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Operative Techniques in

Sports Medicine

Open Latarjet Reconstruction: Tips for Success

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The Latarjet coracoid transfer is a key procedure for reducing anterior shoulder instability in patients with glenoid bone loss. New evidence suggests that subcritical glenoid bone loss, particularly in revision situations, portends an increased risk of recurrent instability. High recurrent instability rates associated with nonoperative management and revision soft tissue stabilization make the Latarjet and other bony stability procedures a must in an orthopaedic surgeons repertoire of recurrent anterior instability management. The long-term outcomes of the Latarjet surpass revision stabilization by soft-tissue correction in those with significant glenoid loss. Despite the promising outcomes of the Latarjet, the complication rate remains high. We present a practical guide to the open Latarjet procedure, addressing many of technical challenges to aid the reader in future decision-making regarding indications, approach, exposure, surgical technique, and rehabilitation.
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KEYWORDS Latarjet, bony stabilization, glenoid bone loss, shoulder instability, subluxation, surgical technique, indication

Introduction

Anterior shoulder instability is a prominent problem in athletes, affecting both their physical ability to perform and their self-assessed condition.[1,2] Patients with primary instability often go on to develop recurrent instability at rates as high as 40%-76%.[3-5] Recurrent instability events further destabilize the shoulder, secondary to capsular laxity, glenoid lesions and humeral head Hill-Sachs lesions.[6,7] Ninety percent of patients with recurrent instability exhibit osseous Bankart lesions or irregularities of the glenoid rim, with previous studies suggesting up to 61% having bipolar bone loss.[6,8,9] Even subcritical glenoid bone loss, particularly in revision situations, has been shown to significantly increase the risk of recurrent instability.[10,11] Recurrent instability of the shoulder requires surgical correction to prevent further dislocation events, progressive glenoid and humeral head bone loss, and decreased quality of life.[7,12] Surgical options for the treatment of anterior shoulder instability include soft tissue procedures, such as labral repair, capsular reconstruction, Bankart repair and remplissage. Bony procedures, such as the Latarjet coracoid transfer, distal tibial allograft, and iliac crest bone grafting are usually reserved for those who fail soft tissue correction or have significant bony deficits such as an inverted-pear glenoid.[13]

The Latarjet coracoid transfer is a bony technique commonly performed in those with recurrent instability. When compared to soft tissue repair, it offers superior results with respect to instability event recurrence, perceived apprehension and patient satisfaction.[14,15] Recurrent instability rates after the Latarjet procedure are reduced to single digits, whereas after soft tissue repair they are greater than 20%.[14,16] Nonetheless, the Latarjet procedure does carry a risk of complications, with rates ranging from 5% to 30%.[17-20] The most common complications include transient neurologic injury, infections, hardware related complications, dislocations, subluxations, and reoperation.[17,18] Although more traditionally performed open, the Latarjet procedure can also be undertaken

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arthroscopically. Multiple studies demonstrate a significant learning curve to the arthroscopic technique and possibly a higher rate of persistent apprehension and redislocation.[19,21] Surgical preference aside, every shoulder surgeon should have a working understanding of the open technique in order to provide a patient the best chance of improved stability and reduced complication risk. We present a technical guide to the open Latarjet in the treatment of recurrent anterior instability. Appropriate exposure of the anterior glenoid is critical in harvesting the coracoid and positioning the graft for optimal outcomes. Important variations in surgical technique, such as location and technique for subscapularis transection, are also covered.

Indications

When evaluating a patient with recurrent anterior shoulder instability it is important to establish the mechanism of primary injury, identify predisposing factors, and determine event frequency. Surgical history and previous imaging should be obtained. A through evaluation includes determination of involvement in sports and functional expectations. Physical examination should include the patient's range of motion (ROM), strength, and neurovascular status to exclude neurologic sequelae specific to recurrent dislocations (eg, axillary nerve injury). Specific anterior instability exam maneuvers include anterior, posterior, superior, and inferior load and shift, apprehension and relocation testing, anterior release, sulcus sign, and anterior drawer.

Imaging workup includes anterior-posterior (AP) and axillary radiographs, computerized tomography (CT) and magnetic resonance imaging (MRI)of the affected shoulder. Radiographs establish the alignment of the humeral head in the glenoid and display obvious bony deformities; MRI examines the integrity of soft tissue elements important to glenohumeral stability and motion; CT further defines bony anatomy to characterize bone lesions. CT scan should include 3D reconstruction with humeral subtraction to allow an en face view of the glenoid for calculation of bone deficit percentage.

Indications for performing a Latarjet procedure include failure of a previous soft tissue arthroscopic repair and the presence of glenoid bone loss or bipolar lesion. The critical bone loss at which Latarjet is recommended over soft tissue repair can vary between 15% and 25%, dependent on the entirely of the clinical picture and the patient's functional expectations.[22] More traditional bone loss thresholds of 20%-25% have been challenged by recent data showing that soft tissue repair in patients with >13.5% glenoid bone loss leads to disproportionate recurrent instability events.[10,11]

Surgical Technique

Anesthesia

General anesthesia is preferred for this operation, ensuring full muscle relaxation for appropriate retraction and exposure during the procedure. An adjunctive interscalene nerve block has been shown to reduce postoperative pain and analgesic requirements and increase patient satisfaction scores in those undergoing arthroscopic and open shoulder surgery.[23,24]

