Technical Note

All Arthroscopic Salvage Technique for Intraoperative Vertical Split Coracoid Graft Fracture in Latarjet Procedure—Technical Note

Ayyappan V. Nair, D.Ortho, D.N.B., M.N.A.M.S., Pramod Kumar Mohan, M.S., Ortho., Pavan Krishna, M.S., Ortho., Ajit Jangale, M.S., M.R.C.S., Syed Kareemulla, M.S., Ortho., Naresh Goud, D. Ortho., D.N.B. Ortho., and Sreejith Thampy, M.S., Ortho.

Abstract: Intraoperative vertical coracoid graft fractures during the Latarjet procedure are well-described complications, which typically have a poor prognosis or may necessitate further iliac crest bone grafting for stabilization. The vertical split coracoid fractures are reasoned to be caused by excessive tightening of the screws, poor bone quality, especially in females and the smaller dimension of the coracoid graft. In this technical note, we propose an arthroscopic salvage technique for salvaging the fractured coracoid graft and to avoid the need for additional bone graft, thereby reducing morbidity to the patient. We use two double-loaded, all-suture anchors (Stryker, India) on either side of the split coracoid graft, and double-pulley configuration of suture tightening is done, providing compression and stability to the fractured graft.

Arthroscopic Latarjet procedure is the preferred method of bony stabilization in recurrent shoulder dislocation with certain criteria. Ideal candidates for the Latarjet treatment include patients with recurrent dislocation, glenoid bone loss higher than 15%, severe soft tissue insufficiency, failed Bankart repair, contact athlete dislocation, and ISIS greater than 4.[1] The long-term outcomes following the Latarjet procedure are good to excellent with comparable results with an open and arthroscopic approach.[2-4] However, the arthroscopic Latarjet procedure has the benefit of addressing additional intra-articular pathologies, such as SLAP lesions, and performing a remplissage for an off-track Hill-Sachs lesion. It also has the advantage of less postoperative pain with an earlier recovery, less bleeding, and slightly fewer instances of instability.[5] Complications of the Latarjet procedure have been described in the literature and can be grouped as intraoperative, hardware-related, graft-related, and neurovascular complications.[6-9] Intraoperative graft fractures have been described, and this technical note aims to demonstrate an arthroscopic salvage procedure of intraoperative vertically split coracoid graft fractures (Video 1). In this technical note, we use a double-pulley configuration of suture tightening with 2 double-loaded, all-suture anchors and salvage of the vertically split coracoid graft are described. Two double-loaded, all-suture anchors (Stryker) are placed on either side of the vertically split coracoid graft and each suture threads are tied over the graft in double-pulley configuration, enabling graft compression and stability.

Surgical Technique (With Video illustration)

Patient Positioning and Portal Placement

Under general anesthesia and an interscalene block, the patient is positioned in the beach chair position. The arm is prepped and draped, held by traction cable with the shoulder in 60° anterior elevation, 10° shoulder abduction, and neutral rotation (Fig 1).

Portal Placement

Surgical Steps

The arthroscopic Latarjet procedure, as described by Lafosse, was performed. The coracoid graft was

From the Bangalore Shoulder Institute, Bangalore, India.

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Address correspondence to Pramod Kumar Mohan, M.S., Ortho, 40,36th Cross, 23rd Main Road, 4th T Block East, Jayanagar, Bangalore, 560041, Karnataka, India. E-mail: pramod.stanley@gmail.com

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Fig 1. Patient positioning and portal placement. The patient is positioned in the beach chair position for the arthroscopic Latarjet procedure, and the right shoulder is prepped and draped.

prepared, osteotomized, and transferred through the subscapularis split. The coracoid graft fixation was carried out with two cannulated metal screws (Depuy-Mitek, Chennai, India) and tightening of the screws was performed. While the tightening of graft was performed, we encountered an iatrogenic vertical split fracture of the coracoid graft, extending until the conjoint tendon insertion (Fig 2). The vertically split coracoid graft was salvaged with the arthroscopic technique, as described below.

Double-Loaded, All-Suture Anchor Placement

Using 4-mm 30° arthroscope, viewing from the mid axillary portal, two double-loaded, all-suture anchors (1.7 mm, Stryker) are placed. The first double-loaded anchor is placed on the medial scapular neck at the level of the coracoid graft, and the second double-loaded anchor is inserted on the glenoid face at the same level as the first anchor. The anchors are inserted from the trans-pectoralis portal, we use a clear cannula (the anchor sheath is cut to the appropriate length for the anchor insertion) for anchor insertion. The suture threads of each anchor are identified as tiger blue and tiger black (Fig 3).

