Technical Note

Arthroscopic Posterior Glenoid Reconstruction With Distal Clavicle Bone-Block

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Abstract: Posterior glenoid bone loss is a potential cause for failure in arthroscopic capsulolabral repair. Although multiple techniques have been described to reconstruct posterior bone defects, they do not reliably yield improved patient outcomes and have high complication rates. We present a technique to reconstruct posterior glenoid bone loss using a distal clavicle autologous bone graft harvested by a mini-open approach and secured arthroscopically with suture buttons. The graft is positioned extra-articularly by repairing the posterior labral complex with a knotless fixation using labral tape.

Posterior shoulder instability, although previously regarded as rare, is increasingly being recognized as a cause of pain and dysfunction, particularly in young athletes.[1] Most patients can be successfully treated conservatively with physical therapy.[2] However, when conservative management fails, capsulolabral repair is the first line of surgical treatment. Nevertheless, in patients with smaller glenoid width and posterior glenoid bone loss, soft tissue repair alone may be insufficient.[3]

Multiple graft options have been described to reconstruct both posterior and anterior glenoid defects. Recently the distal clavicle has been proposed as a graft source, being cost-effective, promptly available, and with minimal donor site morbidity.[4] Arthroscopic fixation of this graft with suture buttons has been described for anterior instability.[5,6] The current technique describes the use of distal clavicle autograft to reconstruct posterior bone defects arthroscopically using all-suture anchors and suture buttons (Video 1).

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Surgical Technique

Preoperative Evaluation

Before deciding on posterior bone block augmentation, patients undergo both magnetic resonance imaging to assess soft tissue pathology and computed tomography to determine the degree of bone loss. Three-dimensional reconstruction aids in planning both to quantify the size of the bone defect and to determine the optimal location of the graft.[7]

Surgery is performed with the patient under general anesthesia in combination with an interscalene block. An examination with the patient under anesthesia is performed to determine the direction and degree of glenohumeral instability. The patient is then positioned in the lateral decubitus with the operative shoulder and arm prepped and draped in a sterile fashion. The limb is positioned in a traction system with 10 lb of balanced traction. Although frequently used in anterior instability, when approaching the posterior glenohumeral area, we recommend not using a bolster under the arm to optimize visualization and facilitate posterior labrum exploration.

Arthroscopic Assessment

A standard posterior portal is created. Two working portals are made, both anteriorly through the rotator interval and anterosuperiorly, with an outside-in technique to position 8 mm and 7.5 mm cannulas. By viewing from the anterosuperior portal, the correct position of the posterior portal is verified to confirm it is parallel to the glenoid surface.

Graft Harvest and Preparation

This graft harvest technique has been previously described by Levin et al.[6] A longitudinal 3 cm incision is

