

A Modification of Anterior Capsular Reconstruction using Acellular Dermal Allograft with Pectoralis Major Tendon Transfer: A Case Report

Andrew M. Schneider, Rebecca G. Burr, Jeffrey P. Liles, William Davis, Nickolas Garbis, Dane H. Salazar

Department of Orthopaedic Surgery, Loyola University Medical Center, Maywood, Illinois

ABSTRACT

The glenohumeral joint requires a complex interplay of both static and dynamic structures to aid in stabilization. We report the case of a 32-year-old male who presented with long-standing shoulder pain and anterior instability following a high school football injury. Previous management included a Bristow procedure and arthroscopic decompression with distal clavicle excision and biceps tenodesis. We performed an anterior capsular reconstruction (ACR) with acellular dermal allograft, as well as a partial rotator cuff repair and pectoralis major tendon transfer. At 3 months, the patient was doing well with no symptoms of instability. ACR with acellular dermal allograft for recurrent anterior shoulder instability is a new modification of previously described dermal allograft use in superior capsular repair. In addition, rotator cuff repair with pectoralis major tendon transfer augments treatment of anterior shoulder instability.

Key words: Anterior capsular reconstruction, Bristow procedure, dermal allograft, rotator cuff repair

INTRODUCTION

he glenohumeral joint requires a complex interplay of both static and dynamic structures to aid in stabilization.^[1] More specifically, the subscapularis muscle and anterior shoulder capsule maintain anterior stability of the glenohumeral joint.^[2] The subscapularis is an important dynamic stabilizer of the shoulder, and the anterior shoulder capsule is a critical static stabilizer of the glenohumeral joint.^[2] Insufficiency or incompetency of these stabilizers, often the result of repeat dislocations, iatrogenic injury from previous surgeries, or complications from thermal capsulorrhaphy, may allow anterior subluxation or dislocation of the humeral head on the glenoid.^[2-4] With progression to irreparable damage of these structures, recurrent anterior shoulder instability can result. This poses a complex and challenging problem for the shoulder physician to treat, as few proven options exist. Following the initial

reported success in the literature of acellular dermal allograft use in superior capsular repair, a technique for the use of acellular dermal allograft for anterior capsular reconstruction (ACR) has surfaced, with promising results.^[2,5] In this report, we describe a modification of ACR that involves the incorporation of acellular dermal allograft, along with rotator cuff repair and pectoralis major tendon transfer for augmented anterior shoulder stability. The patient was informed that the data obtained during his case would be used for publication and he provided consent.

CASE REPORT

An otherwise healthy 32-year-old male presented with longstanding shoulder pain and abduction difficulty that began after an injury initially sustained while playing high school football. He had undergone four prior shoulder surgeries at the time of presentation for anterior-inferior instability.

Address for correspondence:

Dane H. Salazar, Department of Orthopaedic Surgery, Loyola University Medical Center, 2160 S. 1st Ave, Maywood, 60153, Illinois. Phone: 708-216-9000. E-mail: dsalazar@lumc.edu

© 2018 The Author(s). This open access article is distributed under a Creative Commons Attribution (CC-BY) 4.0 license.

His initial surgery was an arthroscopic Bristow procedure (2011, Surgeon A), which initially improved his instability but failed to improve his pain. He then underwent an arthroscopic subacromial decompression (2014, Surgeon A). After a continuing lack of pain relief, he had an additional arthroscopic debridement (2015, Surgeon B), followed by an arthroscopic distal clavicle excision, labral debridement, and mini-open subpectoral biceps tenodesis (2017, Surgeon C). At that time, it was noted by Surgeon C that he was missing the upper one-third of his subscapularis.

On presentation to the senior author, physical examination revealed tenderness to palpation of the left acromioclavicular joint and bicipital groove, as well as active range of motion of the shoulder of 140° of forward flexion, 45° of external rotation, and internal rotation to the thoracolumbar junction. He had anterior luxation with a pivot shift. Apprehension test was negative, and a positive O'Brien's test was present. He had a negative abdominal compression test and slight weakness with bear hug and subscapularis liftoff tests. Radiographs demonstrated the screw from his previous Bristow procedure to be bent, with some anterior luxation on the axillary view. There was some chondromalacia of his glenohumeral joint but no proximal humeral migration apparent. Magnetic resonance (MR) arthrogram showed atrophy and loss of the upper one-third of the subscapularis but otherwise normal musculature of his rotator cuff.