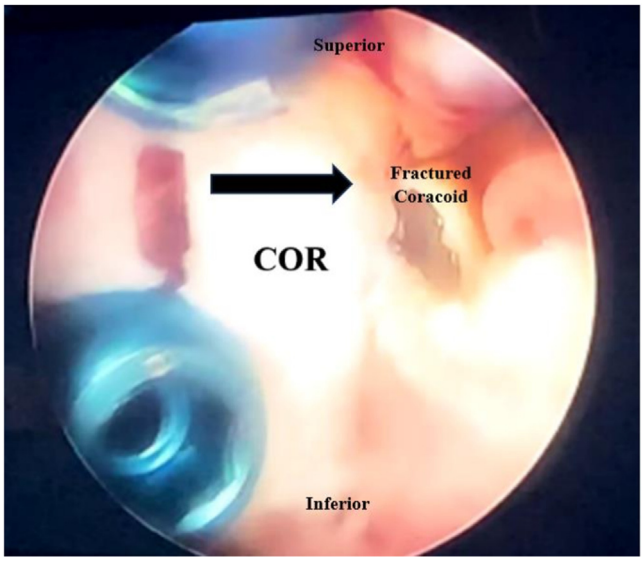

Fig 2. Viewing from the mid-axillary portal with a 4-mm 30° arthroscope in the right shoulder, the vertically split coracoid graft is visualized. The split coracoid graft is found secured with the glenoid bed using 2 titanium metal screws. COR, coracoid.

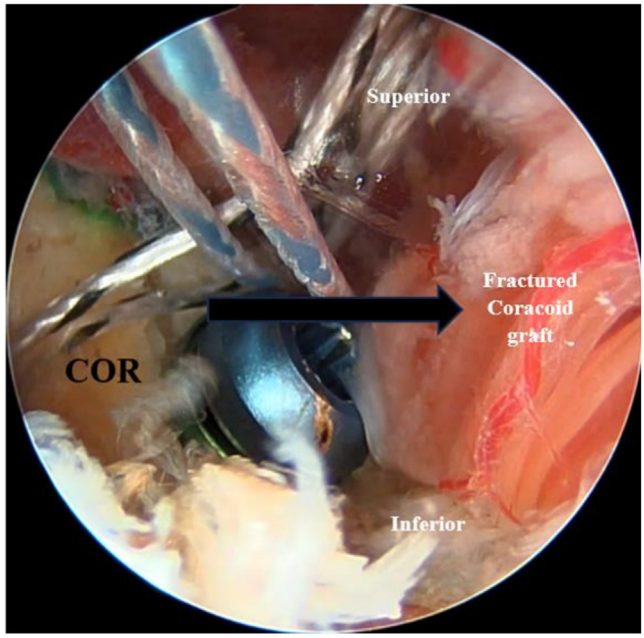

Fig 3. Viewing from the mid-axillary portal with a 4-mm 30° arthroscope in the right shoulder, the vertically split coracoid graft is visualized along with the 2 double-loaded, all-suture anchors on either side of the coracoid graft. One double-loaded, all-suture anchor is placed medially, and another anchor is placed laterally to the graft on the glenoid. COR, coracoid graft.

Suture Management and Placement of First Pulley

Viewing from the mid-axillary portal, the suture threads of each anchor are identified as tiger blue and tiger black. Initially, all the tiger blue suture threads from both the anchors and one tiger black suture thread from each anchor are parked outside the lateral portal. The remaining tiger black threads are retrieved from the trans-pectoralis portal making sure of no soft tissue entanglement. Both the threads are tied together with half-hitching knots from the trans-pectoralis portal through the clear cannula, 6 alternating half-hitching knots are placed. The remaining threads are cut after knotting. Then the other tiger black suture threads parked outside the lateral portal are retrieved from the trans-pectoralis portal, and tightening is done in a pulley fashion after loosening the inferior screw to get adequate compression of the fractured graft. The threads are secured with 6 alternating half-hitching knots and the remaining length of the 2 threads are taken over the graft and secured at the glenoid face at 5 o'clock position with a 2.7-mm push lock anchor (Arthrex, Naples FL) along with the sutures securing the capsulolabral tissue complex.