Patient Positioning and Portal Placement—Shoulder Arthroscopy

An exam under anesthesia is performed to confirm the characteristics of the patient's instability. Grade 3 anterior translation with “locking” of the humeral head in a dislocated position indicates presence of engaging lesion and confirms the indication for bone transfer. Initial diagnostic shoulder arthroscopy is performed in most patients to further evaluate the posterior labrum, the anterior components of instability, and address additional surgical corrections if needed. If the arthroscopy is undertaken, the patient is repositioned prior to the Latarjet. For the shoulder arthroscopy, the patient is placed in a beach chair position, sitting up at 70°. The patient should be brought to the edge of the bed such that the medial border of the scapula is at the edge of the bed. This allows the scapula to fully retract on external rotation and abduction, lateralizing the neck of the coracoid for glenoid neck exposure (Fig. 1). This is in contrast to the positioning for a total shoulder arthroplasty, where the scapula is elevated with a towel to allow exposure of the glenoid face. The forearm is placed in an articulated arm holding device (Spider2 Limb Positioner, Smith & Nephew, Andover, MA).

Patient Repositioning and Deltopectoral Approach—Open Latarjet

After a standard shoulder arthroscopy has been performed, the patient is positioned for the open Latarjet by lowering the head of the bed to a 20-30° incline and abducting and externally rotating the arm. The incision is made 4-5 cm in length, with the superior portion starting 1 cm lateral and inferior to the coracoid process toward the inferior axillary fold (Fig. 1).

Coracoid Exposure

Using the 4-5 cm coracoid-axillary incision, the standard deltopectoral interval is developed and the cephalic vein is mobilized laterally. The conjoint tendon is identified and coracoacromial (CA) ligament is released laterally followed by release of the coracohumeral ligament thereafter to ease coracoid transfer after osteotomy. If desired, the transected CA ligament may be used later to augment capsular closure (Fig. 2). The interval between the conjoint tendon and pectoralis minor is identified and the pectoralis minor is dissected subperiosteally from its insertion using a needle tip bovie to expose the coracoid for osteotomy. Distal dissection is completed with an elevator. The medial coracoid neck and coracoclavicular ligaments are palpated to determine the extent of the osteotomy. The pectoralis minor is not repaired,

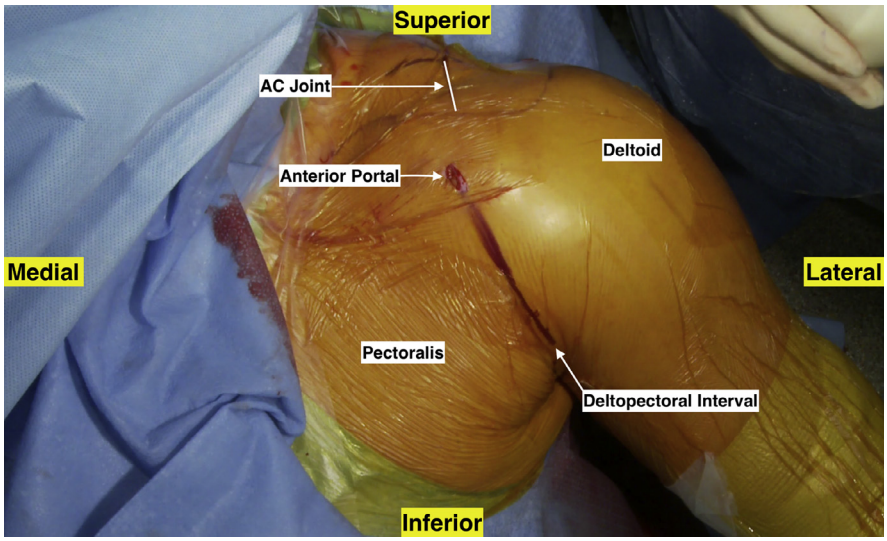

Figure 1 Patient positioning and approach. The patient remains in a beach chair position after diagnostic arthroscopy, with the head of the table adjusted to a 20-30° incline. The left shoulder is abducted and externally rotated to retract the scapula and optimally position the glenoid neck for surgical manipulation.

given repair can lead to excessive medialization and possible impingement on the brachial plexus. The coracoid is marked by bovie at the anterior edge and 2 cm proximal to the tip to ensure enough graft is taken for transfer (Fig. 3). The coracoid is cut medially with a 90° oscillating saw and the osteotomy is completed with a curved osteotome (Fig. 3). Once the osteotomy is complete, a bovie is used to release the medial insertion of the coracohumera ligament to release the coracoid fragment. With the coracoid released, the conjoint tendon is bluntly dissected distally. Careful attention paid to the musculocutaneous nerve, which usually runs 3-5 cm distal to the coracoid process and can be injured during mobilization.

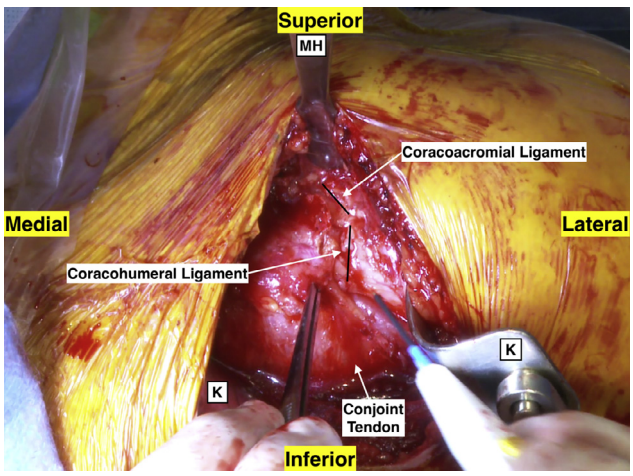

Figure 2 Coracoacromial and coracohumeral ligament transections. Placement of a pointed innomed mini Hohmann retractor on the proximal aspect of the coracoid process enhances visualization of relevant structures. Of specific interest is the CA ligament, pictured above, which is transected along with portions of the CH ligament. K, innomed Kolbel retractor; MH, pointed mini Hohmann retractor.