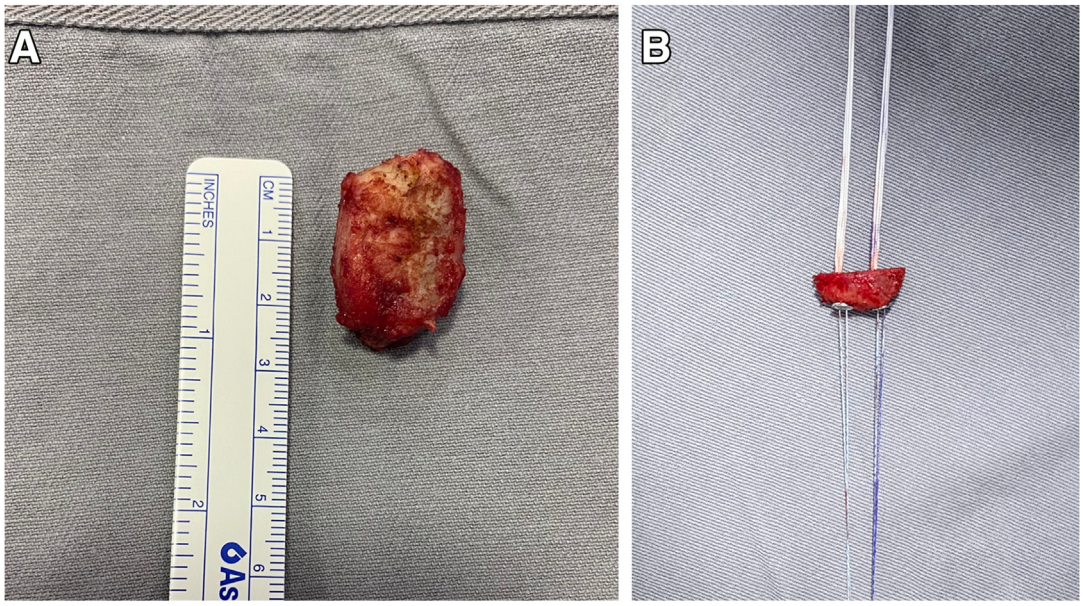

Fig 1. (A) Example of distal clavicle bone block autograft on back table preparation. The cancellous facet is facing backward on the table, and the inferior side is beside the ruler. (B) Example of a distal clavicle autograft loaded with 2 cortical suture buttons. The cancellous facet is facing upward, and the inferior side is facing forward.

made slightly medial to the acromioclavicular (AC) joint. Dissection is carried deep to the joint until 2 small Hohmann retractors can be placed beneath the distal clavicle. A resection of 8 to 10 mm at the distal clavicle is then performed with an oscillating saw blade, preserving the posterior AC ligament. The periosteal flap, capsule, and fascia are closed with braided nonabsorbable interrupted stitches, and the soft tissues are closed in 2 layers.

The graft is placed on the back table for preparation, where it is sized and trimmed. Two 2.8 mm drill holes are made 10 mm apart and 5 mm from the edge of the graft on the medial surface, confirming this distance with the offset measurement tool (Glenoid Bone Loss System; Smith & Nephew, Andover, MA). Using a looped guidewire, 2 double-eyelet suture buttons are then loaded in the graft (Round Endobutton 2 hole; Smith & Nephew). It is ensured that the graft will fit through a 15 mm cannula and that the buttons do not overlap on the cortical surface. The superior and medial edges of the graft and superior sutures are marked to aid orientation during the graft transfer (Fig 1).

Glenoid Preparation

Viewing from the anterosuperior portal, an elevator is used to elevate the posterior capsulolabral complex from the 5- to 10-o'clock positions (Fig 2). A Wissinger rod is placed from the anterior cannula as an articular retractor to push the posterior capsule and allow exposure of the glenoid between the capsule and the infraspinatus. Two PDS sutures are placed percutaneously using a bird-beak grasper on the superior and the inferior regions of the posterior capsule to further enlarge the posterior portal. A curved 4.5 mm shaver is used to debride the glenoid neck and prepare the glenoid defect, removing scar tissue until the subchondral bone is exposed.

Anchor Placement on Posterior Glenoid

A 5 mm offset drill guide (Glenoid Bone Loss System; Smith & Nephew) is used to drill a pilot hole for an all-suture anchor on the posterior glenoid defect, below

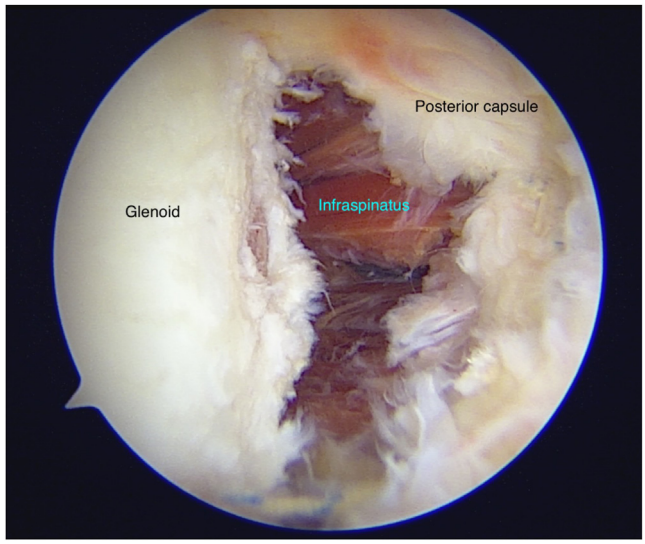

Fig 2. Arthroscopic view of a right shoulder in lateral decubitus from an anterosuperior portal, showing the posterior edge of the glenoid, with the posterior capsulolabral complex elevated from the glenoid edge.