Second Pulley Placement

The single tiger blue suture threads from each anchor are retrieved through the trans-pectoralis portal. The suture threads are retrieved through the clear cannula, making sure there is no soft tissue window between the suture threads. Both threads are tied together with half-hitching knots from the trans-pectoralis portal through the clear cannula, 6 alternating half-hitching knots are placed. The remaining threads are cut after knotting. Then the other tiger blue suture threads parked outside the lateral portal are retrieved from the trans-pectoralis portal, and tightening is done in a pulley fashion. The ends of the suture threads are secured at the glenoid face at 4 o'clock position with 2.7-mm push lock anchors (Arthrex, Naples FL), along with the capsulolabral complex, making the graft extra-articular (Figs 4 and 5).

Final Arthroscopic Evaluation

Final arthroscopic evaluation done from the mid-axillary portal showed adequate compression of the fractured coracoid graft with 2 metal screws. The double-pulley configuration provides adequate compression and sturdy fixation of the coracoid graft, allowing the graft to heal (Fig 6).

Postoperative Protocol

Postoperatively, the patient was immobilized in an arm sling. Shoulder shrugs, passive elbow mobilization, and hand grips were started from day 1 after surgery. Passive shoulder forward flexion and external rotation were started on the 10th day to achieve full passive forward flexion and external rotation at the end of the 6 weeks. The patient was encouraged to perform computer work after suture removal on day 10 after surgery. Active shoulder movements and strengthening

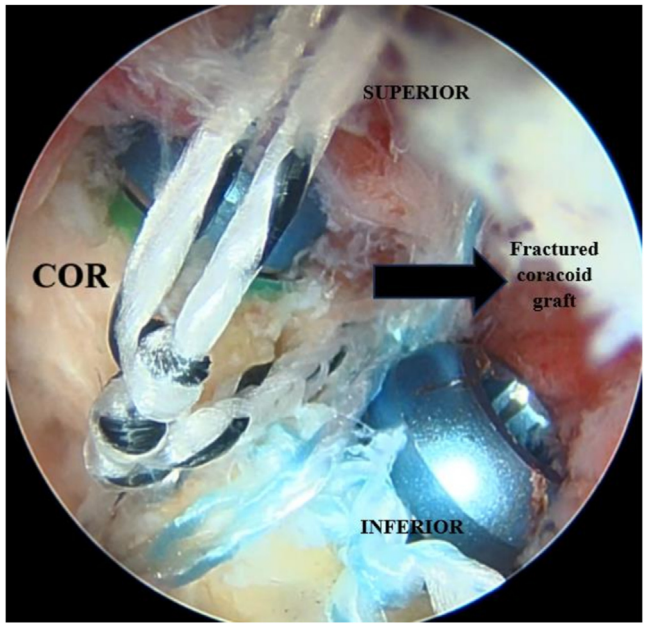

Fig 4. Viewing from the mid-axillary portal with a 4-mm 30° arthroscope in the right shoulder, the double-pulley configuration, using two double-loaded, all-suture anchors, is seen, along with the adequately compressed coracoid graft. COR, coracoid graft.

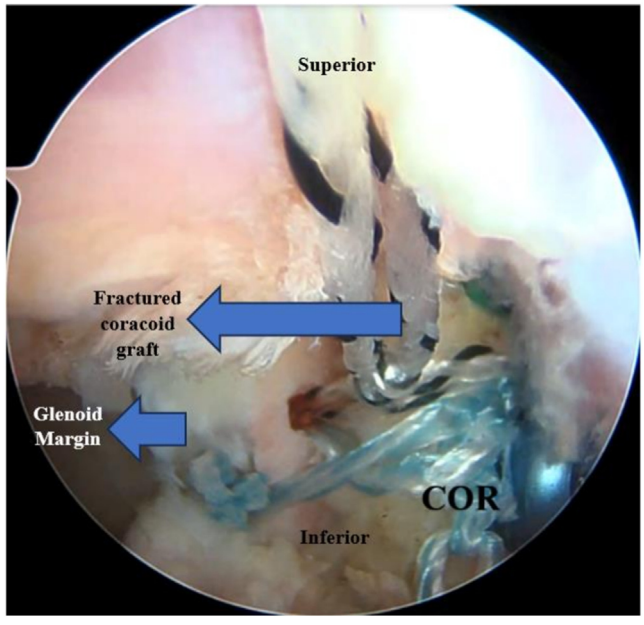

Fig 5. Viewing from the mid-axillary portal with a 4-mm 30° arthroscope in the right shoulder, fixation of the one end of the double-pulley along with capsulolabral tissue complex with 2.7-mm Push Lock anchor is visualized. COR, coracoid graft.

