Technical Note

Open Latarjet with Metal-Free Cerclage Fixation

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Abstract: Despite multiple modifications, the Latarjet is still the most popular procedure for recurrent anterior shoulder instability with glenoid bone loss**.** Partial or subtotal resorption of the graft is common, potentially leading to hardware prominence and risk of anterior soft-tissue impingement. To minimize the technical difficulties and morbidity associated with metallic implants, a coracoid and conjoint tendon transfer with a mini-open approach using Cerclage tape suture is described, as an alternative for the Latarjet procedure typically performed with metal screws and plates.

The Latarjet procedure has continuously evolved to lessen the burden of complications associated with bony transfer. Its indications have expanded over time, from failed Bankart repair in recurrent shoulder instability and glenoid bone loss of up to 25% to a primary Latarjet in high-risk patients with subcritical bone loss.[1] Additional indications include an engaging Hill–Sachs lesion and poor quality of the capsulolabral tissue. Isolated soft-tissue stabilization has the lowest recurrence rate and the best outcome when performed after a first shoulder dislocation. However, in the presence of bone loss, failure rates can range from 0% to 75%.[2,3]

In patients with shoulder instability who are followed over a long period of time, the Latarjet has shown a clear advantage, with increased levels of stability, patient satisfaction, and return to sport.[4] The Latarjet procedure recently has evolved from open or arthroscopically assisted to an all-arthroscopic approach. In comparison with the arthroscopic procedure, a mini-open Latarjet provides adequate exposure with a shorter learning curve and minimal technical difficulties.[5]

Despite the numerous advantages and excellent stability provided by Latarjet procedure, it has brought a new set of complications, most of which are associated with the metal implants, particularly when they become proud after graft resorption and are a source of pain.[6,7] Other complications are associated with the surgical technique, including improper positioning and angulation of the screws, inadequate screw length, screw migration, pullout, bending, fracture of the bone graft, and risk of brachial plexus injury while trying to insert screws parallel to the glenoid.[8,9] In addition, the far anteromedial portal used for screw placement in the arthroscopic Latarjet technique puts the axillary and musculocutaneous nerves at risk.[10]

To minimize the morbidity related to these implants and the number of revisions, a metal-free coracoid transfer using a high-strength suture tape system through 2 tunnels drilled in the glenoid is proposed.[9] This metal-free coracoid cerclage fixation using a mini-open approach can provide a safe and effective construct and avoids metal-induced and neurologic complications associated with the traditional procedure.[11,12]

Preoperative Assessment

The bone loss is measured on computed tomography scan images with the best-fit circle method with an "en face" view of the glenoid. Indications for this technique

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The authors report the following potential conflicts of interest or sources of funding: A.H. reports consulting fees or honorariums and support to travel to meetings for the study or for other purposes, during the course of the study; and payment for the development of educational presentations and travel/accommodation/meeting expenses unrelated to activities listed, outside the submitted work. He also reports personal support for travel from Arthrex to perform this recording video. In addition, A.H. and A.C. have a patent for Bone Cerclage Suture Fixation Method licensed by Arthrex. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Received August 9, 2022; accepted November 11, 2022.

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2212-6287/221016
https://doi.org/10.1016/j.eats.2022.11.030

Table 1. Advantages and Disadvantages of the Technique

Advantages
• Safe and direct access to the coracoid; osteotomy, prepare the articular surface, release the conjoined tendon, and drill the tunnels.
• Better control in positioning the hook guide at the center of the anterior glenoid defect.
• A specific drill guide is positioned exactly parallel to the joint line.
• The correct position and fixation of the coracoid are confirmed under direct visualization.
• Cerclage fixation leads to greater rotational stability than 2 autonomous suture-based fixation points.
• Fully metal-free fixation implant.
• No image scattering on follow-up computed tomography scans.
• Shorter operative time as compared with all-arthroscopic technique.
• Short learning curve.
Disadvantages
• Difficulty performing the technique in the lateral decubitus position.
• Open surgery is more invasive compared with arthroscopic techniques.
• Need for a small posterior incision to insert drill guide.

include patients with more than 10% of anterior glenoid bone loss, failed previous surgery, inadequate soft tissue, and collision athletes. Patients with Bankart lesions without glenoid bone loss, isolated cortical Hill–Sachs lesions, and more than 25% anterior bone loss are considered contraindications. The advantages and disadvantages of this technique are discussed in Table 1.

Surgical Technique (With Video Illustration)

The surgical technique is demonstrated in the Video 1.

Step 1: Incision, Isolation of Conjoint Tendon, Coracoid Osteotomy, and Drilling

The patient is placed in the beach-chair position, under general anesthesia, with the arm in a holder to control its position during the procedure. A 5-cm longitudinal skin incision is made, lateral to the coracoid tip and just below the acromion. The cephalic vein should be identified, protected, and retracted away in the deltopectoral plane. The muscle interval is then released and opened, palpating the coracoid process (Fig 1 A and B). Once it is fully identified, the conjoined tendon should be isolated and protected, releasing the coracoacromial ligament laterally (Fig 1B and 2A) and pectoralis minor medially.

The coracoid osteotomy is performed with an angled motorized saw, cutting it from the base and distal to the coracoclavicular ligaments (Fig 3D). Decortication of the inferior aspect of the graft must be performed. In this way, an adequate surface of cancellous bone is obtained. Two 3-mm tunnels are marked and drilled in the graft, 1 cm from each other (Fig 3 E and F).