At this point, the patient had previously underwent a significant amount of physical therapy, but his symptoms were still lifestyle limiting. He was counseled about his treatment options and opted for ACR with dermal allograft, subscapularis repair, and pectoralis major tendon transfer. This procedure is described below in detail.

Surgical technique

Step 1: Pre-operative workup

The above case presents a complex patient in which anterior shoulder instability remained after 4 previous surgeries. His case was further complicated by a change in his native shoulder anatomy following a Bristow procedure. Pre-operative workup included a physical examination assessing range of motion and strength, as well as provocative testing. Plain radiographs [Figure 1] and MR arthrogram of the left shoulder were obtained.

Step 2: Starting the case

The procedure was performed with the patient under general anesthesia with an interscalene nerve block. The patient was placed in a beach chair position using a Spider positioner. Following physical examination of the left shoulder under anesthesia, standard preparation and draping of the shoulder were performed.

Step 3: Open technique

The previous deltopectoral incision was utilized and extended distally for the pectoralis tendon harvest. Skin flaps were developed down to the muscular fascia with the identification of the fat stripe between the pectoralis and deltoid. The cephalic vein was identified and dissected medially with the pectoralis major while the deltoid was swept off the proximal humerus. The pectoralis major muscle and anterior circumflex vessels were identified.

Step 4: Pectoralis major preparation

A #2 FiberWire was placed into the pectoralis major tendon as a traction suture while the entire tendon was incised from superior to inferior off the bone. Two #5 FiberWire sutures were placed using a Mason Allen stitch into the pectoralis tendon for later repair, and the tendon was mobilized ensuring complete excursion to the lesser tuberosity [Figure 2].



Figure 1: Anteroposterior radiograph of the left shoulder demonstrating a slightly bent screw from a prior Bristow procedure



Figure 2: FiberWire sutures placed as a Mason-Allen stitch into the pectoralis tendon for later repair

Step 5: Subscapularis bed preparation

An incision was made into the anterior capsule with care to ensure a 5×8 mm lateral stump off the lesser tuberosity. The rotator cuff interval was opened above the upper rolled border and taken medially. The capsule was lifted off the proximal humeral neck and a Fukuda retractor was placed. At this point, the cartilage of the humeral head and glenoid was inspected for defects, and none were noted.

Step 6: Glenoid anchor placement

Glenoid anchors were placed at 6 o'clock, 7:30, and 9 o'clock position for later repair [Figure 3].

Step 7: Humeral anchor placement

The anterior capsule stump was dissected off the lesser tuberosity and three single-loaded suture anchors were placed along the anatomic neck of the proximal humerus in a



Figure 3: Glenoid anchors placed at 6 o'clock, 7:30, and 9 o'clock position



Figure 4: Three single-loaded suture anchors placed along the anatomic neck of the proximal humerus

non-articular portion. The arm was placed in approximately 40–45° of adducted external rotation to avoid internal rotation and overtightening of the capsule when measuring the anchor distances [Figure 4].

Step 8: Graft preparation and placement

The dimensions of the dermal allograft were measured with a flexible suture passer. The FiberWire loaded in the six respective anchors was passed through the allograft; six strands medially and six strands laterally. The graft was tied down medially, with care taken to tie locking knots that cinched the graft all the way down [Figure 5]. The lateral sutures were then tensioned, passed through the allograft, and tied down [Figure 6]. The remaining lateral tendon was amputated and trimmed [Figure 7]. The anterior capsule was then tested to ensure there was no anterior translation or luxation of the humeral head. Native anterior capsule and subscapularis tissue were imbricated by tying together in



Figure 5: The graft was tied down medially, with care taken to tie locking knots that cinched the graft all the way down



Figure 6: The lateral sutures being passed through the allograft



Figure 7: The remaining lateral tendon was amputated and trimmed, and the anterior capsular reconstruction is completed

pants over vest fashion using #2 Ethibond and figure of eight sutures.