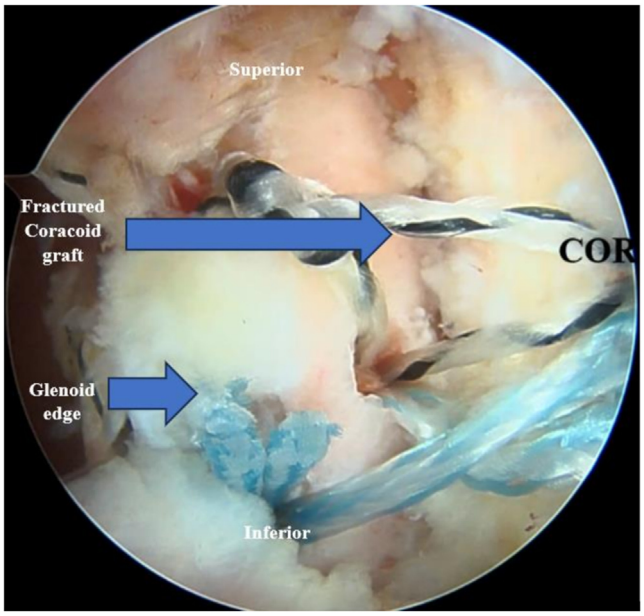

Fig 6. Viewing from the mid-axillary portal with a 4-mm 30° arthroscope in the right shoulder, 30° arthroscope, final construct with coracoid graft, capsulolabral tissue complex, and double-pulley configuration are secured with two 2.7-mm Push Lock is visualized. The 2.7-mm Push Lock is placed over the glenoid face, along with sutures and the capsulolabral tissue complex. COR, coracoid graft.

exercises were initiated at the end of 6 weeks and continued until the third month. The patient was allowed to return to daily activities in the sixth week, and sporting activities were allowed only after 6 months after the postoperative CT scan showed good bony union and remodelling.

Discussion

The learning curve in performing arthroscopic Latarjet was steep, which resulted in increased complication rates in the early learning period.[7,10] Overall, complication rates following Latarjet procedure were estimated to be 17.3%.[11] The advantages of arthroscopic Latarjet included less bleeding, less postoperative pain, less scarring, and early postoperative mobilization.[5,12,13]

Intraoperative coracoid graft fractures were well documented in the literature with rates of 5.2—7% during the arthroscopic Latarjet procedure. Athwal et al. documented graft fractures, as the most common adverse effect following arthroscopic Latarjet and estimated their frequency to be 7%.[14] Lafosse et al. documented graft fractures in 1% of their case series following arthroscopic Latarjet.[15] The rates of coracoid graft fracture during open Latarjet were estimated to be 1.5%.[16]

Graft fractures during the Latarjet procedure were due to overtightening of the metallic screws, a smaller coracoid graft and poor quality of the bone.[13,17] Athwal et al. proposed that good under-surface preparation of the coracoid graft can reduce the incidence of graft fractures. Maintaining 9-mm distance between the screw holes, using the two-finger technique for screw tightening, using top hats with metallic screws, and ensuring adequate graft length, adequate coracoid and glenoid preparation can reduce the graft fracture rates during the procedure.[14]

Depending on the fracture pattern and the stability of the graft after fixation, intraoperative graft fractures can be addressed. Transverse graft fractures may occur at the level of the beta screw (proximal screw), between

