Technical Note

Revision Shoulder Instability Surgery After Failed Latarjet: Glenoid Reconstruction Using Distal Tibial Allograft and Humeral Head Reconstruction Using Osteochondral Allograft

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Abstract: Revision surgery for a failed Latarjet procedure is rare and technically demanding with few viable options. Similarly, massive defects to the articular humeral head require thoughtful techniques to recreate a congruent joint. Revision options for failed Latarjet have been studied, but there is yet to be a consensus on graft options. Distal tibial allograft has shown favorable outcomes in midterm data. Humeral head osteochondral allograft has also shown favorable outcomes for very large humeral head defects. However, there is a paucity of literature to demonstrate efficacy of combining the 2 aforementioned techniques. Revision shoulder instability surgery with glenoid reconstruction using distal tibial allograft and humeral head reconstruction using osteochondral allograft restores the glenohumeral articulation while preserving the remaining native bone stock.

The incidence of shoulder dislocations is approximately 23% in the United States, with a higher prevalence in the male population.[1] Rate of recurrence is extremely high after index dislocation, ranging from 805 to 90% and is correlated with younger age. Bankart lesions are present in 80% to 90% of traumatic shoulder dislocation patients.[2] Bony Bankart lesions (fracture of anterior inferior glenoid) are present in up to 49% of patients with recurrent dislocations. The humeral head can also be affected by traumatic dislocation, resulting in a Hill-Sachs defect (posterior superior humeral head chondral impaction injury). These are present in 80% of traumatic dislocations and approximately 25% of atraumatic dislocations.[3] Seizures account for 2% to 5% of all shoulder dislocations.[2] Shoulder dislocations occur in 0.92% of seizures.[2] Forceful contraction in an isolated muscle group such as in a tonic phase of a seizure, is enough force to dislocate the glenohumeral joint. Posterior dislocations are seen with seizure activity, however anterior dislocation still remains more common even in the setting of seizure.

Management of shoulder instability varies depending on the residual anatomy of the glenohumeral joint. Operative management includes arthroscopic or open soft tissue imbrication or repair, bony buttressing for osseous defects, and salvage procedures for the recurrent dislocator after failure of initial surgical and medical management.

Patient Evaluation, Imaging, and Indications

The ideal patient for this technique is young and suffers from recurrent instability and profound bone loss and anatomic deformity after a standard Latarjet procedure fails. Physical examination typically includes positive apprehension and relocation tests, as well as a positive load and shift test result. Imaging demonstrates change over time from a bony Bankart lesion with

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>20% bone loss, and a large Hill-Sachs lesion (Figs 1-4) to eventual failure through Latarjet screws and worsening of his Hill-Sachs lesion (Fig 5). Because of interval progression of glenoid and humeral head bone loss and morphological changes of the native anatomy, an extensive reconstruction strategy is required. The aim of this technique is to demonstrate that combined glenohumeral reconstruction using fresh distal tibia allograft for glenoid reconstruction and fresh humeral head allograft for humeral head reconstruction (Fig 6) in the setting of failed Latarjet glenoid reconstruction and marked humeral head deformity is a viable solution.

Surgical Technique

A demonstration of this technique in the left shoulder is provided in Video 1.

Patient Positioning and Preparation

The patient receives a regional interscalene block, in addition to general anesthesia with endotracheal intubation. They are then positioned on the operative table in the beach chair position for optimal glenohumeral exposure.

Surgical Approach and Removal of Hardware

A previous deltopectoral incision is used with slight extension both proximally and distally. Because of the failed Latarjet procedure, the conjoined tendon is scarred down through the subscapularis split. The long head biceps tendon is identified at the superior border of the pectoralis major tendon, tagged with FiberWire suture, and used to follow dissection of the rotator interval into the glenohumeral articulation. The long head biceps tendon is then tenotomized, and the remaining proximal tendon is amputated. The subscapularis tendon insertion is then identified at the lesser tuberosity. Using a micro-sagittal saw, a fleck osteotomy of the lesser tuberosity is performed, and the subscapularis tendon is elevated off of the humerus (Fig 6). Blunt finger soft tissue release of the anterior and posterior subscapularis is performed, and a tag suture is placed for aid in retraction. Significant glenoid bone loss is appreciated with 2 cannulated broken screws seen in the anterior medial glenoid.

