Technical Note

Arthroscopic Bone Block Cerclage: A Fixation Method for Glenoid Bone Loss Reconstruction Without Metal Implants

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Abstract: Large glenoid bone loss defects are associated with higher failure rates after arthroscopic Bankart repair in cases of glenohumeral anterior instability, further necessitating bone graft reconstruction. Because most techniques use strong initial fixation using metal devices, bone graft resorption considered to be closely related to the presence of metal components is a potential shortcoming of these techniques. We describe an arthroscopic technique for anatomical reconstruction of the glenoid that uses a tricortical iliac crest with a metal-free fixation method using 2 ultra-high-strength sutures (FiberTape Cerclage System; Arthrex, Naples, FL), which provide substantial stability to the graft, and finishing with a capsulolabral reconstruction.

Glenohumeral instability with large anteroinferior bone loss that changes the shape of the glenoid has been associated with failure of arthroscopic Bankart repair procedures.[1,2] Failure is defined by the presence of defects greater than 15% to 20%,[3] but ''subcritical'' bone loss is also associated with a subjective feeling of instability and poorer results.[4] Although anatomical and nonanatomical bone graft reconstruction have been used for the treatment of these cases, most of these techniques use metal implants for fixation, independent of the graft used.[5-17] Bone resorption and residual pain are considered to be closely related to the absence of a sufficiently stable graft fixation and the presence of metal implants.[18-20]

We describe an anatomical arthroscopic reconstruction technique that uses a tricortical iliac crest bone graft with a nonmetal fixation method using 2 ultra-high-strength suture tapes. The tapes are passed from the posterior to the anterior glenoid rim, passing through the graft from the anterior to the posterior part, compressing the cancellous face of the graft to the glenoid defect, increasing the stability of the structure, and eliminating secondary metal-related problems. The final step involves extraarticular capsulolabral reconstruction (Video 1). The advantages, disadvantages, and possible complications of this technique are described (Table 1).

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Surgical Technique

Preoperative Assessment

All patients with 2 or more shoulder dislocations were studied using 3-dimensional computed tomography with humeral head suppression to ensure accurate preoperative planning. This surgical technique is indicated for anteroinferior major defects covering at least 15% of the glenoid surface (Table 2).

Patient Position and Arthroscopic Diagnosis

The patient was positioned in the lateral decubitus position with 30° of posterior obliquity to ensure that the glenoid was parallel to the floor. Posterior sacral and dorsal stops were placed. The arm was put into a

Table 1. Advantages and Disadvantages of the Technique

Advantages
• Can be used for auto- or allografts
• Requires small drill tunnels (2.4 mm)
• Preserves joint capsule with reconstruction
• Involves strong and broad compression of the graft with greater stability
• Does not use metal implants
• Reproducible technique and easy revision
Disadvantages
• Demanding technique in comparison with other arthroscopic glenoid augmentations
• Requires preparation of the graft
• Possibility of wrong graft positioning
• Presents minimal vascular-nervous risk; however, using the posterior guide assures safety during procedure
• Compression depends of the bone graft quality

Table 2. Initial Evaluation of Shoulder Instability

First dislocation mechanism
Number of episodes
External aid for reduction
Ligament hyperlaxity
Test of apprehension − repositioning − release
Functional scales: Western Ontario Shoulder Instability index; Quick-Disabilities of the Arm, Shoulder, and Hand; American Shoulder and Elbow Surgeons
Radiology: anteroposterior radiograph and Bernadeau projection
3-dimensional computed tomography scan with humeral suppression
Best fit circle for calculating glenoid bone defect by area and diameter
Measurement of humeral defect (Hill-Sachs lesion) for studying the ''on-track/off-track'' method.

traction foam sleeve (3-Point Shoulder Distraction System; Arthrex, Naples, FL) to use 2 points of traction. The bony structures and arthroscopic portals were drawn.

Although capsulolabral and bony injuries can be confirmed in a posterior view, the glenoid defect cannot be measured in this view. The Hill-Sachs injury was visualized and its vertical or horizontal direction and size were described. Other pathologies such as the long head of the biceps and rotator cuff lesions were discarded.

Glenoid Preparation

An anterior portal was realized above the rotator interval and an 8.25-mm cannula was placed (Arthrex). Camera vision was switched to a superior portal behind the biceps tendon and an accessory portal, and the trans-subscapular deep axillary at 5 o'clock was established.