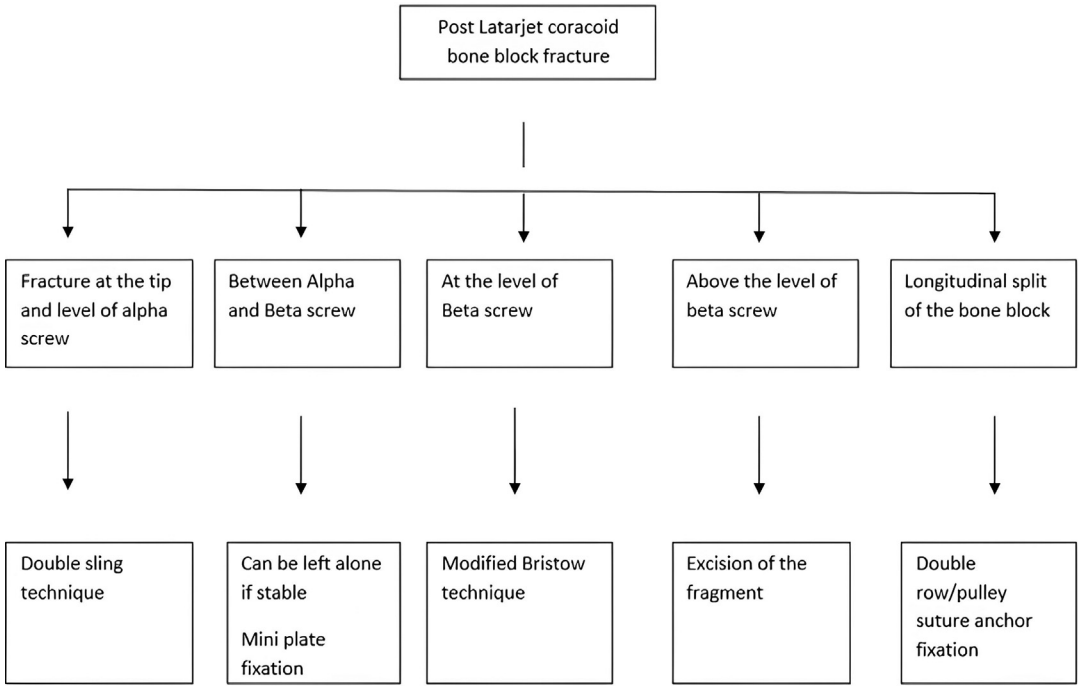

Fig 7. Flowchart for management of intraoperative coracoid graft fractures.

Table 1. Advantages, Pitfalls and Pearls of the Salvage Technique for Coracoid Graft Fracture

Advantages
1. The technique is relatively easy and reproducible for arthroscopy surgeons trained in arthroscopic Latarjet.
2. The technique can also be used for graft salvage, while performing open Latarjet.
3. The same portals used for arthroscopic Latarjet can be used for this technique.
4. Double-loaded, all-suture anchors are easier to place on both sides of the coracoid graft due to the low profile of the anchors.
5. The double-pulley method enables adequate compression of the fracture fragments.

Pitfalls
1. Technically demanding for surgeons who are not trained in the arthroscopic Latarjet procedure
2. Only vertical split fractures can be salvaged with this technique.
3. Very osteoporotic coracoid is difficult to salvage using the method.

Pearls:
1. Adequate visualization of the fractured graft is essential for performing the technique.
2. Cortical screws should be loosened to enable achieving adequate compression of the graft.

the beta and alpha screws, at the level of the alpha screw (distal screw), or at the joint tendon attachment. Depending on the location of the fracture, the fracture may be addressed. The flowchart outlines the management procedure to be followed in the event of transverse graft fractures (Fig 7).

Coracoid graft fractures that were not salvageable were treated with the Eden-Hybinette procedure, which requires iliac crest graft harvest. Although the procedure provided satisfactory outcomes, donor site morbidity should be considered. With our method, vertical split graft fractures that were previously treated with iliac crest bone grafting (Eden-Hybinette) can be salvaged. One advantage of our salvage technique is it can be performed arthroscopically and can also be used while performing open Latarjet. The technique was relatively easy and reproducible, ensuring dependable results. Kongmalai et al. proposed a salvage method for vertical graft fractures using 2 suture anchors on the medial glenoid neck during open Latarjet procedure.[18] The advantages of our proposed technique are that using two double-loaded, all-suture anchors on either side of the graft in a pulley fashion provides adequate compression of the fractured graft, and it can be done in all-arthroscopic fashion (Table 1). We retained the metal screws instead of removing the screws; the screws were loosened a bit to achieve adequate graft compression and left in place (Fig 8).