Graft Preparation and Position

After release of the coracoid, it is clamped and rotated to expose its inferior surface. The inferior surface is decorticated using saw or burr to create a flat articulating surface with the prepared glenoid surface and optimize likelihood of successful bony fusion (Fig. 4). The coracoid guide is used to plan out screw hole positioning and predrill 2 holes. The 2 bicortical screws can be placed 10 or 15 mm apart depending upon size of coracoid graft and receptive glenoid surface (Fig. 4). Once the holes are predrilled through the coracoid, the future screw entry site is marked by bovie to aid in finding the holes during screw placement. Next, the offset is measured from the center of the proximal predrilled hole to the articulating edge of the coracoid. This determines glenoid neck screw position for optimal articular congruity (Fig. 5). Depth is also measured to help determine screw length for eventual fixation.

The method described above for coracoid positioning is the standard/traditional technique for Latarjet, in which the lateral surface of the coracoid acts as the articular surface, as opposed to the congruent arc technique in which the coracoid is rotated such that the inferior surface of the coracoid becomes the articular surface.[25] The advantage to the congruent arc modification technique is that it provides a wider dimension of the coracoid for the articular surface, thus increasing the AP dimension of the glenoid more than the standard technique.[26,27] There is also evidence to suggest that the inferior surface of the coracoid provides better congruence with the glenohumeral joint than does the lateral surface.[26,28-30] Despite these advantages, the congruent arc technique has some drawbacks including decreased superior to inferior coracoid thickness, decreased surface area for bony fusion and increased difficulty in screw placement during graft fixation secondary to a more narrow bony block.[27,31] The narrower but longer bone block of the

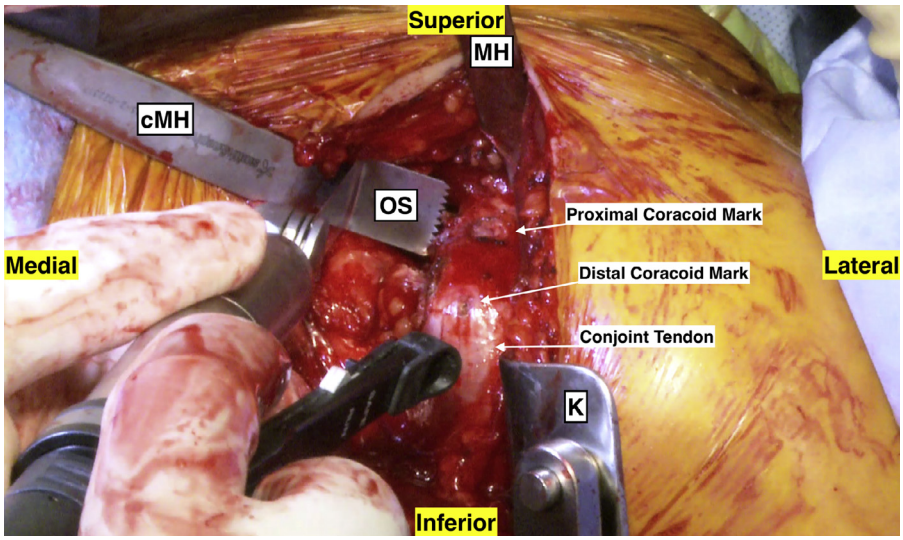

Figure 3 Coracoid osteotomy. The coracoid osteotomy is made proximal to the proximal coracoid mark using a 90 degree oscillating saw, ensuring at least 2 cm of coracoid for transfer. cMH, curvilinear mini Hohmann retractor; K, innomed Kolbel retractor; MH, pointed mini Hohmann retractor; OS, oscillating saw.

congruent arc technique leads to a higher concern for fracture and an increased lever arm, which could lead to screw failure.[27,31] Due to these concerns, the author feels that the standard technique provides sufficient anterior posterior bony correction and appropriate joint congruity without the unnecessary risk of screw failure. If larger bony correction is felt to be necessary, a distal tibial allograft would be preferred by the author.[32]

Glenoid Exposure

The glenoid is exposed via subscapularis dissection and horizontal capsulotomy. The margins of the subscapularis are defined inferiorly by the anterior circumflex vessels, laterally by the long head of the biceps, and superiorly by the biceps and rotator cuff interval. The subscapularis is split horizontally at about the 50-yard line. Performing a subscapularis split allows one to maintain the integrity of the subscapularis, with some data suggesting that tenotomy or an L-shaped incision of the subscapularis can lead to subscapularis atrophy and reduced subscapularis strength compared to the subscapularis split technique.[33-35] The level of subscapularis split should be low enough to visualize inferior glenoid, usually at the 50-yard line or at one-third to two-thirds from the inferior border of the subscapularis (Fig. 7). Dissection begins in the muscle, medial to the musculotendinous