Capsulolabral lesions were elevated from 1 to 6 o'clock, allowing visualization of subscapular muscle fibers. From an axillary approach, we placed a SutureLasso (Arthrex) to place a polydioxanone suture (PDS) through the capsulolabral complex, which facilitated suture manipulation (Fig 1) and defect visualization. The anterior glenoid defect was debrided and abraded to improve the biological integration of the graft.

In situ sizing of the defect is very important to achieve a perfect fit of the allograft. We used an arthroscopic probe or a specific measuring probe (Arthroscopic Measurement Probe, 220 mm, 60°; Arthrex) from the posterior portal to measure the anteroposterior defect and from the interval portal to measure from proximal-to-distal and anteroposterior width according to the bare area when possible (Fig 2).

To calculate where the drill guide would be placed, we made a mark at a minimum distance of 10 mm from the lower edge of the longitudinal-sized defect.

Allograft Preparation

Cuts with an oscillating saw were made according to the measurements previously obtained from the glenoid defect (Fig 3). The iliac crest graft determines the depth, which is usually 10 to 12 mm. The curved edge that best resembles the glenoid rim was selected. Graft sizes were usually 28 to 30 × 10 × 10 mm. The graft was marked on the articular face. The tricortical allograft tunnels were made with a 2.4-mm drill from the

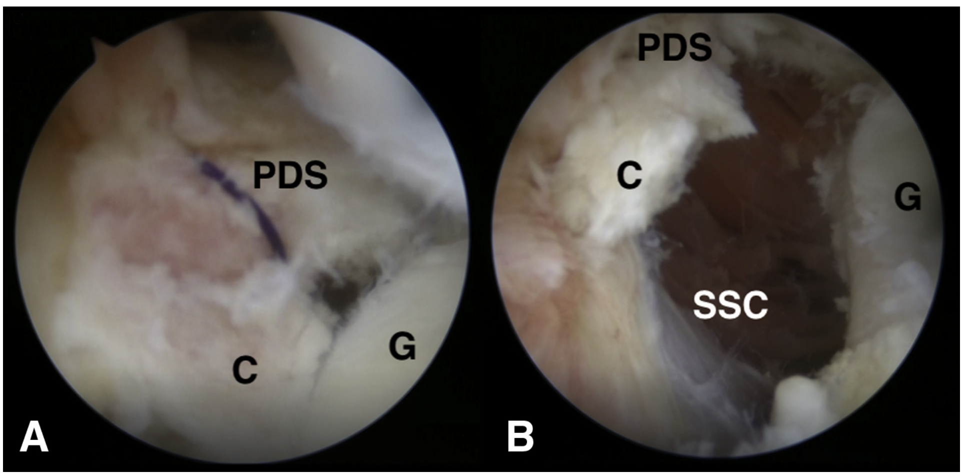

Fig 1. Right shoulder. Arthroscopic view, anterosuperior portal. (A) Debridement and lifting of the glenoid labrum and placement of PDS sutures for labrum manipulation and visualization improvement. (B) Subscapular muscle fibers must be seen. (C, capsule; G, glenoid; PDS, polydioxanone suture; SSC, subscapularis.)