Step 2: Subscapularis Split, Glenoid Neck Exposure, and Introduction of a Specific Drill Guide

Using retractors between the deltoid and conjoint tendon, the subscapularis must be identified and split slightly below the mid-level while maintaining the arm in adduction and external rotation to tension the muscle. The capsule is separated with blunt dissection, using sutures on the superior or inferior border of the subscapularis muscle to improve access. A vertical incision is made in the capsule, medial to the joint line, leaving enough tissue for a subsequent repair (Fig 2 A and B). At this point, the capsuloligamentous complex

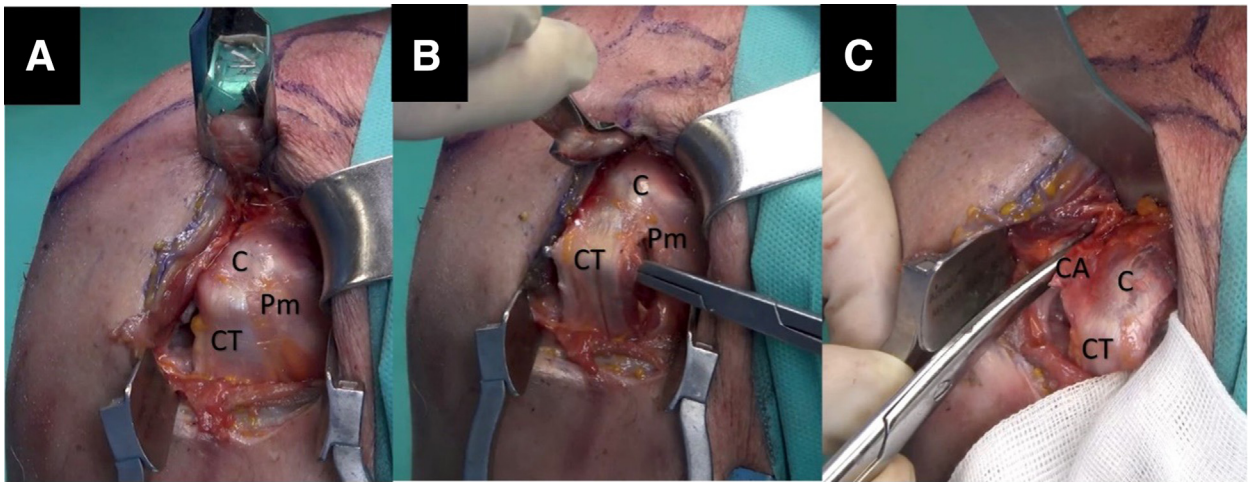

Fig 1. Right shoulder, beach-chair position, anterior view. (A-C) A 5-cm vertical incision is made, from the tip of the coracoid process to the axilla. The deltopectoral grove is opened. The coracoacromial ligament must be released laterally, leaving a small stump and the pectoralis minor medially. The conjoined tendon should be isolated and protected. (C, coracoid process; CA, coracoacromial ligament; CT, conjoined tendon; Pm, pectoralis minor.)