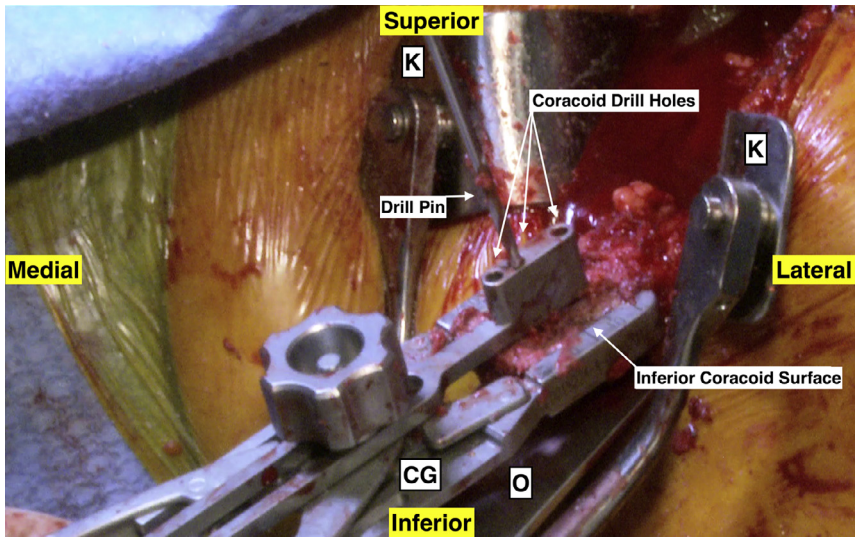

Figure 4 Inferior coracoid surface and drill holes. A coracoid guide is used to grasp the coracoid, exposing its inferior surface for decortication. The guide is designed to facilitate the drilling of 2 holes, as pictured above. The specific drill holes are chosen based on the size of the coracoid graft for transfer. The drill exit sites on the superior glenoid surface are marked with bovie for ease of visualization. CG, coracoid guide; K, innomed Kolbel retractor; O, broad flat osteotome.

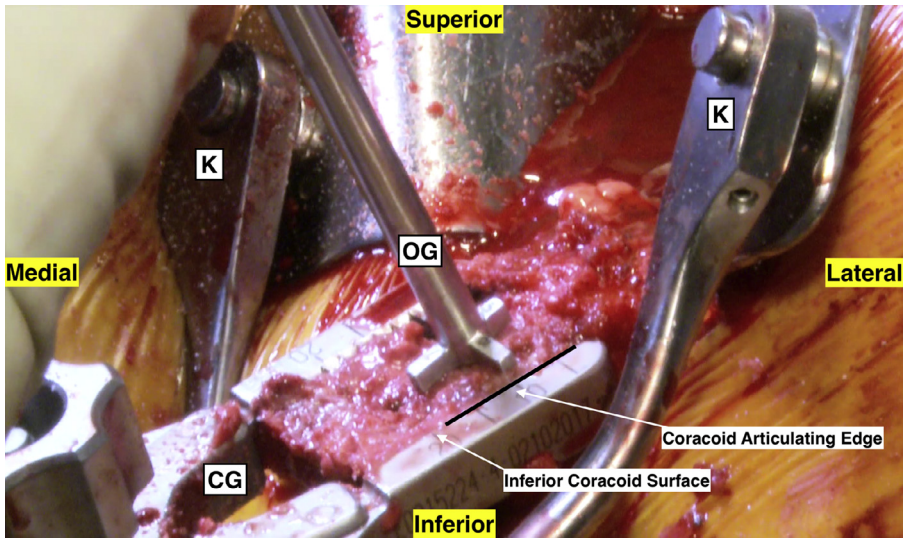

Figure 5 Offset guide. The offset guide measures the distance from the center of the coracoid drill holes to the articular edge. Accounting for graft offset helps ensure a smooth gleno-coracoid articular surface. Coracoid depth is measured thereafter using a depth gauge. CG, coracoid guide; K, innomed Kolbel retractor; OG, offset guide.

junction where the capsule can be easily identified. The capsule is bluntly dissected to establish the capsule-subscapularis interval. The glenoid can be localized in this interval via palpation. In some cases, due to anterior translation of the humerus, a posterior directed force can reduce the humerus and allow for improved dissection and palpation. The capsule is horizontally incised, using caution not to damage the articular surfaces underneath. The capsulotomy is then extended horizontally to fully expose the anterior glenoid and a place a Fukuda retractor (Fig. 6). The capsule and labrum are bluntly elevated both superiorly and inferiorly to create capsular flaps that are tagged for later repair. Once this capsule is peeled away with assistance of a bovie, the bony anterior glenoid margin is exposed. Exposure is facilitated using a glenoid neck pitch fork type retractor (Fig. 6).