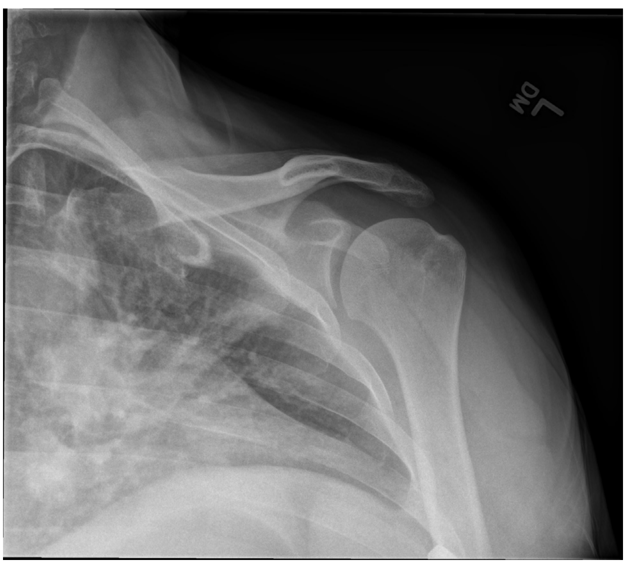

Fig 1. Pre-Latarjet preoperative anteroposterior x-ray film.

Fig 2. Pre-Latarjet preoperative axillary x-ray film, with Hill-Sachs lesion evident.

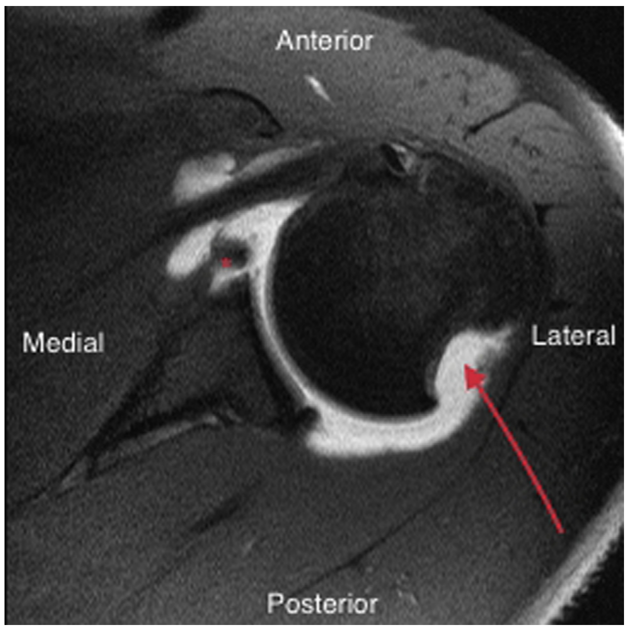

Fig 3. Pre-Latarjet preoperative axillary magnetic resonance image showing large Bankart lesion and Hill-Sachs lesion. *Star* shows bony Bankart lesion; *arrow* indicates the Hill-Sachs lesion.

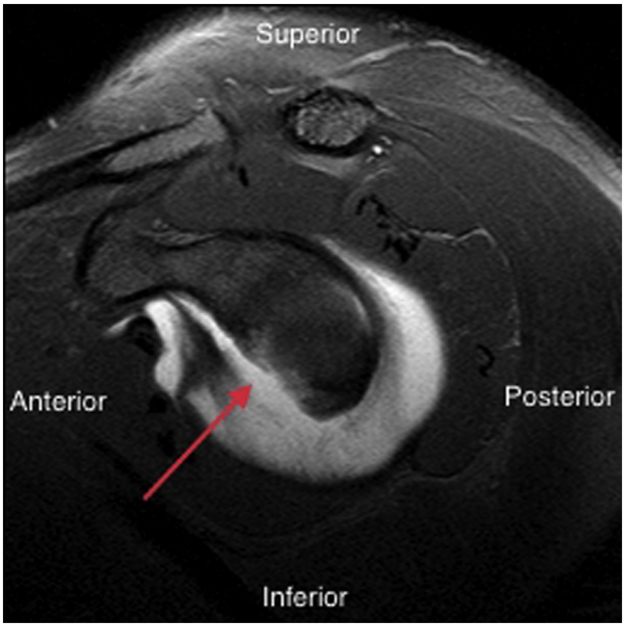

Fig 4. Pre-Latarjet preoperative sagittal magnetic resonance image showing extent of anterior glenoid bone loss. *Arrow* indicates the anterior glenoid bone loss.

Humeral head flattening with atypical wear morphology and osteophyte formation can be appreciated. The humeral head is then externally rotated revealing a large Hill-Sachs lesion. The retained 2 glenoid screws are removed without complication. Further dissection medially and posteriorly reveals the displaced coracoid from prior Latarjet procedure. Care is taken to protect the axillary nerve and nerve innervation to the subscapularis. The 2 screw heads and 2-hole plate are then removed from the coracoid, and the conjoined tendon is then tagged with a heavy suture for later incorporation.