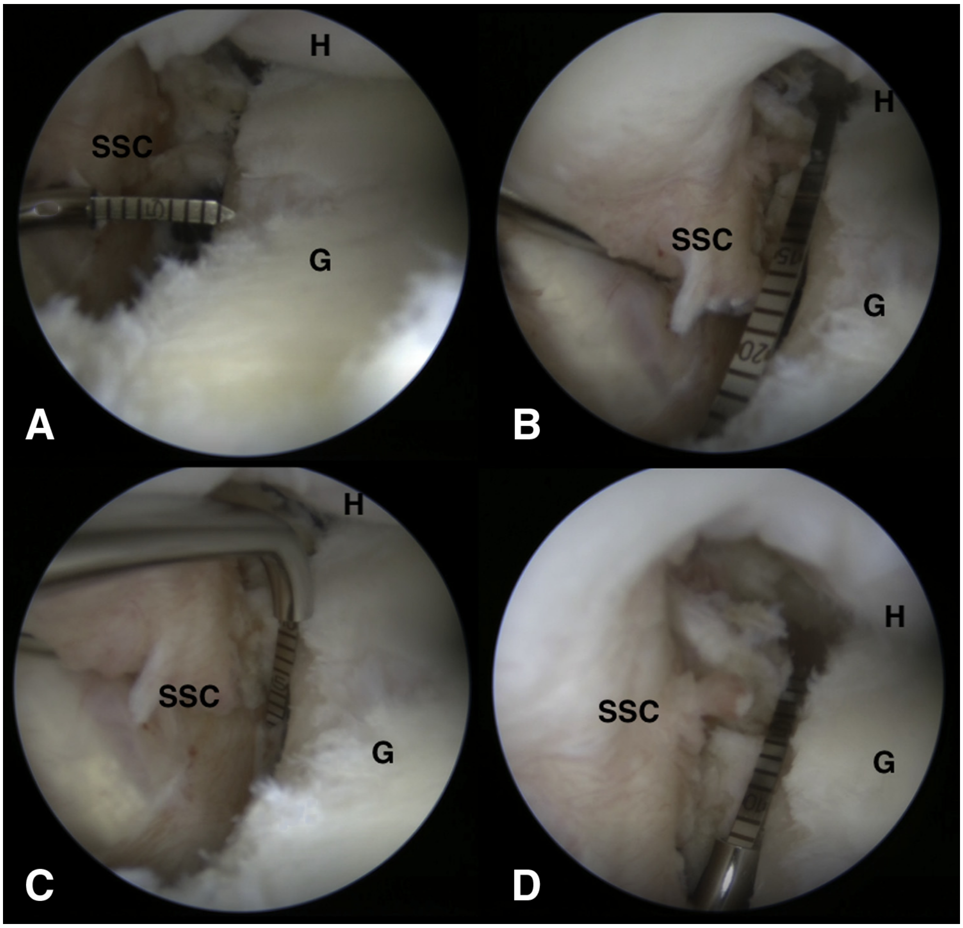

Fig 2. Right shoulder. Arthroscopic view, anterosuperior portal. (A) Intraoperative measurement of the anteroposterior defect, (B) long-side proximal-distal defect, and (C) middle-lateral wide defect. (D) Distance from the bare area to the distal end defect is also measured. Measurement probe in anterior portal.

cancellous to the cortical side. The lower tunnel was made first 10 mm from the proposed lower rim, after which the higher tunnel was made 10 mm superior to the first, imitating the dimensions of the glenoid drill guide (Fig 4).

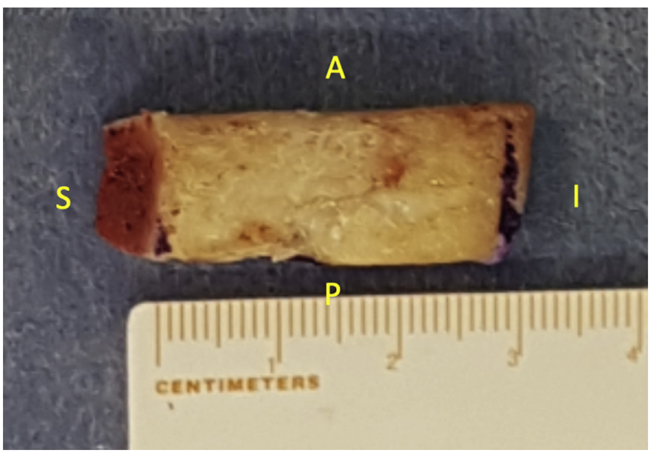

Fig 3. Prepped iliac crest allograft. Photographic markings according to the joint position. (A, anterior; I, inferior, P, posterior; S, superior) and measurement for tunnel position.