Coracoid Fixation

Once the glenoid neck is exposed, the anterior surface of the glenoid neck is decorticated to create a flat surface and increase fusion potential of the graft. An offset drill guide is selected corresponding to the offset measurement obtained during graft preparation. The inferior hole is drilled bicortically on the glenoid neck, angling 15° away from the joint line using the paddle on the offset guide placed flush to the glenoid face. The typical position is 5 o'clock. Once the initial glenoid hole is drilled, depth is measured bicortically to determine screw size for graft fixation. Screw placement starts with placement of threaded cannulated screw through the coracoid, leaving 1 cm protruding through the coracoid. Finding the glenoid pilot hole can be made easier by passing a guide wire through the cannulated screw that is in the

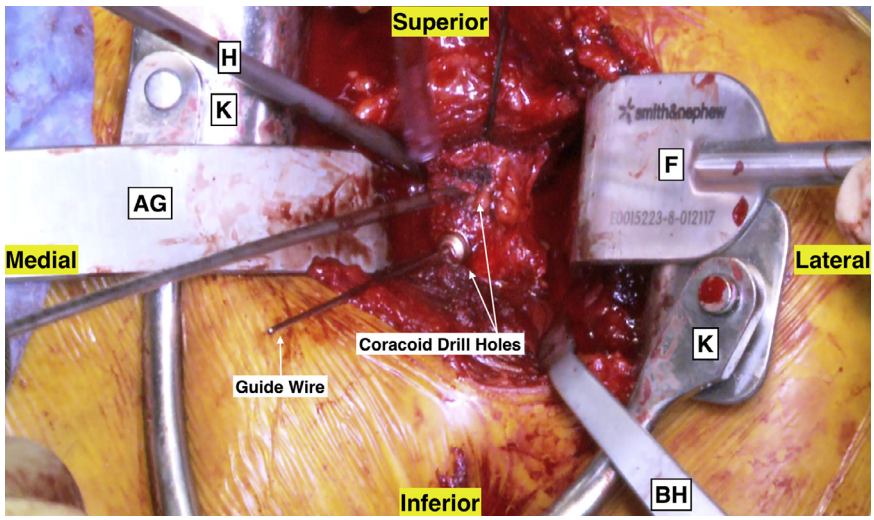

Figure 6 Coracoid drilling. The 1st screw is tightened, allowing for rotation of the coracoid to match offset prior to drill hole placement. During drilling of the 2nd pilot hole, the guide wire is maintained within the 1st coracoid drill hole to help match the drill angle. AG, anterior glenoid retractor; BH, narrow bent Hohmann retractor; F, Fukuda retractor; H, hex screwdriver; K, innomed Kolbel retractor.

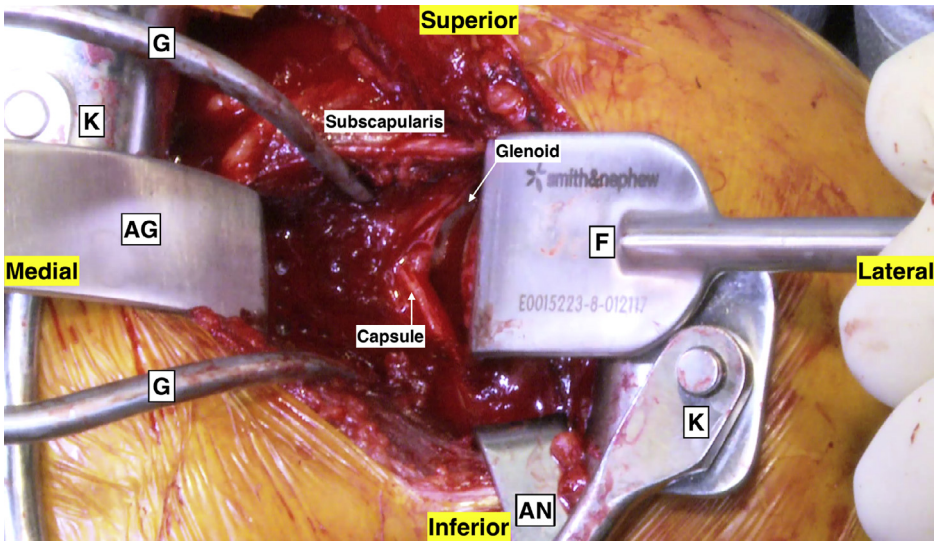

Figure 7 Anterior glenoid exposure. The innomed Gelpi retractor is placed in a superior-inferior direction, developing the interval of the subscapularis split and exposing the underlying shoulder capsule. An innomed Kolbel retractor maintains the deltopectoral interval. A Fukuda retractor is placed through the anterior capsulotomy into the glenohumeral joint and an anterior glenoid retractor is placed deep to the subscapularis to expose the anterior glenoid neck. AG, anterior glenoid retractor; AN, army navy retractor; F, Fukuda retractor; G, innomed Gelpi retractor; K, innomed Kolbel retractor.

coracoid. Once the coracoid is seated against the anterior glenoid, articular congruity is checked. The coracoid should be flush to slightly recessed compared with the glenoid surface. Any overhang of the coracoid is corrected to prevent alterations in shoulder biomechanics.[26] For placement of the second screw, the guide wire is replaced into the first screw to help ensure parallel screw positioning (Fig. 6). While seating both screws, they are tightened in an alternating fashion to bring down the graft evenly. Once the graft is seated firmly against the glenoid neck, angular congruity with the glenoid is rechecked. Any overhang is corrected with a burr or with repositioning of the graft.

Retraction and Instrumentation

Retraction during the open Latarjet procedure is critical for coracoid osteotomy and graft placement. Appropriate coracoid exposure is achieved with use of Gelpi and Kolbel retractors in maintenance of the deltopectoral interval. A pointed innomed mini Hohmann retractor can be placed superior to the coracoid to allow for exposure and transection of the CA ligament (Fig. 2). A curvilinear innomed mini Hohmann retractor placed on the medial coracoid surface to create the exposure necessary for oscillating saw osteotomy (Fig. 3).

