1579.
13. Clevenger T, Vance RE, Bachus KN, *et al*. Biomechanical comparison of acromioclavicular joint reconstructions using coracoclavicular tendon grafts with and without coracoacromial ligament transfer. Arthroscopy. 2011;27:24-30.
14. Boström Windhamre HA, Von Heideken JP, Une-Larsson VE, Ekelund AL. Surgical treatment of chronic acromioclavicular dislocations: A comparative study of Weaver- Dunn augmented with PDS-braid or hook plate. J Shoulder ELB Surg. 2010;19(7):1040.

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