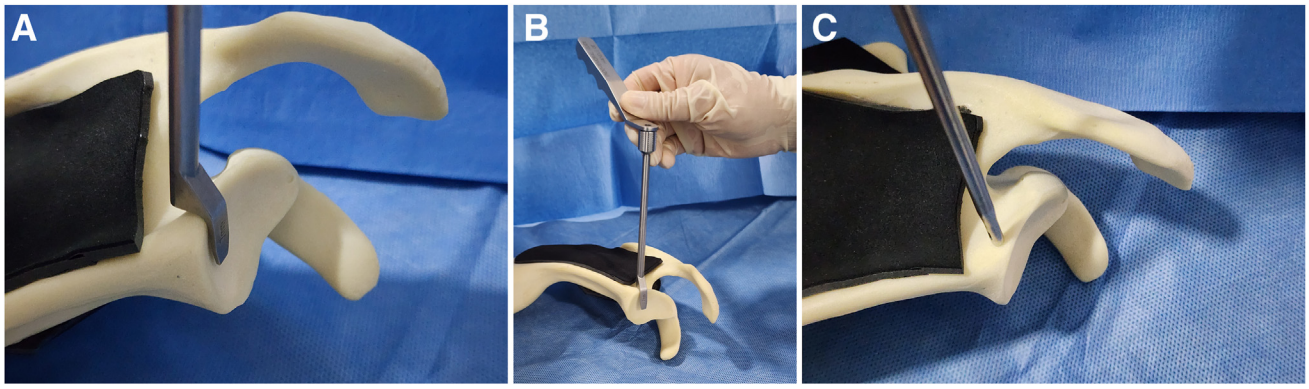

Fig 3. (A, B) Scapula anatomical model showing the positioning of a glenoid offset drill guide on the edge of the glenoid. The drill guide is used to drill a pilot hole below the equator of the glenoid on the posterior bone loss. (C) Scapula anatomical model showing the insertion of a 2.8mm all-suture anchor on the area of glenoid bone loss. This anchor will be used to fix the graft in place.

the equator and parallel to the glenoid surface (Fig 3). This will be the pilot hole for a 2.8 mm all-suture anchor (Q-FIX all-suture anchor 2 sutures; Smith & Nephew). A second pilot hole is also drilled on the edge of the glenoid edge superiorly (10 o'clock) where a 2.7 mm knotless anchor (Microraptor knotless anchor; Smith & Nephew) will be inserted by the end of the procedure for capsular repair. This hole must be drilled before placing the all-suture anchors to ensure that drilling for the knotless labral repair will not damage the anchors. The all-suture anchor is then inserted (Fig 4), and a second all-suture anchor is placed 10 mm inferiorly, also using the glenoid offset drill guide. The suture limbs from both anchors are retrieved through the anterior cannula.

Graft Transfer and Fixation

A 15 mm cannula is positioned through the posterior portal, between the posterior capsule and the infraspinatus (Fig 5). The suture limbs of the anchors are retrieved through this cannula and each pair is loaded using a looped guide through the double eyelets of each suture button. A Nice knot is created for each suture button and it is used to deliver the graft, tightening sequentially the sutures to shuttle the graft into the joint (Fig 6). The graft is then tilted and shuttled through the cannula. It is imperative that the graft sits flush to the glenoid surface and below the equator (Fig 7). Both Nice knots are tightened, and a mechanical tensioning device is used, tightening the suture limbs 3 times up to 100N (Fig 8), ensuring compression of the graft arthroscopically. We use 2 tensioning devices, alternating and maintaining tension in each button, followed by 3 square knots in each suture button to lock the construct. The suture limbs are then cut.

Capsulolabral Repair

Finally, once the graft is secured in place, the posterior capsule is repaired on the superior glenoid edge using labral tape (1.5 mm Minitape; Smith & Nephew) and a knotless anchor on the previously drilled pilot hole (Fig 9). This restores the posterior capsulolabral complex, rendering the graft extra-articular (Fig 10). Pearls and pitfalls of the surgical technique are described in Table 1.

After the procedure the patient is immobilized with a sling in neutral rotation for 5 weeks. At 3 weeks passive range of motion is initiated during physical therapy. Active range of motion is initiated at week 6, gradually progressing to resistance strengthening and muscle endurance exercises. A postoperative computed tomography scan is obtained at 3 months to evaluate graft healing (Fig 11).