An innomed Gelpi retractor is used to maintain the interval between the subscapularis and the capsule for glenoid exposure after the subscapularis is split (Fig. 7). Following anterior capsulotomy, a Fukuda retractor helps mobilize the glenohumeral joint (Fig. 7). Using the Fukuda retractor, the humeral head is retracted laterally to allow for visualization of the articulating surface of the glenoid. Subsequently, an anterior glenoid retractor is placed in subscapularis-capsule interval, further exposing the anterior glenoid surface for decortication and eventual coracoid fixation (Fig. 7). Removal of the Kolbel may facilitate further retraction of the glenoid retractor for optimal anterior glenoid visualization.

Capsule Management

Once the coracoid is fixed to the glenoid, the capsule is repaired. There are several different methods by which to make the capsular closure, much of which depends on the

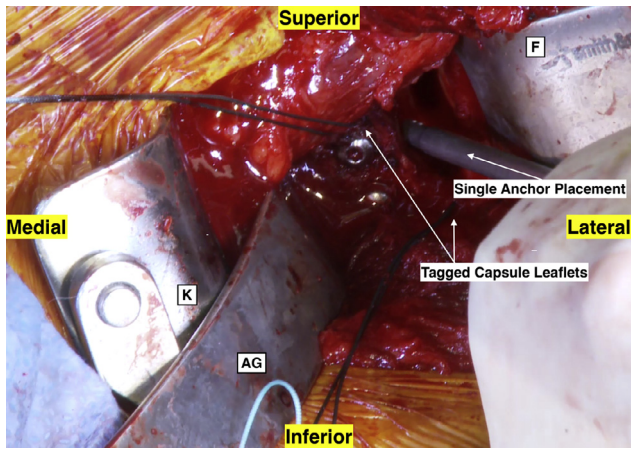

Figure 8 Single anchor placement for inferior capsular closure. Two tagged leaflets of the inferior and superior capsule are pictured, previously transected and to be repaired after coracoid fixation. The position of the single anchor is at the articulation of the glenoid and the graft, with care placed to avoid the metal screws attaching graft to glenoid. AG, anterior glenoid retractor; F, Fukuda retractor; K, innomed Kolbel retractor.

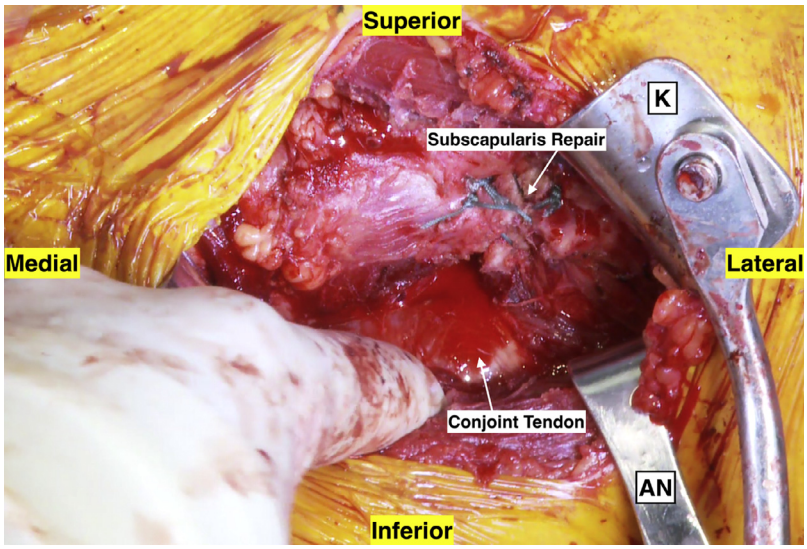

Figure 9 Capsular and subscapularis repair. The conjoint tendon runs inferior and medial to the subscapularis. Also pictured is the subscapularis repair, which is completed laterally. AN, army navy retractor; K, innomed Kolbel retractor.

orientation of capsular incision and surgeon preference. If a vertical capsular incision was made, then the remnant CA ligament can be integrated into the lateral capsule. If a horizontal capsular incision was made, the CA ligament on the coracoid can be incorporated into the capsular repair in a pants over vest fashion. Some will attach the capsule to the screws, or to an anchor, while others will not close the capsule altogether.

The authors preference for capsular closure involves the placement of a single anchor between the graft and glenoid in the AP direction, and between the screws in a superior inferior direction, such that the graft remains extraarticular in relation to the capsular repair (Fig. 8). This maintains anatomical reduction and ensures proper tensioning of the capsular tissue to reduce the risk of an insufficient inferior capsule. The capsule and subscapularis split are closed lateral to the coracoid insertion (Fig. 9). If repairable, the authors

Table 1 Surgical Pitfalls and Technical Pearls

Surgical Pitfalls	Pearls
Inappropriate anterior inferior glenoid exposure and improper graft placement	- Remove the Kolbel retractor - Apply less force on Fukuda retractor, more force on anterior glenoid retractor - Ensure medial aspect of scapula aligns with lateral edge of bed to allow full retraction
Difficulty finding glenoid pilot hole for screw placement leading to increased operative time	- Place guide wire through coracoid screw and utilize wire to find glenoid pilot hole - During coracoid graft harvesting, mark superficial surface screw exit sites with bovie
Iatrogenic neurologic injury to: • Suprascapular nerve • Musculocutaneous nerve	- Suprascapular Nerve: ensure appropriate exit site of superior screw to avoid entrapment, with $<28^{\circ}$ medial tilt in the axial plane and $<29^{\circ}$ of inclination in the coronal plane[38] - Musculocutaneous Nerve: utilize soft blunt dissection to free nerve from coracoid attachments and further traction
Inappropriate graft placement leading to inappropriate articular incongruity	- Ensure 2 o'clock and 5 o'clock screw position on the glenoid neck - Lightly tighten inferior screw to allow for rotation of coracoid prior to fixation - Leave guide wire in inferior screw hole to match screw trajectories - Utilize offset guide to help approximate chondral surface of the glenoid[39] - Ensure alignment of coracoid-glenoid articular surface after fixation, fixing any incongruences with a burr

will also fix the superior capsule, but this can be difficult with the presence of a large coracoid bone block.