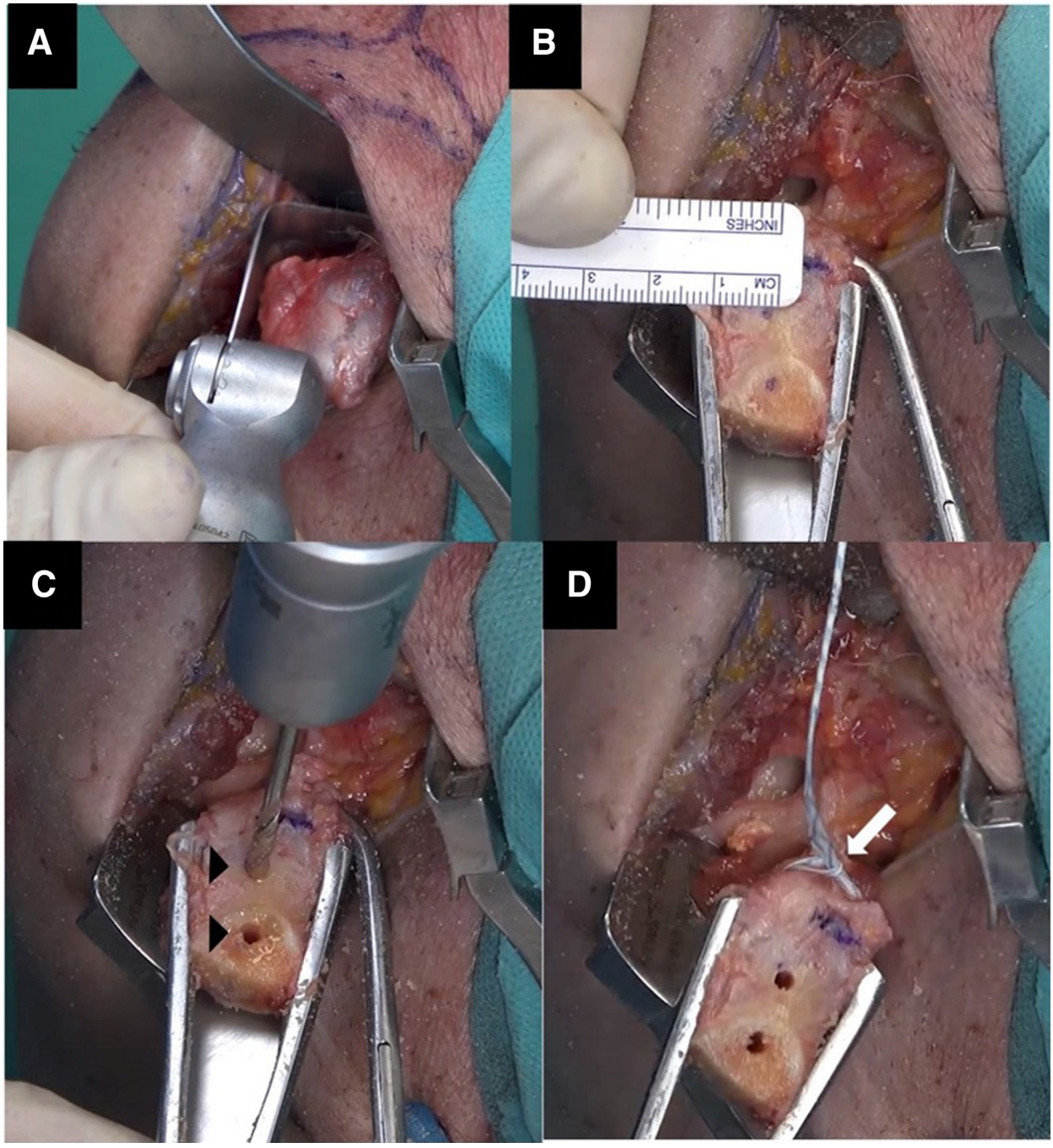

Fig 2. Right shoulder, beach-chair position, anterior view. (A) Using an angle motorized saw, perform the osteotomy of the coracoid process at its base. (B) With skin, the marker identifies and draws 2 points separated by 1 cm in the coracoid graft. (C) While securing the graft, drill two 3-mm holes following the previous marks on the graft (arrowheads). (D) secure the coracoid using a suture around its base during the surgery (arrow).

is detached from the 1- to 5-o'clock position. The anterior surface of the glenoid neck should be lightly decorticated to enhance the flush bony contact and provide better healing potential (Fig 2C).

From the anterior incision, a Wissinger rod is introduced through the glenohumeral joint line, parallel to the glenoid surface and between 2 and 5 o'clock, in the center of the anterior glenoid bone defect. At the exact point where the Wissinger rod pushes the skin posteriorly, a small incision is made to allow the metal rod to complete the inside-out approach (Fig 4A). A half-pipe cannula is subsequently inserted over the rod from anterior to posterior. A specific glenoid drill guide hook is inserted through the posterior horizontal incision with the guidance of the half pipe cannula (Fig 4 B and C).