Step 9: Pectoralis major tenodesis

To prepare for the pectoralis tenodesis, two 4 mm holes were drilled in the lesser tuberosity. Two pectoralis tenodesis buttons were loaded with the FiberWire suture, previously placed in the pectoralis major tendon. The buttons were then placed into the drill holes and locked. One limb of the suture was passed through the tendon in a Mason-Allen fashion, ensuring excellent fixation of the pectoralis major head to the lesser tuberosity.

Step 10: Closure

The wound was irrigated and hemostasis obtained, followed by a layered closure.

Step 11: Post-operative care

The patient was placed in a sling without an abduction pillow, as a position of slight internal rotation was preferred to take tension off both the anterior repair and pectoralis tendon transfer. He was discharged home the day of surgery.

RESULTS

The first phase of rehabilitation (weeks 1–6) focused on protecting his repair. He remained in the sling during this period, coming out for pendulum exercises and elbow and wrist range of motion. Passive and active external rotation to $<30^{\circ}$, flexion to 130° , and scapular plane abduction to 90° was permitted. The second stage of rehabilitation (7–12 weeks) focused on improving his range of motion through formal physical therapy. The sling was discontinued and a lifting limit of 5 pounds was permitted. Scapular plane abduction up to 130° , internal and external rotation, and forward flexion

to tolerance were permitted. At 3 months, the patient entered the final phase of rehabilitation with goal for full function. Lifting and range of motion restrictions were discontinued.

At his 3-month follow-up visit, our patient was doing well. He reported occasional night pain but no symptoms of instability. Physical examination showed 150° of active forward elevation, 50° of external rotation, and internal rotation to L5. The patient reported occasional tremors in the operative extremity and subsequently underwent an electromyography study, which was normal.

DISCUSSION

The glenohumeral joint is inherently unstable, with only 25% of the humeral head contacting the glenoid at any point during shoulder range of motion.^[4] Due to this, the glenohumeral joint relies on a complex interplay of static and dynamic structures for stability.^[4] When shoulder stability is traumatically compromised, by far the most common direction of pathologic humeral head movement is anterior.^[4] If a trial of non-operative treatment fails or is not an option, the management of recurrent instability becomes complex and challenging. Furthermore, multiple failed surgeries for instability often render the anterior capsule insufficient, leaving the surgeon with few viable reconstructive options, as was the case with our patient.

Several surgical techniques have been described to address recurrent anterior instability of the shoulder, with varying results. The Bristow procedure is a method of joint stabilization in which the tip of the coracoid is transferred to the anteroinferior glenoid neck.^[6,7] Multiple modifications of this procedure have been made, but the essential result is a bone block of coracoid that has been transferred to reinforce the anterior inferior glenoid, using the subscapularis for augmented stability.^[6,7] In a 26-year follow-up of Naval midshipmen, Shroder et al. reported 71.2% of patients with a good or excellent Single Assessment Numeric Evaluation. However, recurrent instability occurred in 15.4% of their shoulders. Tendon transfers using pectoralis major, latissimus dorsi, tibialis anterior, and iliotibial band grafts have also been described with inconsistent results.[8-11] In Braun et al.'s series of 15 patients, they used tibialis anterior tendon allograft to reconstruct the main stabilizing structures of the anterior labrum.^[12] Adequate stability was gained in 70% of their shoulders and no further surgery was required, and the average ASES score increased by 37 points at a mean follow-up of 37 months. Six shoulders were considered failures and required further surgical treatment after a mean of 9 months. Alcid et al. reported a series of 15 patients after performing ACR with hamstring autograft and tibialis anterior allograft. At a minimum 2-year follow-up, one-third of their patients had symptomatic recurrent subluxations.^[13]

Acellular dermal allografts have been employed in superior capsular reconstruction procedures with encouraging results.^[14,15] According to Mihata *et al.*, this graft may act as a static stabilizer of the joint, as well as support rotator cuff reincorporation.^[16] More recently, a technique for ACR using acellular dermal allograft has been described for chronic anterior shoulder instability.^[2,5] This is a technically challenging procedure with unknown long-term outcomes but has advantages that make it attractive as a surgical solution for recurrent anterior shoulder instability after prior failed procedures. It is an anatomic reconstruction without donor site morbidity and is easy to prepare.^[2,5] Our modification of this technique uses an open approach, along with the addition a transfer of the pectoralis major tendon to the lesser tuberosity for additional anterior stability.