Rehabilitation

The authors preference for rehabilitation protocol includes use of an Ultrasling for 4 weeks. The patient is allowed to start full passive ROM of the elbow and wrist immediately and passive ROM of the shoulder at 10 days postoperatively. Passive shoulder ROM is first limited to external rotation to 30° with the arm at the side and forward elevation to 120°. The patient is advanced to full ROM 4 weeks postoperatively. Strengthening is started at 10-12 weeks. The author normally obtains a postoperative CT at 4 months to evaluate for bony union. If the patient has good bony union and full ROM with adequate strength, they may return to unrestricted activities at 4 months postoperation.

Conclusion

The Latarjet coracoid transfer remains a common treatment option for recurrent anterior shoulder instability, particularly in cases of concurrent glenoid bone loss.[14,15] Transfer of the coracoid process brings anterior stability to the shoulder joint via a combination of the "sling" effect, which provides dynamic support due to repositioning of the conjoint tendon, the "bony block" effect, and restoration of capsular tension.[36,37] The mechanisms listed may help to explain single digit instability recurrence rates after Latarjet, in comparison to double digit instability recurrence rates after soft-tissue correction.[14-16] The indications for Latarjet are expanding with new studies showing that even minimal glenoid bone loss predisposes to increased recurrence of instability.[6,8,10,11] Thus, understanding the technique of an open Latarjet is imperative in providing glenoid bone loss or revision patients the best chance at success after surgery while avoiding preventable complications (Table 1).[17-20]

Conflicts of Interest

Brandon J. Manderle, Alexander Beletsky, Joseph N. Liu, Grant H. Garcia: None.

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References

1. Kawasaki T, Ota C, Urayama S, et al: Incidence of and risk factors for traumatic anterior shoulder dislocation: an epidemiologic study in high-school rugby players. J Shoulder Elbow Surg 23(11):1624-1630, 2014
2. Owens BD, Duffey ML, Nelson BJ, et al: The incidence and characteristics of shoulder instability at the United States Military Academy. Am J Sports Med 35(7):1168-1173, 2007
3. Olds M, Ellis R, Donaldson K, et al: Risk factors which predispose first-time traumatic anterior shoulder dislocations to recurrent instability in adults: a systematic review and meta-analysis. Br J Sports Med 49(14):913-922, 2015
4. Roberts SB, Beattie N, McNiven ND, et al: The natural history of primary anterior dislocation of the glenohumeral joint in adolescence. Bone Joint J 97-B(4):520-526, 2015
5. Leroux T, Wasserstein D, Veillette C, et al: Epidemiology of primary anterior shoulder dislocation requiring closed reduction in Ontario, Canada. Am J Sports Med 42(2):442-450, 2014
6. Piasecki DP, Verma NN, Romeo AA, et al: Glenoid bone deficiency in recurrent anterior shoulder instability: diagnosis and management. J Am Acad Orthop Surg 17(8):482-493, 2009
7. Haber DB, Sanchez A, Sanchez G, et al: Bipolar Bone Loss of the Shoulder Joint due to Recurrent Instability: Use of Fresh Osteochondral Distal Tibia and Humeral Head Allografts. Arthrosc Tech 6(3):e893-e899, 2017
8. Sugaya H, Moriishi J, Dohi M, et al: Glenoid rim morphology in recurrent anterior glenohumeral instability. J Bone Joint Surg Am 85-A (5):878-884, 2003
9. Nakagawa S, Ozaki R, Take Y, et al: Relationship Between Glenoid Defects and Hill-Sachs Lesions in Shoulders With Traumatic Anterior Instability. Am J Sports Med 43(11):2763-2773, 2015
10. Shaha JS, Cook JB, Song DJ, et al: Redefining "Critical" Bone Loss in Shoulder Instability: Functional Outcomes Worsen With "Subcritical" Bone Loss. Am J Sports Med 43(7):1719-1725, 2015
11. Dickens JF, Owens BD, Cameron KL, et al: The Effect of Subcritical Bone Loss and Exposure on Recurrent Instability After Arthroscopic Bankart Repair in Intercollegiate American Football. Am J Sports Med 45(8):1769-1775, 2017
12. Hovelius L, Olofsson A, Sandstrom B, et al: Nonoperative treatment of primary anterior shoulder dislocation in patients forty years of age and younger. a prospective twenty-five-year follow-up. J Bone Joint Surg Am 90(5):945-952, 2008
13. Lo IK, Parten PM, Burkhart SS: The inverted pear glenoid: an indicator of significant glenoid bone loss. Arthroscopy 20(2):169-174, 2004
14. Zimmermann SM, Scheyerer MJ, Farshad M, et al: Long-Term Restoration of Anterior Shoulder Stability: A Retrospective Analysis of Arthroscopic Bankart Repair Versus Open Latarjet Procedure. J Bone Joint Surg Am 98(23):1954-1961, 2016
15. Burkhart SS, De Beer JF, Barth JR, et al: Results of modified Latarjet reconstruction in patients with anteroinferior instability and significant bone loss. Arthroscopy 23(10):1033-1041, 2007
16. Owens BD, DeBerardino TM, Nelson BJ, et al: Long-term follow-up of acute arthroscopic Bankart repair for initial anterior shoulder dislocations in young athletes. Am J Sports Med 37(4):669-673, 2009
17. Gartsman GM, Waggenspack WN Jr., O'Connor DP, et al: Immediate and early complications of the open Latarjet procedure: a retrospective review of a large consecutive case series. J Shoulder Elbow Surg 26 (1):68-72, 2017
18. Yang JS, Mazzocca AD, Cote MP, et al: Recurrent Anterior Shoulder Instability With Combined Bone Loss: Treatment and Results With the Modified Latarjet Procedure. Am J Sports Med 44(4):922-932, 2016
19. Griesser MJ, Harris JD, McCoy BW, et al: Complications and re-operations after Bristow-Latarjet shoulder stabilization: a systematic review. J Shoulder Elbow Surg 22(2):286-292, 2013
20. Shah AA, Butler RB, Romanowski J, et al: Short-term complications of the Latarjet procedure. J Bone Joint Surg Am 94(6):495-501, 2012
21. Hurley ET, Lim Fat D, Farrington SK, et al: Open Versus Arthroscopic Latarjet Procedure for Anterior Shoulder Instability: A Systematic Review and Meta-analysis. Am J Sports Med 47(5):1248-1253, 2019
22. Chen AL, Hunt SA, Hawkins RJ, et al: Management of bone loss associated with recurrent anterior glenohumeral instability. Am J Sports Med 33(6):912-925, 2005
23. Hughes MS, Matava MJ, Wright RW, et al: Interscalene brachial plexus block for arthroscopic shoulder surgery: a systematic review. J Bone Joint Surg Am 95(14):1318-1324, 2013
24. Baskan S, Cankaya D, Unal H, et al: Comparison of continuous interscalene block and subacromial infusion of local anesthetic for postoperative analgesia after open shoulder surgery. J Orthop Surg (Hong Kong) 25 (1):2309499016684093, 2017
25. McHale KJ, Sanchez G, Lavery KP, et al: Latarjet Technique for Treatment of Anterior Shoulder Instability With Glenoid Bone Loss. Arthrosc Tech 6(3):e791-e799, 2017