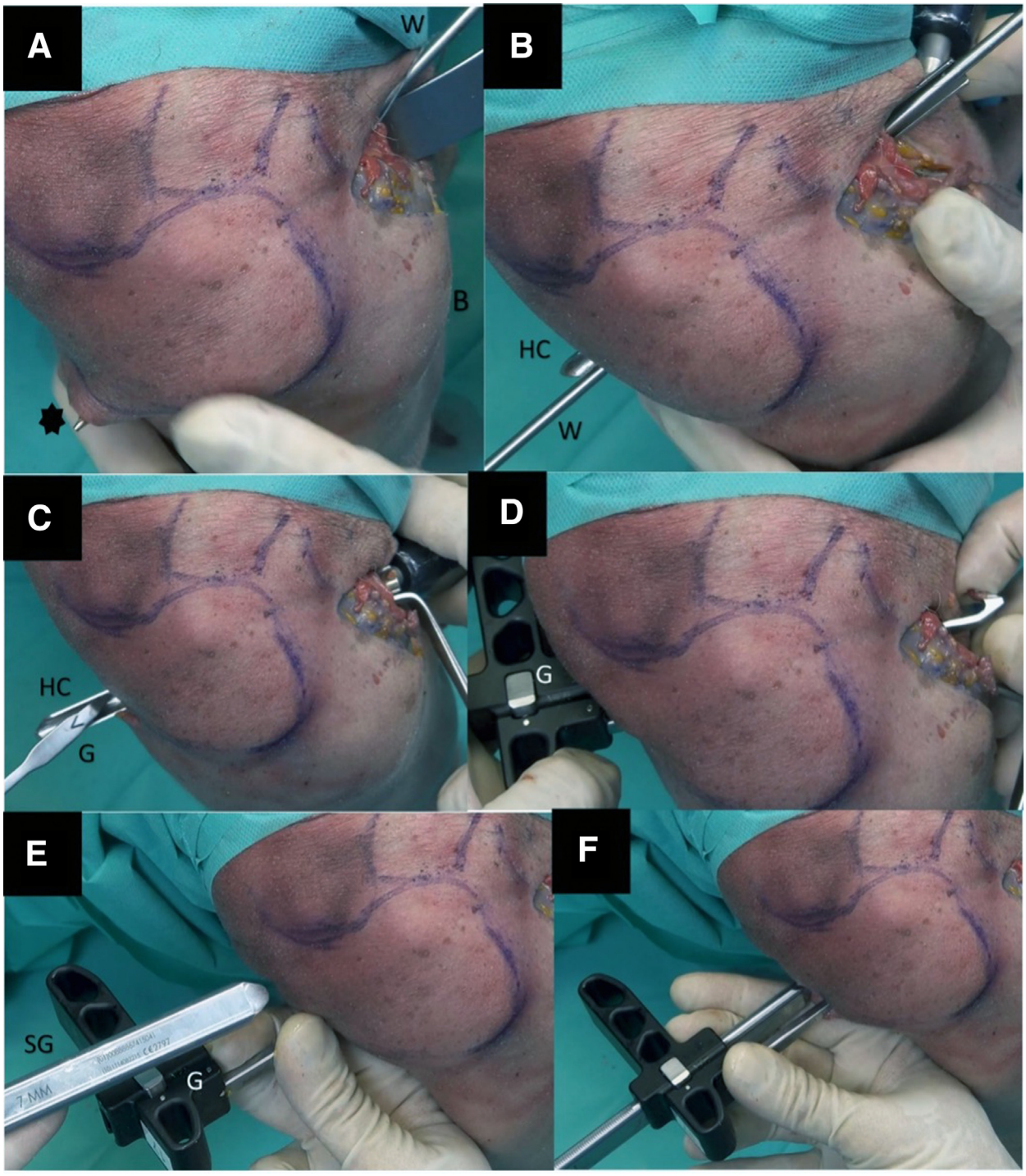

Fig 3. Right shoulder, beach-chair position, posterosuperior view. (A) Introduce a Wissinger rod through the anterior incision, across, and parallel to the glenohumeral joint. Mark the point where the rod pushes the posterior skin. Make a horizontal incision (black star) at that level and pass the Wissinger rod. (B-D) The half-pipe cannula should be introduced following the switching stick from anterior to posterior. Once the cannula is through, the hook guide is inserted from posterior to anterior over the half pipe. The hook is then centered on the glenoid rim defect. (E-F) A specific sleeve drill guide (Arthrex) is assembled to the handle of the hook and introduced using the posterior incision. (B, anterior aspect of the shoulder; G, hook guide; HC, half-pipe cannula; SG, specific sleeve drill guide; W, Wissinger rod.)

The guide hook should be centered on the glenoid rim of the defect. Once the hook is inserted, a specific drill guide (Arthrex, Naples, FL) is assembled to the handle of the hook and introduced using the posterior incision (Fig 4D). The specific drill guide should rest against the posterior glenoid neck.

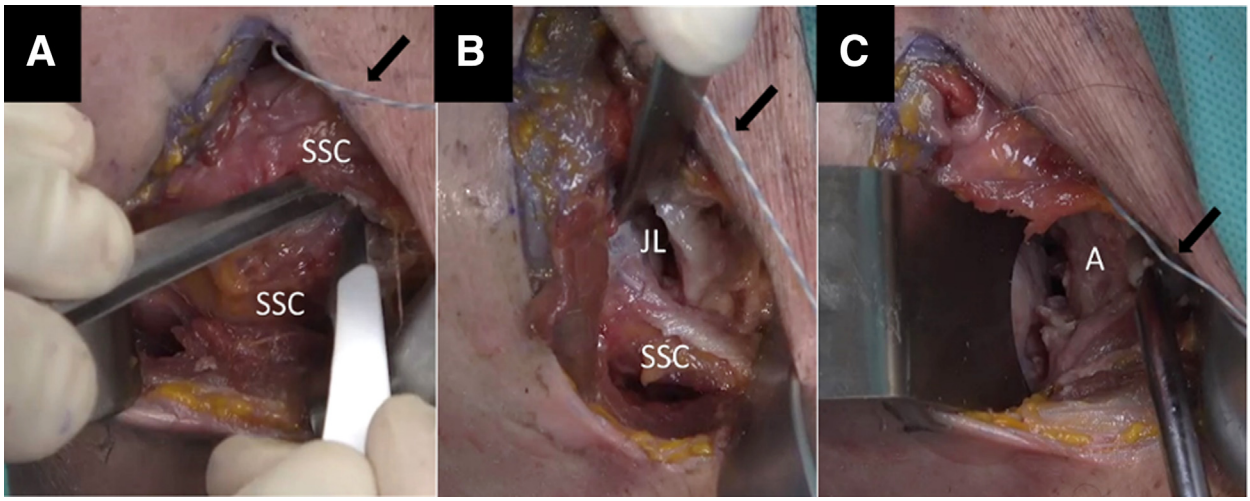

Fig 4. Right shoulder, beach-chair position, anterior view. (A) Split through the subscapularis tendon between the middle and inferior third, with the arm in adduction and external rotation to tension the muscle. (B-C) While feeling the joint line, a vertical incision is made to the capsule medially, leaving a stump for the posterior repair. Using the small glenoid retractor medially and a Fukuda retractor, the anterior surface of the glenoid neck should be debrided to enhance graft healing. Arrow: Suture attached to the coracoid process base. (A, anterior glenoid neck; JL, joint line; SSC, subscapularis tendon.)