Posterior Glenoid Drilling

An arthroscopic posterior guide (Arthrex) was introduced. The hook component was placed parallel to the glenoid, just above our previous mark and 5 mm deep,

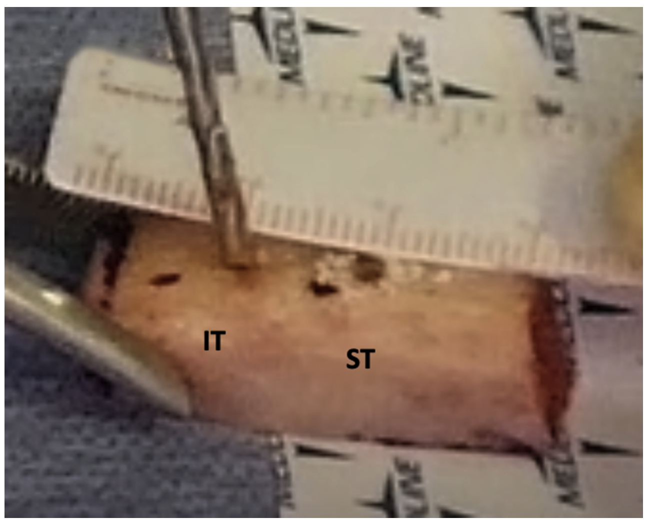

Fig 4. Prepped iliac crest allograft. Allograft tunnel drilling separated 10 mm similar to the drill guide with a 2.4- mm drill (IT, inferior tunnel; ST, superior tunnel.).

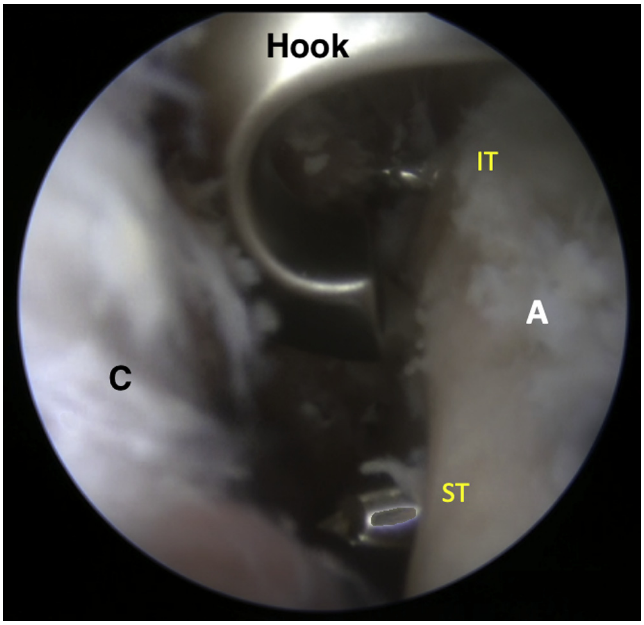

Fig 5. Right shoulder. Arthroscopic view, anterosuperior portal view of the posterior drill guide with a hook position 5 mm deep of the anterior glenoid surface and parallel to it for correct placement of drill tunnels, both separated by 10 mm. (A, anterior glenoid defect; C, capsule; IT, inferior tunnel; ST, superior tunnel.)

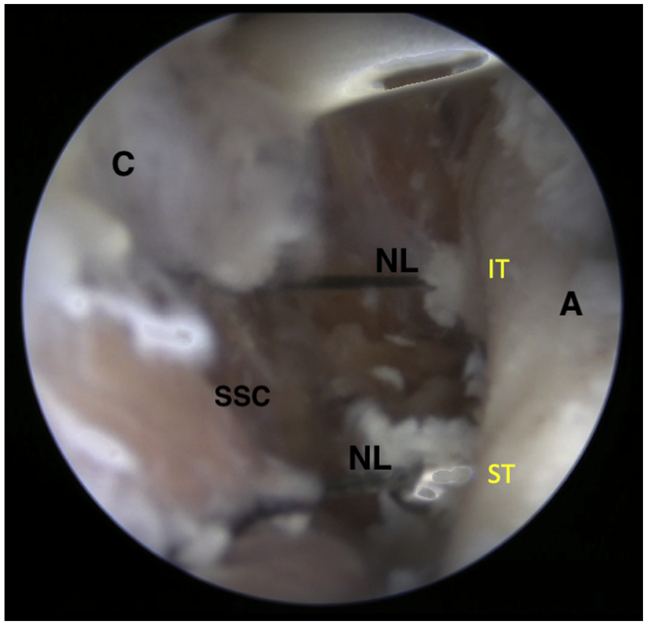

Fig 6. Right shoulder. Arthroscopic view, anterosuperior portal. Intraoperative view of the nitinol pass. Leaving 1 loop posterior and the other 1 anterior is important. (A, anterior glenoid defect; C, capsule; IT, inferior tunnel; NL, nitinol with loop; ST, superior tunnel; SSC, subscapularis.)

as close as possible to the center of the defect. The drill guide component was placed posterior to the glenoid surface. The guide allowed drilling of 2 holes with 2.4-mm cannulated drills through the glenoid 10 mm apart (Fig 5), keeping in mind the distance from the lower edge of the defect.