In summary, the treatment of recurrent anterior shoulder instability is challenging. This case report describes a modification of ACR using acellular dermal allograft, along with rotator cuff repair and pectoralis major tendon transfer for augmented anterior stability. We believe this to be a viable surgical option for recurrent anterior shoulder instability in an active patient population with lifestyle-limiting symptoms; however, long-term outcome data are needed.

ACKNOWLEDGMENTS

We would like to acknowledge Elyse Brinkmann, MD, for her hard work and dedication to patient care, and for providing the intraoperative photographs.

REFERENCES

- Moeckel BH, Altchek DW, Warren RF, Wickiewicz TL, Dines DM. Instability of the shoulder after arthroplasty. J Bone Joint Surg Am 1993;75:492-7.
- Pogorzelski J, Hussain ZB, Lebus GF, Fritz EM, Millett PJ. Anterior capsular reconstruction for irreparable subscapularis tears. Arthrosc Tech 2017;6:e951-e958.
- Mihata T, Lee TQ, Watanabe C, Fukunishi K, Ohue M, Tsujimura T, *et al.* Clinical results of arthroscopic superior capsule reconstruction for irreparable rotator cuff tears. Arthroscopy 2013;29:459-70.
- Dumont GD, Russell RD, Robertson WJ. Anterior shoulder instability: A review of pathoanatomy, diagnosis and treatment. Curr Rev Musculoskelet Med 2011;4:200-7.
- 5. Kwapisz A, Tokish JM. Anterior capsule reconstruction

technique with an acellular dermal allograft. Arthrosc Tech 2017;6:e1945-e1952.

- Schroder DT, Provencher MT, Mologne TS, Muldoon MP, Cox JS. The modified bristow procedure for anterior shoulder instability: 26-year outcomes in naval academy midshipmen. Am J Sports Med 2006;34:778-86.
- Thomas PR, Parks BG, Douoguih WA. Anterior shoulder instability with bristow procedure versus conjoined tendon transfer alone in a simple soft-tissue model. Arthroscopy 2010;26:1189-94.
- Iannotti JP, Antoniou J, Williams GR, Ramsey ML. Iliotibial band reconstruction for treatment of glenohumeral instability associated with irreparable capsular deficiency. J Shoulder Elbow Surg 2002;11:618-23.
- 9. Warner JJ. Management of massive irreparable rotator cuff tears: The role of tendon transfer. Instr Course Lect 2001;50:63-71.
- 10. Resch H, Povacz P, Ritter E, Matschi W. Transfer of the pectoralis major muscle for the treatment of irreparable rupture of the subscapularis tendon. J Bone Joint Surg Am 2000;82:372-82.
- 11. Herzberg G, Urien JP, Dimnet J. Potential excursion and relative tension of muscles in the shoulder girdle: Relevance to tendon transfers. J Shoulder Elbow Surg 1999;8:430-7.
- Braun S, Horan MP, Millett PJ. Open reconstruction of the anterior glenohumeral capsulolabral structures with tendon allograft in chronic shoulder instability. Oper Orthop Traumatol 2011;23:29-36.
- 13. Alcid JG, Powell SE, Tibone JE. Revision anterior capsular shoulder stabilization using hamstring tendon autograft and tibialis tendon allograft reinforcement: Minimum two-year follow-up. J Shoulder Elbow Surg 2007;16:268-72.
- Tokish JM, Beicker C. Superior capsule reconstruction technique using an acellular dermal allograft. Arthrosc Tech 2015;4:e833-9.
- 15. Burkhart S, Denard P, Tokish J, Brady P. Preliminary results of arthroscopic superior capsule reconstruction with dermal allograft. Arthroscopy 2017;33:e20.
- Mihata T, McGarry MH, Pirolo JM, Kinoshita M, Lee TQ. Superior capsule reconstruction to restore superior stability in irreparable rotator cuff tears: A biomechanical cadaveric study. Am J Sports Med 2012;40:2248-55.

How to cite this article: Schneider AM, Burr RG, Liles JP, Davis W, Garbis N, Salazar DH. A Modification of Anterior Capsular Reconstruction using Acellular Dermal Allograft with Pectoralis Major Tendon Transfer: A Case Report. Clin Res Orthop 2018;1(2):1-5.