Step 3. Glenoid Tunnel Drilling and Suture Passing

Two tunnels are then drilled through the glenoid using 3-mm cannulated drill bits. The drills are carefully advanced until they exit at the anterior cortex of the glenoid neck (Fig 3A). After removing the stylet from the drills, the remaining cannulated outer sleeves are used to pass 2 nitinol wires (Fig 3B). To avoid breakage during traction, the nitinol wires are immediately replaced with 2 different-colored high-strength suture links (FiberLink/TigerLink; Arthrex), leaving one loop directed anteriorly and one loop directed posteriorly (Fig 3C).

Step 4: Cerclage Journey and Construct Interconnection

Two cerclage suture tapes (FiberTape/TigerTape Cerclage; Arthrex) are loaded into the suture with the posterior loop and shuttled through the respective glenoid bone tunnel, ensuring smooth sliding of the tapes within this and each following tunnel by pulling back and forth from each end. Both systems are then passed through the first corresponding graft tunnel, starting at the decorticated surface, and back in the opposite direction through the second tunnel of the coracoid graft. It is critical while assembling the construct to ensure that the distal glenoid tunnel will be lined up to the graft tunnel closest to the conjoint tendon. Finally, the cerclage suture tapes are loaded into the suture with the anterior loop and shuttled back to the posterior aspect of the glenoid through the remaining glenoid tunnel, completing the circular configuration of the construct (Fig 5 A-E).

Step 5: Cerclage Suture Tape Final Fixation and Reconstruction of the Capsulolabral Complex

The cerclage tapes in each system are manually interconnected using the preconfigured racking hitch knots. Then, the knots are reduced against the posterior aspect of the glenoid neck by applying alternating symmetrical traction of the interconnected tapes. This ensures that the debrided articular coracoid surface side is pulled against the glenoid defect. Correct positioning and fixation of the graft are checked under direct visualization. Each system is then locked with 4 alternating half-hitch knots to secure the final construct, after applying tension to the suture of the first half hitch using a knot-pusher while holding the post aside. If necessary, a mechanical tensioner (FiberTape Cerclage Tensioner; Arthrex) can be used instead of a knot-pusher to apply a 134 N (30 lbs) load before locking to ensure adequate compression (Fig 6 A-D).

At this point, the capsulolabral complex is reinserted to the anterior glenoid rim using 1.8-mm all-suture knotless implants (Knotless FiberTak; Arthrex), or suturing the remanent coracoacromial ligament to the medial detached capsule, which makes the graft extra-articular. The subscapularis split is repaired using nonabsorbable sutures and the incisions are closed in a standard fashion, concluding the procedure (Fig 7). Tips, pearls, and pitfalls of this technique are presented in Table 2.

Postoperative Care

The shoulder is immobilized in neutral rotation using a sling for a period of 3 weeks, followed by isometric strengthening of periscapular muscles and deltoid.