Discussion

Although previously thought to be rare, posterior instability is being increasingly recognized as a cause of

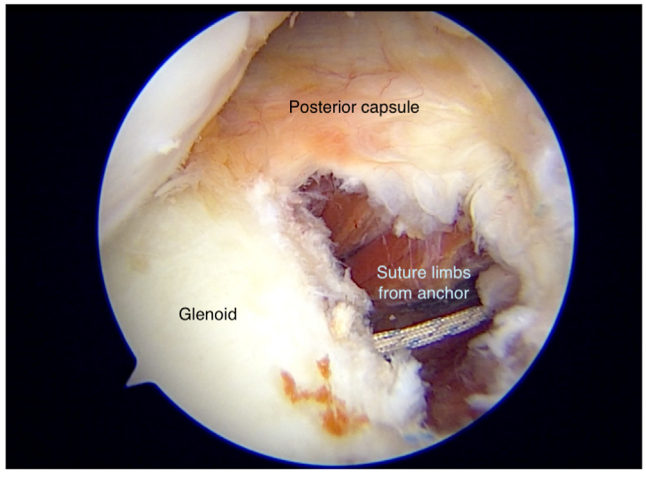

Fig 4. Arthroscopic view of a right shoulder in lateral decubitus from an anterosuperior portal of the posterior glenoid. The first anchor is placed on the area of bone loss parallel to the glenoid surface. The posterior capsulolabral complex has been elevated.

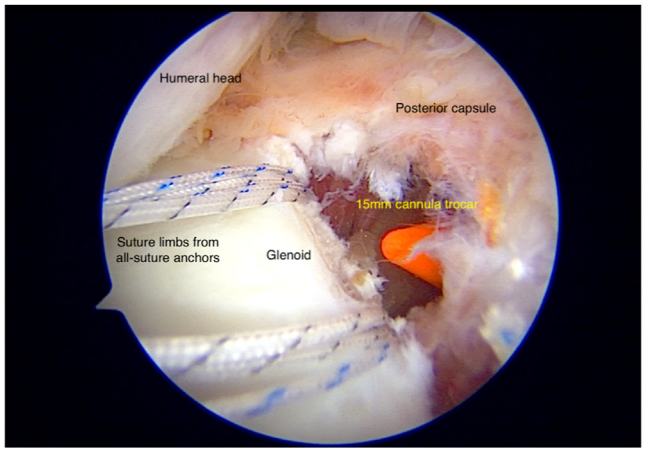

Fig 5. Arthroscopic view of the posterior glenoid view of a right shoulder in lateral decubitus from an anterosuperior portal. A 15 mm cannula is positioned beneath the posterior capsule. Two 2.8 mm all-suture anchors have been placed on the glenoid defect, and the suture limbs have been retrieved through the anterior cannula.

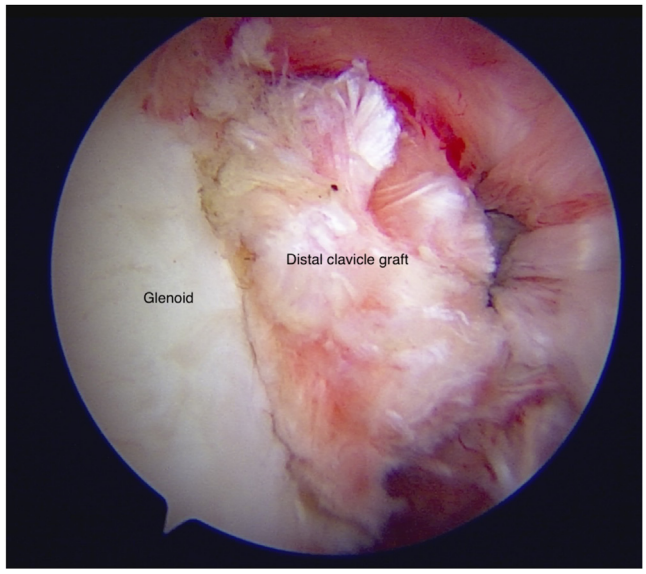

Fig 7. Arthroscopic view of right shoulder in lateral decubitus from an anterosuperior portal. The distal clavicle autograft has been transferred to the posterior glenoid and fixed in place with 2 double eyelet suture buttons.

pain and dysfunction particularly in young athletes. Rothrauff et al.[2] stated that although capsulolabral repair is a durable treatment, up to 35% of patients meet criteria for failure, and up to 13% require revision surgery. One potential cause for failure is glenoid bone loss. Arner et al.[3] found that a threshold of 11% posterior glenoid bone loss implicated a 10 times higher failure rate in patients treated with arthroscopic labral repair.