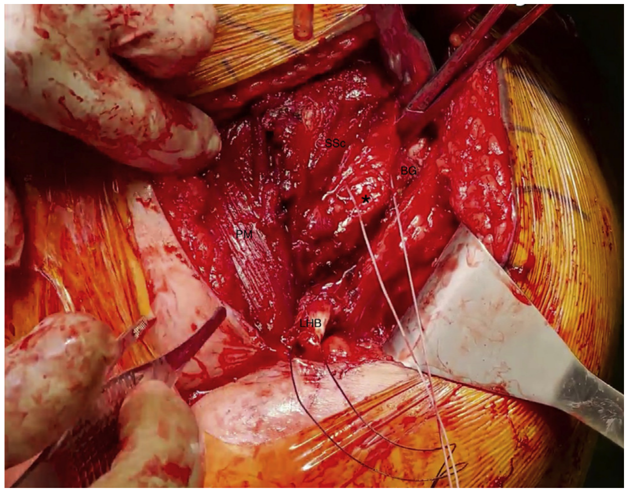

Fig 6. Deltopectoral approach with exposure for lesser tuberosity osteotomy (LTO). SSc, subscapularis tendon; PM, pectoralis major; LHB, long head biceps tendon (tenotomized); BG, biceps groove. *Asterisk* indicates lesser tuberosity. Notice, conjoined tendon is not in the field because of prior repositioning with the Latarjet procedure.

Glenoid Preparation

The anterior glenoid is prepared utilizing a round-tip burr to create a level surface for graft implantation. The glenoid graft is trialed with an Arthrex augment (Arthrex, Naples, FL) to adequately recreate the native glenoid and fill the sizable defect (Fig 7).

Distal Tibial Allograft Preparation and Fixation

Fresh distal tibia allograft (DTA) is prepared on the back table using an oscillating saw to the measurements obtained from trial augmentation (Fig 8). The DTA is then brought into the field and provisionally fixed with K-wires recreate the glenoid articular surface (Fig 9).

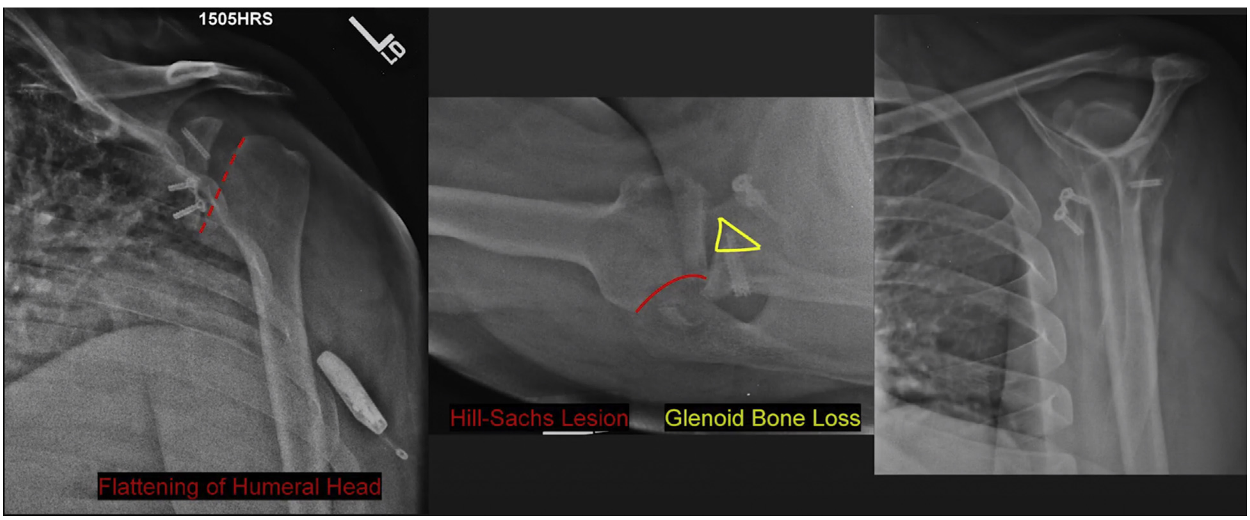

Fig 5. Post Latarjet x-ray films demonstrating failed Latarjet after subsequent seizure-induced dislocation resulting in fracture through the screws.

Fig 7. Example of the Arthrex distal tibia allograft trial guide.

The superior and inferior holes are drilled in lag-by-technique fashion, and two 4.0 cannulated screws, with suture washers, are used to compress the DTA to the anterior glenoid (Fig 10). A third point of fixation is then drilled in between the 2 cannulated screws and a suture button TightRope (Arthrex) is placed to augment the fixation (Fig 11).