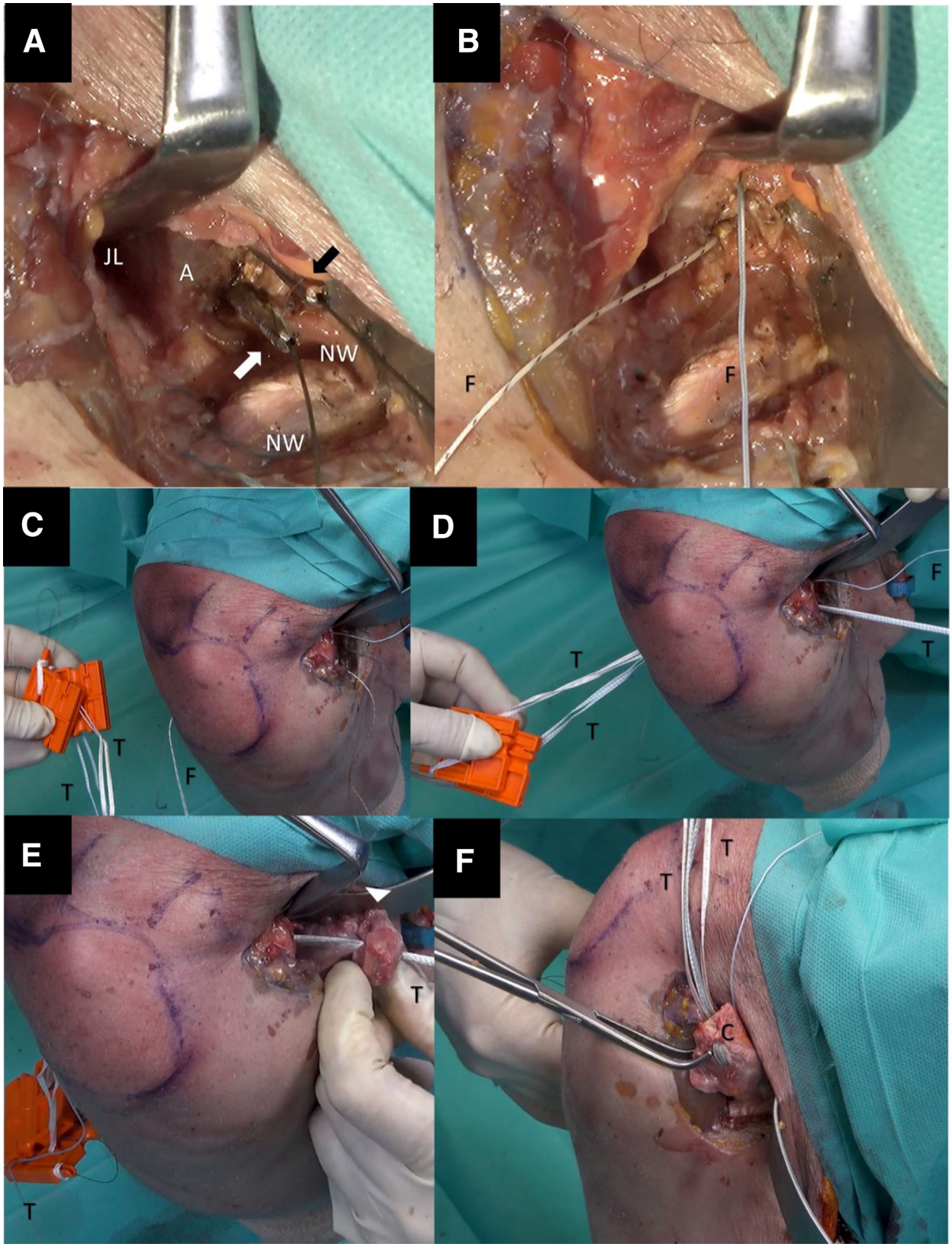

Fig 5. Right shoulder, beach-chair position, anterior view. (A) A 3-mm cannulated drill is passed through both sleeve guide holes until exiting on the anterior aspect of the glenoid. Pass 2 nitinol wires through the cannulated drill (arrows). (B) Replace the nitinol wires with 2 different colors of high-strength sutures link (Arthrex) to avoid breakage during traction. (C-F) Introduce and secure 2 preconfigured cerclage suture tapes (Arthrex) with the same length and tension to the one suture Link with the loop posteriorly. Get them through the respective tunnel in the graft (arrowhead) and floss them. Finally retrieve them through the second tunnel in the graft, forming a U cerclage, and retrieve them through the second suture link with the anterior loop. (A, anterior surface of the glenoid; C, coracoid process; F, high-strength FiberLink; JL, joint line; NW, nitinol wire; T, cerclage tapes.)