26. Ghodadra N, Gupta A, Romeo AA, et al: Normalization of glenohumeral articular contact pressures after Latarjet or iliac crest bone-grafting. J Bone Joint Surg Am 92(6):1478-1489, 2010
27. Montgomery SR, Katthagen JC, Mikula JD, et al: Anatomic and Biomechanical Comparison of the Classic and Congruent-Arc Techniques of the Latarjet Procedure. Am J Sports Med 45(6):1252-1260, 2017
28. Armitage MS, Elkinson I, Giles JW, et al: An anatomic, computed tomographic assessment of the coracoid process with special reference to the congruent-arc latarjet procedure. Arthroscopy 27(11):1485-1489, 2011
29. Dehaan A, Munch J, Durkan M, et al: Reconstruction of a bony bankart lesion: best fit based on radius of curvature. Am J Sports Med 41 (5):1140-1145, 2013
30. Noonan B, Hollister SJ, Sekiya JK, et al: Comparison of reconstructive procedures for glenoid bone loss associated with recurrent anterior shoulder instability. J Shoulder Elbow Surg 23(8):1113-1119, 2014
31. Dumont GD, Vopat BG, Parada S, et al: Traditional Versus Congruent Arc Latarjet Technique: Effect on Surface Area for Union and Bone Width Surrounding Screws. Arthroscopy 33(5):946-952, 2017
32. Bhatia S, Van Thiel GS, Gupta D, et al: Comparison of glenohumeral contact pressures and contact areas after glenoid reconstruction with latarjet or distal tibial osteochondral allografts. Am J Sports Med 41 (8):1900-1908, 2013
33. Paladini P, Merolla G, De Santis E, et al: Long-term subscapularis strength assessment after Bristow-Latarjet procedure: isometric study. J Shoulder Elbow Surg 21(1):42-47, 2012
34. Ersen A, Birisik F, Ozben H, et al: Latarjet procedure using subscapularis split approach offers better rotational endurance than partial tenotomy for anterior shoulder instability. Knee Surg Sports Traumatol Arthrosc 26(1):88-93, 2018
35. Scheibel M, Tsynman A, Magosch P, et al: Postoperative subscapularis muscle insufficiency after primary and revision open shoulder stabilization. Am J Sports Med 34(10):1586-1593, 2006
36. Yamamoto N, Muraki T, An KN, et al: The stabilizing mechanism of the Latarjet procedure: a cadaveric study. J Bone Joint Surg Am 95 (15):1390-1397, 2013
37. Giles JW, Boons HW, Elkinson I, et al: Does the dynamic sling effect of the Latarjet procedure improve shoulder stability? A biomechanical evaluation. J Shoulder Elbow Surg 22(6):821-827, 2013
38. Shishido H, Kikuchi S: Injury of the suprascapular nerve in shoulder surgery: an anatomic study. J Shoulder Elbow Surg 10(4):372-376, 2001
39. Gupta A, Delaney R, Petkin K, et al: Complications of the Latarjet procedure. Curr Rev Musculoskelet Med 8(1):59-66, 2015