The central pins of the cannulated drills were extracted, and 2 nitinol wires with loops, 1 for each tunnel, were passed and retrieved through the anterosuperior interval portal (Fig 6). The drills, drill guide, and hook were then removed.

Allograft Accommodation and Fixation

To facilitate suture passage through the bones, the nitinol wires were replaced with 2 loop sutures (FiberLink/TigerLink sutures, Arthrex), as recommended, 1 with the loop anterior and the other with the loop posterior (Fig 7). Both sutures were also passed through the graft tunnels.

Using the FiberLink posterior loop, 2 ultra-high-strength suture tapes (FiberTape Cerclage System, Arthrex) were passed from the posterior to anterior side and retrieved through the anterosuperior portal. They were then passed through the allograft tunnel from the

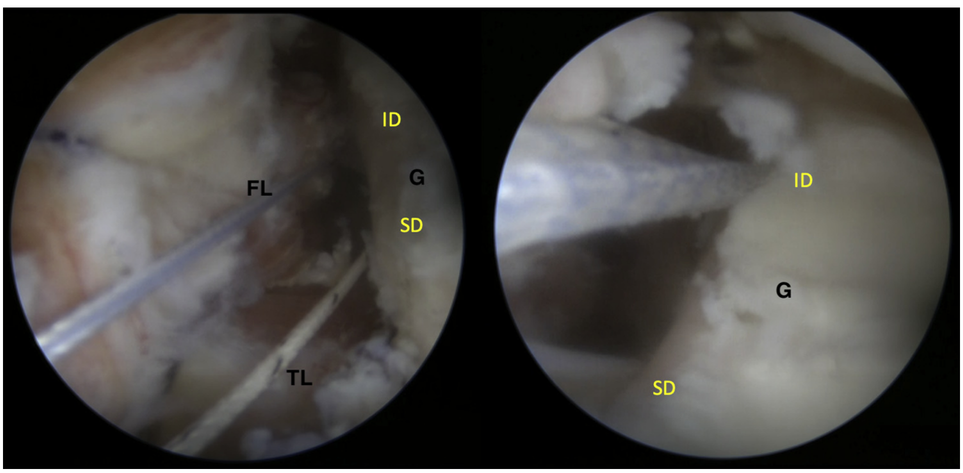

Fig 7. Right shoulder. Arthroscopic view, anterosuperior portal. (A) Exchange of nitinol wires to ensure more resistant FiberLink-TigerLink sutures and easier and safer (B) FiberTape-TigerTape passage through glenoid and graft tunnels. (FL, FiberLink; ID, inferior tunnel; SD, superior tunnel; TL, TigerLink.)

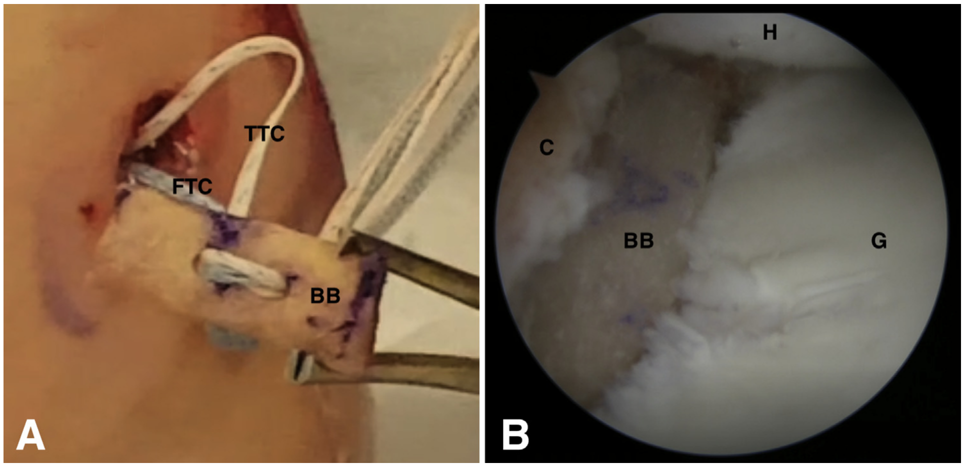

Fig 8. Right shoulder. Patient in lateral decubitus. (A) Shirt button allograft image before insertion through the interval portal without a cannula. Right shoulder. (B) Anterosuperior portal. Intraoperative view of allograft positioning. (BB, bone block graft; C, capsule; FTC, FiberTape Cerclage; G, glenoid; H, humeral head; TTC, TigerTape Cerclage.)