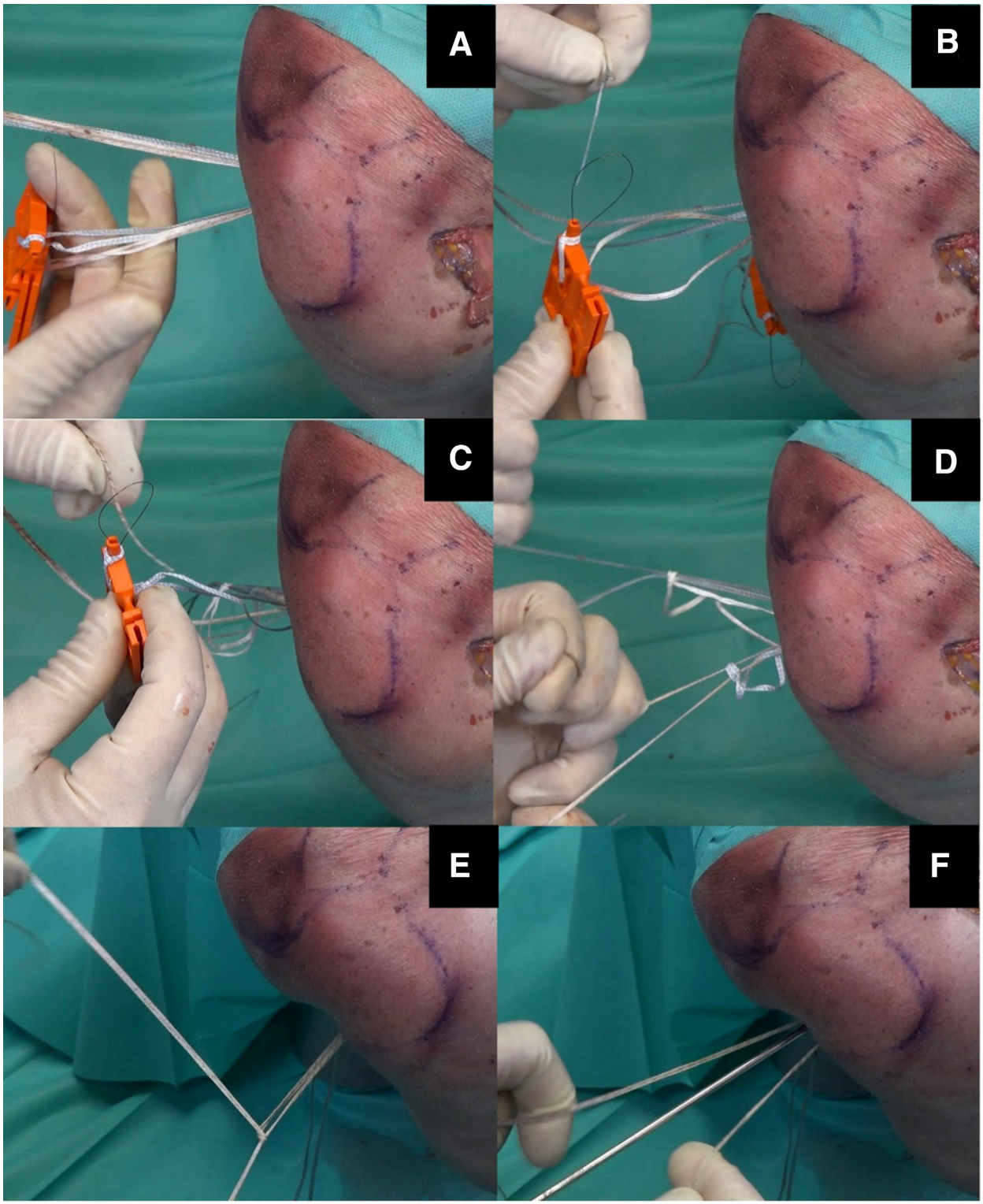

Fig 6. Right shoulder, beach-chair position superior view. (A-B) Once the cerclage tapes are recovered on the posterior aspect of the shoulder, we interconnect the tapes using the nitinol loop of the preconfigured knot, completing the cerclage suture system. (C-D) Pulling from each suture limb of both cerclages alternatively and symmetrically the knots slide against the posterior glenoid neck. (E-F) Lock the system with alternate four-half hitch knots using the knot-pusher while holding the post aside.

Mobility exercises of the elbow and hand are encouraged. External rotation of up to 20° in abduction is permitted. Actively assisted mobilization is started at 3 weeks and muscle-strengthening exercises are further increased at 6 weeks postoperatively. Return to sports is allowed at 4 months postoperatively. Radiographic

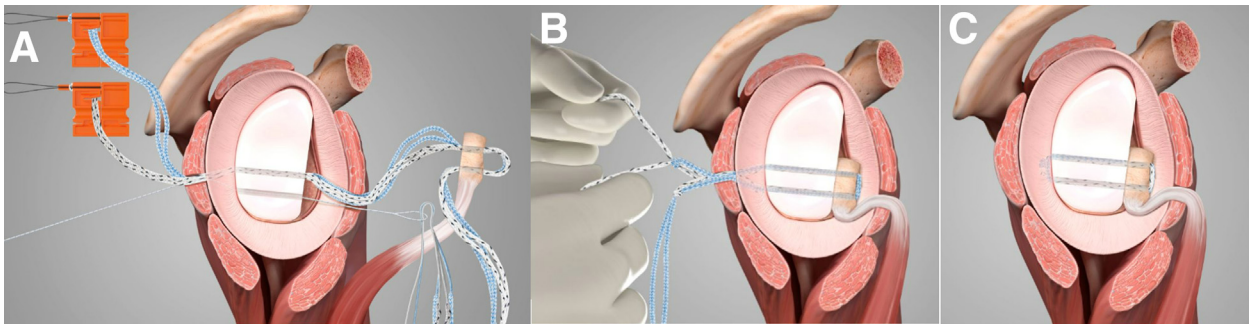

Fig 7. Right shoulder, sagittal view, the final scheme. (A-C) Two cerclage suture tapes (Arthrex) are passed through the proximal glenoid tunnel and through the coracoid graft. Using a high-strength suture link (Arthrex) the suture tapes are retrieved to the posterior aspect of the glenoid neck. (B) Once the cerclage suture system is interconnected, each suture limb is pulled alternatively and symmetrically sliding the knots against the posterior glenoid neck. (C) Final view of the construct locked with four-half hitch knots and knot-pusher.

postoperative controls are performed at 3 and 6 weeks' follow-up with neutral anteroposterior and Bernageau views of the shoulder. The position of the coracoid process is assessed with an early postoperative computed tomography scan. The limitations and risks of this technique are discussed in Table 3.

Discussion

Management of shoulder instability has always had some of the widest range of options in orthopaedic surgery, not only because it is one of the most challenging pathologies but also due to the lack of consensus on different criteria of treatment.[6,13] Since being introduced in 1954 by Michel Latarjet, the Latarjet procedure has been considered the gold standard for recurrent shoulder instability and bipolar bone loss, with good long-term results.[14] In the United States, the number of Latarjet procedure increased significantly from 3% in 2007 to 18% in 2015, in all shoulder stabilization techniques.[15] The main indications for Latarjet are critical or subcritical glenoid bone defects, off-track lesions, professional athletes involved in contact sports even in absence of critical bone defects, and revision surgeries.[16,17] Despite excellent reported outcomes, intraoperative, immediate, and long-term complications have been reported at a rate of 15% to 30%, including graft malpositioning, nerve injury, nonunion, osteolysis, screw breakage, and prominence, as well as a revision rate of up to 7 %.[6,18] Various case series also show that common reasons for revision are related to the implants.[6,7,18-20] Because of this, several modifications have been described in the last few years to minimize complications.[7,19,21-23]

Traditionally, Latarjet has been performed with an open approach, but minimally invasive techniques have recently become more common. The possibility of improved management of associated shoulder pathologies, reduced shoulder stiffness, faster rehabilitation, and cosmesis are some of the advantages provided by the arthroscopic procedure.[19] Nevertheless, the arthroscopic approach requires advanced arthroscopic shoulder surgery skills, has a steeper learning curve, and preparation and harvesting of the graft is technically more challenging and more time-consuming.[5,24-26] The risk of nerve injury is also greater in the arthroscopic technique, due to the supramammary portal which is a prerequisite for ideal graft positioning.[11] Cost is another drawback when performed arthroscopically; as it can be double the cost of open surgery.