Improper visualization of the graft while securing the knots following the double-pulley technique will result in graft loosening due to slackness of the knots. Coracoid graft fractures following arthroscopic Latarjet performed with cerclage tapes or cortical button are at risk of failure if double-pulley salvage technique is tried in such scenarios. Overcompression of the double pulley

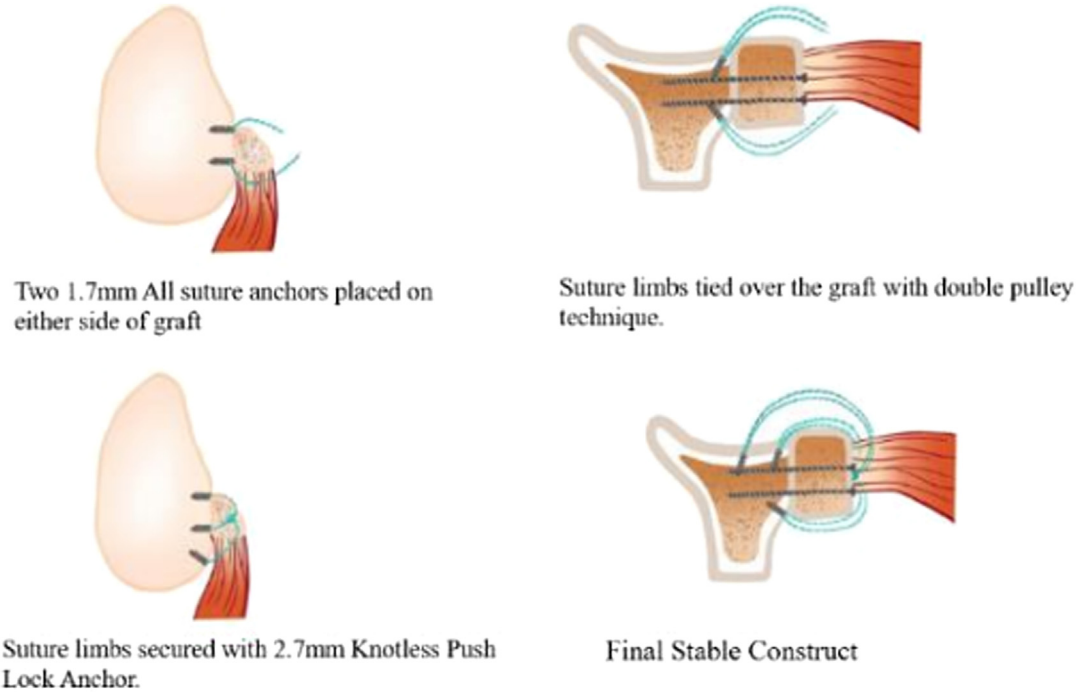

Fig 8. Animated figures showing the double-pulley salvage technique for vertically split coracoid graft in the right shoulder. The graft is salvaged with two double-loaded, all-suture anchors passed over the graft using the double-pulley fashion and securing the ends of the sutures with 2.7-mm Push Lock anchor.

Fig 9. CT scans of the right shoulder at 3 months after Latarjet surgery showing good bony union of the coracoid graft. The coracoid graft is found to be incorporated with the glenoid, and there is no evidence of graft loosening or screw loosening.

Table 2. Risks and Limitations of the Procedure

1. All-suture anchors are preferred for double pulley due to the low-profile nature of the anchors.
2. Osteoporosis can result in crushing of the graft when compression is applied with the double pulley.
3. Double-pulley technique of graft salvage can be done preferably following fractures encountered during arthroscopic screw Latarjet.
4. Improper visualization while securing the arthroscopic knots may result in slackness of the knots and subsequent graft loosening.

can cause crushing of the graft in cases where there is a very osteoporotic coracoid. Requirement of additional graft sources should be anticipated following graft fractures while performing the Latarjet procedure.

We have two cases of vertically split intraoperative coracoid graft fractures, which were salvaged with the proposed treatment method. We followed up the patients with CT scan at the third month to assess bony integration, as well as clinical follow-up for 1 year after surgery. We found good bony union in follow-up CT scans and good clinical outcomes following the graft salvage technique (Fig 9).

The all-arthroscopic salvage technique for the intraoperative vertical split of coracoid graft fracture is a simple, reproducible, and dependable option for coracoid graft salvage. Good preparation of the graft and avoiding overtightening of the screws can help avoid graft fracture. Being female, having osteoporotic grafts, and having smaller graft lengths were risk factors for graft fractures (Table 2).

Disclosure

The authors report no conflicts of interest in the authorship and publication of this article. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

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