Posterior glenoid bone loss has morphological differences compared to anterior bone loss.[8] Livesey et al.[9] found that it occurs more inferiorly and with increased obliquity. In our technique, bearing this evidence in mind, we position the graft below the equator.

Multiple techniques have been described to manage glenoid defects. Cooper et al.[10] described an open technique using distal tibial allograft for posterior bone loss. Regarding arthroscopic techniques, Cusano et al.[11] have described a technique using an arthroscopic Latarjet fixation set to reconstruct posterior bone defects using this type of graft. Alternatively, van Spanning et al.[12] described the updated arthroscopic

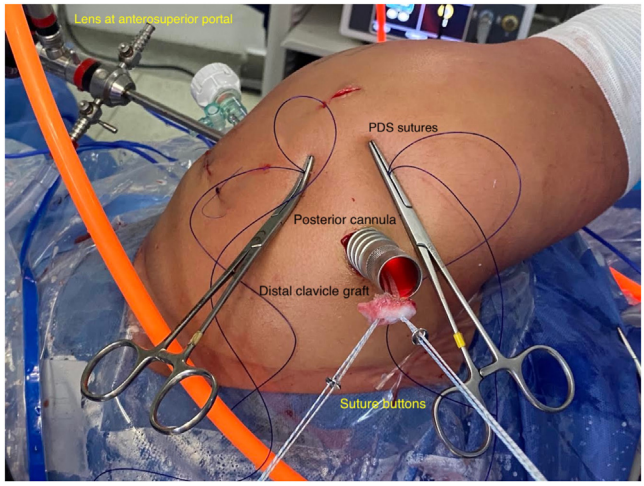

Fig 6. Intraoperative external view of the a right shoulder of a patient in left lateral decubitus. The distal clavicle graft is being shuttled through a 15 mm cannula using 2 double-eyelet buttons sliding the bone graft with Nice knots. Two PDS percutaneous sutures placed on the posterior capsule enlarge the posterior portal.

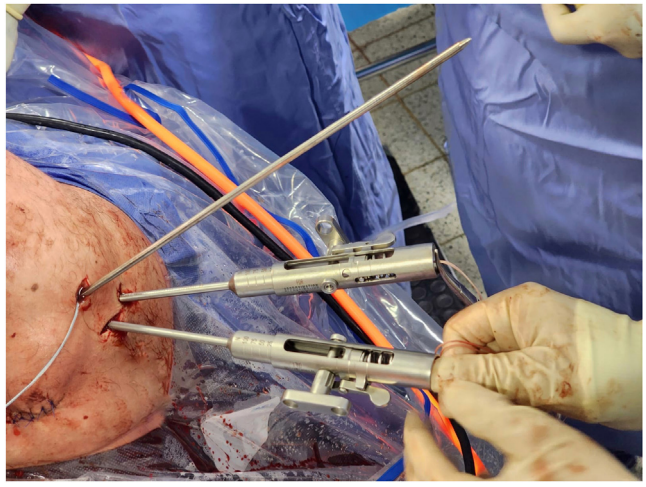

Fig 8. External view of the right shoulder of a patient in left lateral decubitus. Two mechanical tensioning devices are used to securely fix 2 double eyelet suture buttons that are used to securely fix and compress a distal clavicle autograft.