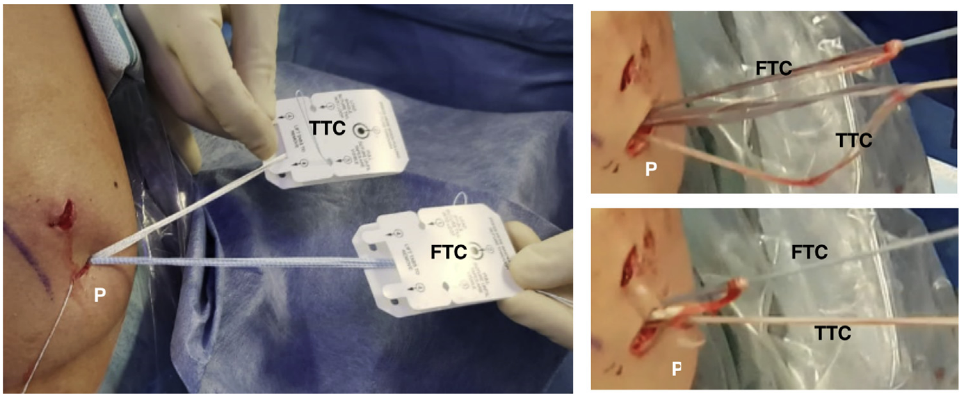

Fig 9. Right shoulder. Patient in lateral decubitus. FiberTape and TigerTape Cerclage System and reduction of sutures with alternating traction movement. (FTC, FiberTape Cerclage; P, accessory medial posterior portal; TTC: TigerTape Cerclage.)

cancellous bone side to the cortical side. Both FiberTape Cerclage sutures were then loaded in the TigerLink anterior loop to pass them from the allograft cortical side to the cancellous side (looking like a shirt button) and from the anterior to posterior side through the glenoid. The allograft was introduced through the interval portal by pulling all FiberTape Cerclage sutures and held with a Kocher clamp (Fig 8).

Once the allograft was inserted and well-positioned, the sutures were interconnected to create a continuous loop. The tail of the FiberTape suture was loaded through the pretied racking hitch knot of the TigerTape and vice versa. This allowed the application of alternating traction on each suture limb to reduce the knots to the posterior glenoid side and achieve symmetrical tensioning of the construct (Fig 9).

Once the stability of the graft was fixed and checked, the 2 knots were tensioned and locked, 1 after the other, applying a mechanical force equal to 80 N with a tensioner (FiberTape Cerclage Tensioner, Arthrex) (Fig 10) and with at least 3 alternating knots. Graft fixation was checked. Finally, stable fixation was obtained for graft integration.

Capsulolabral Repair

Finally, 3 or 4 “all suture” FiberTak suture anchors (Arthrex) were placed at the native glenoid rim, starting from the middle at 3 to 4 o’clock, and introduced through an axillary portal after retrieving the PDS sutures used at the beginning of the technique. The next anchor was placed inferiorly and 1 or 2 more anchors were placed superiorly, reattaching the capsulolabral

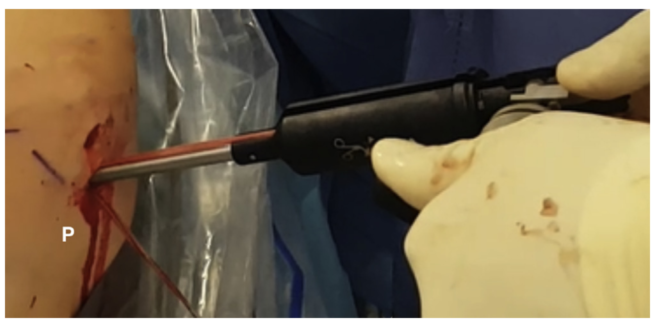

Fig 10. Right shoulder. Patient in lateral decubitus. Applying tension to sutures by using a cerclage tensioner set to 80 N. Sutures must be knotted and blocked after this step. (P, accessory medial posterior portal.)