The open Latarjet procedure, on the other hand, has the advantage of better graft placement in the coronal plane, a shallower learning curve, shorter operative time, safer and easier access to the coracoid and preparation of the articular surface, and better control of tool positioning, as compared to all-arthroscopic technique.[26,27]

Osteolysis of the graft has been shown to occur regardless of the surgical technique while having very little influence on the clinical stability of the shoulder.[21,28,29] Most often, osteolysis happens in the superficial zone of the graft which is outside the best fit circle and theoretically remains unloaded.[12,30] This ultimately leads to the prominence of the metallic implants, which causes subscapularis irritation and humeral head impingement. Bioabsorbable screws, in contrast, have shown an unacceptably high rate of graft osteolysis.[31]

Suture-button fixation has been proposed as a safe and reliable alternative for screws in the open Latarjet, demonstrating similar healing rates, time to return to sports, and functional results when compared with the classic screw technique.[22,23,32,33] Boileau et al.[23] reported a nonunion-rate-of-5% when using suture-button fixation, which is below the rate shown in some screw-fixation series, despite these promising results, there is still a need for more studies and a longer period of follow-up to confirm these conclusions.

Table 2. Tips, Pearls, and Pitfalls

Tips and Pearls
• The inferior aspect of the coracoid graft must be prepared to obtain a flush bone surface.
• A full decortication of the anterior glenoid defect should improve graft healing.
• A medial vertical capsule incision among subscapularis split leaves enough tissue to perform an adequate repair to the native glenoid rim or to coracoacromial ligament remanent at the end of the surgery.
• Introduce the Wissinger rod from the anterior incision, at the midpoint of the glenoid defect, to establish a safe posterior exit and the exact point where to assemble the specific drill guide on the posterior aspect of the shoulder.
• Maintain the same length and the full tension of the cerclage construct in every single bone tunnel during each pass of the suture tapes.
• Manually, alternatively, and symmetrically traction of every single limb of the cerclage tape from the posterior improves the sliding of the knots and prevents slacks to the posterior scapular neck.
• The cerclage tapes are manually interlocked with the pretied knot of the counterpart.
• Use a knot-pusher to tension the hitching half suture while holding the post aside. Four alternating half hitch knots should be performed.
• Add a tensioner if necessary to attain optimal fixation
Pitfalls
• The conjoined tendon should be completely identified and isolated at the beginning of the surgery to avoid damage to the neurologic structures.
• Use an angle motorized saw to protect the skin and get better control of the osteotomy, starting lateral and finishing from superiorly to lower the risk of brachial plexus lesion.
• Traction on the coracoid could lead to a musculocutaneous nerve injury.
• Exchange the nitinol wire loops with sutures link to avoid transportation issues.
• Use the nonthreaded k-wire for capsulolabral repair to avoid cerclage tape damage.

The procedure aims to propose a metal-free Latarjet fixation technique to avoid implant-related complications, which are responsible for one half of the reported revision surgeries.[7,20,34]

This fixation and surgical approach method are equally relevant for shoulder surgeons who perform Latarjet open or arthroscopically. The use of 2 interconnected high-strength cerclage suture tapes (4 limbs) achieves a compression that mimics the compression obtained by a plate, which was proven on cyclic loading of graft in vitro.[11,35] In a recently published biomechanical study, there was no statistically significant difference in translation, shoulder stiffness, and force to dislocate the shoulder between free bone block fixed with cerclage and Latarjet screw fixation.[36]

With this metal-free technique, results are consistent and accurate, especially because of the specifically designed fixed angle hook guide for drilling the tunnels parallel to the glenoid articular surface. Drilling the tunnels from posterior to anterior with the specifically designed jig also prevents putting the brachial plexus under considerable stress. In the same context, Taverna et al.[37] showed no nerve injuries in a series of 60 patients in which a specific jig was used. It also has been reported that the use of a posterior glenoid guide for drilling the tunnels improves the accuracy of the coracoid graft position when compared with the free hand open technique, avoiding lateral, medial, or high graft position.[37]

Table 3. Risks and Limitations of This Technique

Limitation
• Requires a specifically designed guide and cerclage tapes.
• Full access to the posterior shoulder in a beach chair position.
Risks
• Brachial plexus injury during the coracoid manipulation.
• Overtensioning using a tensioner could break the graft.
• Hematoma because of open surgery.

The use of cerclage suture tapes eliminates the risk of nerve injury when passing screws through the glenoid, particularly if they are divergent more than 10°, putting the suprascapular nerve at risk.[27] In addition, with the cerclage tapes under direct visualization, the risk of nonunion due to inadequate tensioning of the graft or graft fracture because of inadvertent overtensioning are reduced.

Metal-free Latarjet cerclage performed with a mini-open approach is not an anatomical procedure, reducing the previously reported issues and providing perfectly aligned bony tunnels and restoration of the glenoid track.

The authors prefer to perform a Bankart repair on top of the graft and glenoid rim interface, to improve proprioception and reduce patient apprehension.[38] It recently has been reported that the capsular repair leads to clinically insignificant restriction of the external rotation in abduction.[39] Damage to the cerclage suture tape construct is avoided by using nonthreaded K-wires while repairing the labrum.

Conclusions

The presented mini-open, metal-free Latarjet cerclage technique is a safe, reproducible surgical procedure for treating anterior shoulder instability, which looks to avoid hardware-related complications associated with previously described gold standard techniques.

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