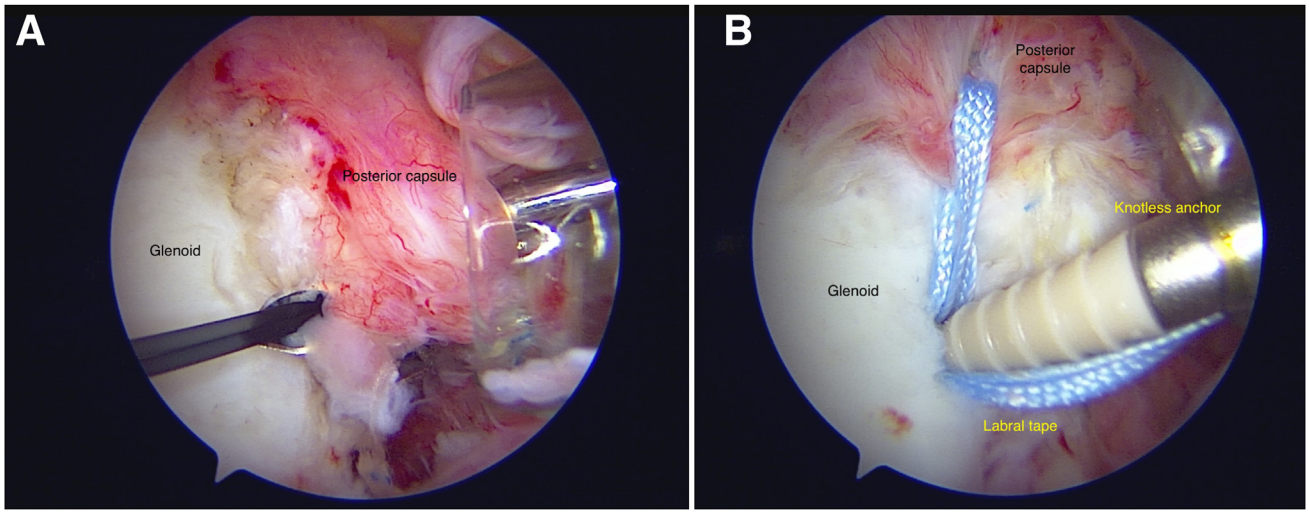

Fig 9. Arthroscopic view of right shoulder in lateral decubitus from an anterosuperior portal. The posterior capsule is imbricated using a suture passer (A) over the graft. The capsulolabral complex is repaired using labral tape and a knotless anchor (B) on a previously drilled pilot hole.

technique initially described by Lafosse, using an iliac crest graft fixed arthroscopically with screws. Other fixation devices have been used to reduce the potential hardware and neurovascular complications of screw fixation. Taverna et al.[13] used cortical buttons to fix a tri-cortical iliac crest graft for anterior glenoid bone loss. Valenti et al.[14] have also described the use of suture buttons to arthroscopically reconstruct posterior bone loss using iliac crest graft. Other metal-free devices such as arthroscopic tape cerclage systems have also been described to secure this type of graft.[15] However, these graft options for posterior instability have potential disadvantages and raise concerns in costs or donor site morbidity.

On the other hand, for anterior instability other graft sources have been described to reduce donor site morbidity. The use of distal clavicle graft was initially described by Tokish et al.[4] as a free graft option to reconstruct both anterior and posterior glenoid bone defects. It is locally available, cost-effective and safe. Boileau et al.[5] modified this technique using the concave undersurface of the clavicle to build a "congruent arc" to match the glenoid curvature,[6] which we also use in our reconstruction. Although this

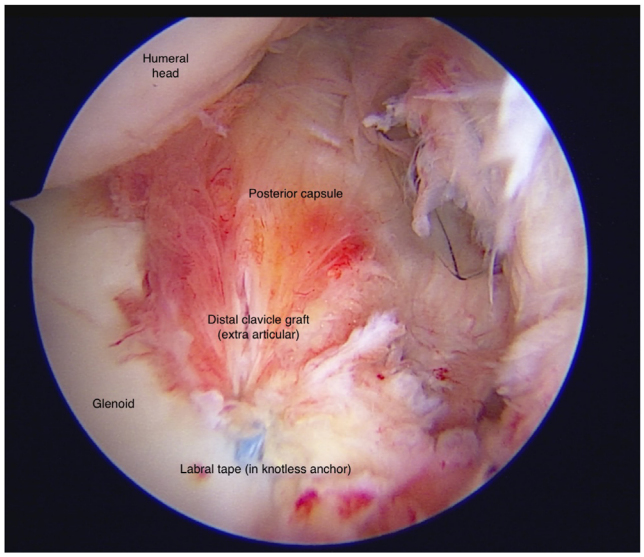

Fig 10. Arthroscopic view right shoulder in lateral decubitus from an anterosuperior portal. The posterior capsulolabral complex has been fixed over the graft, rendering the graft extra-articular.