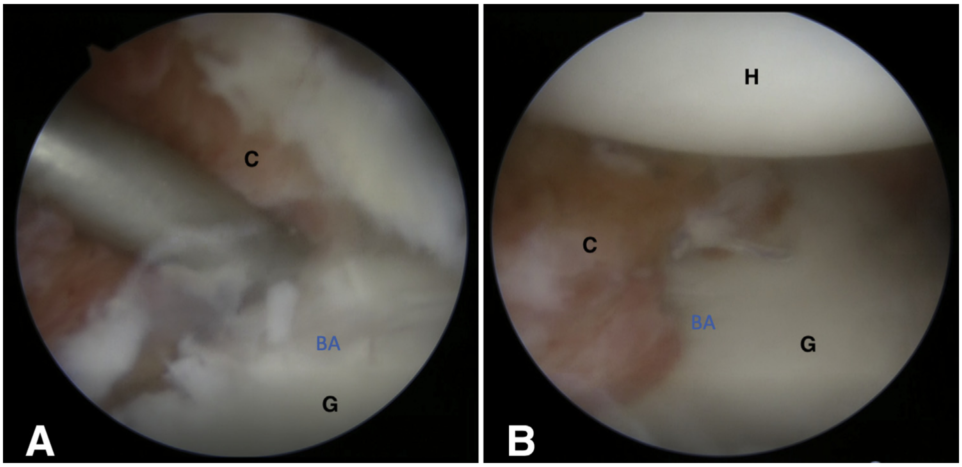

Fig 11. Right shoulder. Arthroscopic view, anterosuperior portal. Intraoperative view of (A) first implant insertion for capsulelabral reparation and (B) the final result. (BA, bare area; C, capsule; G, glenoid; H, humeral head.)

complex and leaving the graft extraarticular (Fig 11). Some tips and pitfalls of the technique are described (Table 3).

Discussion

Glenoid bone defects reduce the surface area available for humeral head contact, restricting articular congruity leading to shoulder instability. It is now accepted that patients with defects greater than 15% to 20% should be treated with reconstruction techniques. Many surgical techniques have been described to treat these patients, but most of them involve metal devices. Two techniques used nonmetal hardware with good results,[21] but only a few arthroscopic techniques have been described.[9,16,22] Anatomical arthroscopic glenoid reconstruction techniques offer advantages such as a low recurrence rate, good functional results, maintenance of the integrity and function of coracobrachialis, short head of the biceps, and pectoralis minor, and preservation of the normal function of the subscapularis tendon.[23,24] Furthermore, in patients who undergo these techniques, another anatomical or nonanatomical procedure could be performed in case of failure.

Table 3. Tips and Pitfalls of the Technique

Tips
Double posterior approach: 1 arthroscopic posterior portal and 1 for the drill guide
Anterior interval approach expansion with index size to allow easy graft passage
Nitinol wire with loop are passed with exchanged loops: 1 with the anterior loop and another with the posterior loop
FiberLink/TigerLink loop suture to simplify the cerclage suture passage
FiberTak uses a 1.6-mm drill, lowering the risk of damaging the tape sutures
Pitfalls
Capsulolabral complex obstructs the view and room to work
Anterior glenoid rim debridement should be carefully performed
Hook component, if badly positioned, leads to graft malpositioning
Drilling tunnels superficial or deeper than 5 mm from the surface lead to graft malpositioning

The presence of metal devices and their roles in graft resorption, humeral osteoarthritis, neurovascular injury, and anterior chronic pain remain points of debate. Zhu et al.[25] reported 90.5% graft resorption at 1 year after the Latarjet procedure in a computed tomography scan study, similar to the results reported by Di Giacomo et al.,[26] but they reported no correlation with functional outcomes. Complications related to the Latarjet procedure have been reported in 25% of patients, in contrast to anatomical arthroscopic techniques that report low rates of complications. The process of covering the allograft during capsulolabral reconstruction may have resulted in a lower progression rate to osteoarthritis in comparison with the Latarjet procedure.[19,23,27-29]

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