Table 1. Pearls and Pitfalls

Pearls
Enlarging the posterior portal arthroscopically between the posterior capsule and the infraspinatus facilitates graft transfer. Using a Wissinger rod from the anterior portal and PDS traction sutures on the posterior capsule aids in this step.
Drilling a pilot hole for final posterior capsulolabral repair before placing the graft ensures that the drill does not converge with the anchors used to fix the graft and aids as a landmark for graft positioning.
Bearing in mind that posterior bone loss is located inferiorly and with increased obliquity, the graft must be fixed below the equator of the glenoid.
Using an offset drill guide to position the anchors on the glenoid defect permits an accurate location of the graft flush to the glenoid surface.
Pitfalls
Resecting more than 15 mm of the distal clavicle may result in AC instability and dysfunction.
Insufficient glenoid preparation may result in a graft mis-match or leave interposed tissue that may result in insufficient compression during tensioning.
Inadequate tensioning or hand tensioning of the suture buttons may result in insufficient compression and graft displacement or non-union.

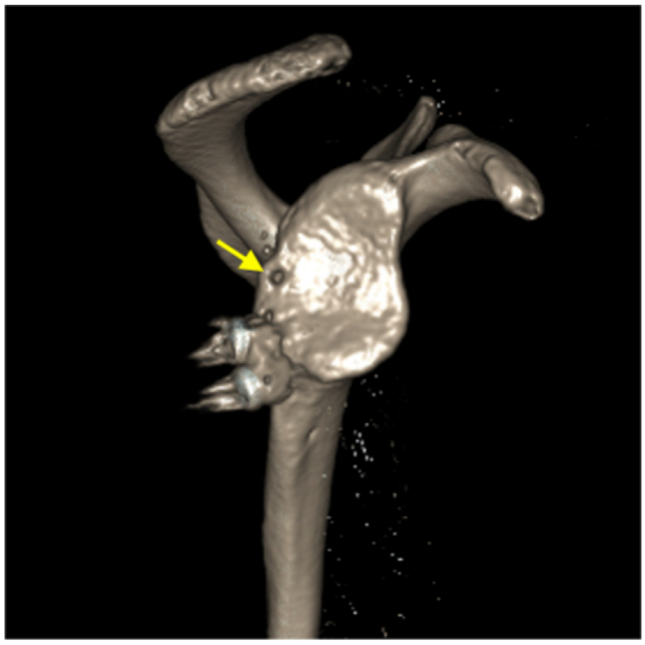

Fig 11. Postoperative computed tomography scan with 3D reconstruction with an en-face view of the posterior glenoid bone block reconstruction. The distal clavicle bone-block was secured with 2 suture buttons. Arrow: pilot hole for posterior capsulolabral repair, superior to graft.

sacrifices the osteochondral surface of the graft, repairing the capsulolabral complex places the graft extra-articularly preventing contact between the humeral head and the graft. Levin et al.[6] described harvesting the graft with a mini-open approach, similar to our harvest and fixation technique. We used an offset drill guide on the posterior glenoid to determine the correct location of the anchors used to secure the graft. We fixed the graft with 2 double-eyelet suture buttons through each anchor and achieved compression using a tensioning device. This mechanical tensioning transforms flexible fixation into a rigid construct and has proven high bone block healing rates.[16] Suture button fixation is a safe and reliable alternative to screw fixation, achieving predictable healing.[17-19] Repairing the posterior capsule with labral tape and knotless anchors offers the advantages of knotless techniques while achieving a smooth compression of the labrum with less potential of suture "cut through" and a low profile repair to reduce concern for chondral harm.[20]

Table 2. Advantages of the Technique

Arthroscopic technique using suture buttons for fixation facilitates graft shuttling and reduces neurovascular and hardware complications of screws.
The distal clavicle graft is easily harvested and causes minimal donor site morbidity.
Repairing the posterior capsulolabral complex with labral tape and knotless anchors provides a smooth compression of the labrum rendering the graft extra-articular.

Advantages of our technique are summarized in (Table 2).

Cognetti et al.[21] found in a recent systematic review that posterior bone block augmentation to date does not reliably yield improved functional outcomes, and complications and failures are frequent. Hence, there is a need to present these novel techniques and alternatives to treat posterior glenoid instability to improve patient outcomes.

Disclosures

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