Fig 8. Distal tibia allograft (DTA) osteotomized using Arthrex trial guide pre-planned measurements. *Asterisk* indicates DTA with provisional fixation k-wires.

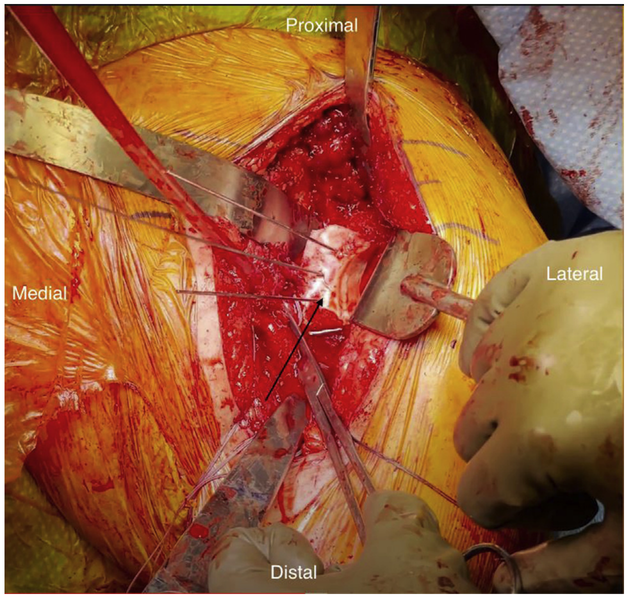

Fig 9. Provisional fixation of the distal tibia allograft (DTA) with K-wires. *Arrow* shows DTA resting on prepared anterior glenoid.

Native Humeral Head Preparation

Native humeral head is prepared with the oscillating saw and round tip burr to create fresh level surfaces for the allograft implantation (Fig 12). A ruler is then used to measure the size of the defect.

Fresh Humeral Head Allograft Preparation and Fixation

The fresh humeral head allograft is prepared on the back table and cut with an oscillating saw to lay flush against the native humerus recreating a smooth articular congruency using previous measurements (Fig 13).

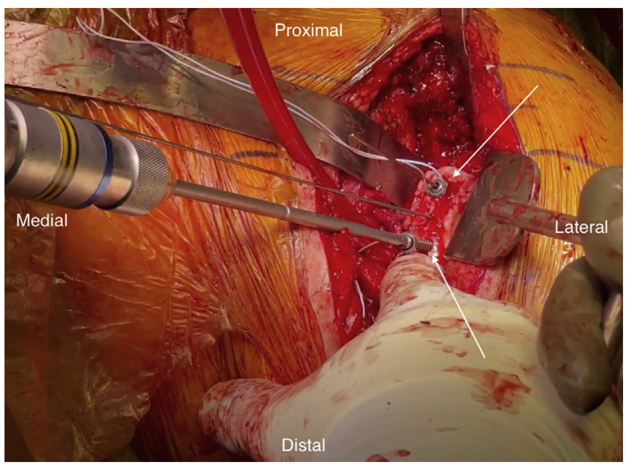

Fig 10. Placement of the superior and inferior cannulated screws with suture washers (*arrows*).

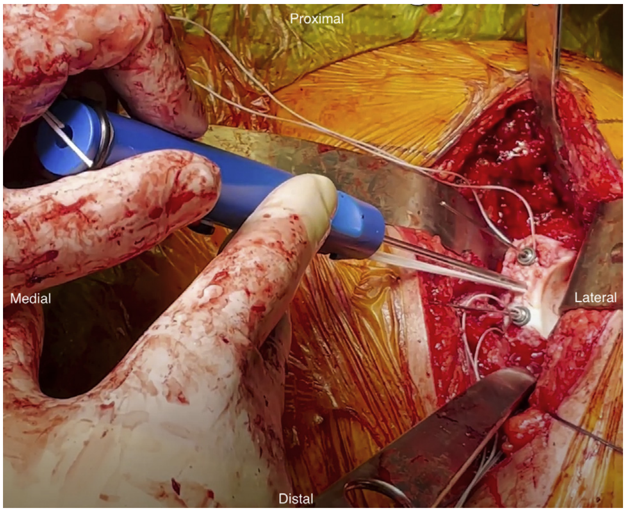

Fig 11. Placement of the Arthrex TightRope fixation in the mid-body DTA between the 2 cannulated screws.

ViviGen cellular graft matrix (DePuy Synthes; J&J, West Chester, PA) is placed on the freshened surfaces to facilitate the biologic response. The humeral head allograft is then secured with 3 cannulated 4.0 mm headless compression screws in divergent trajectories,

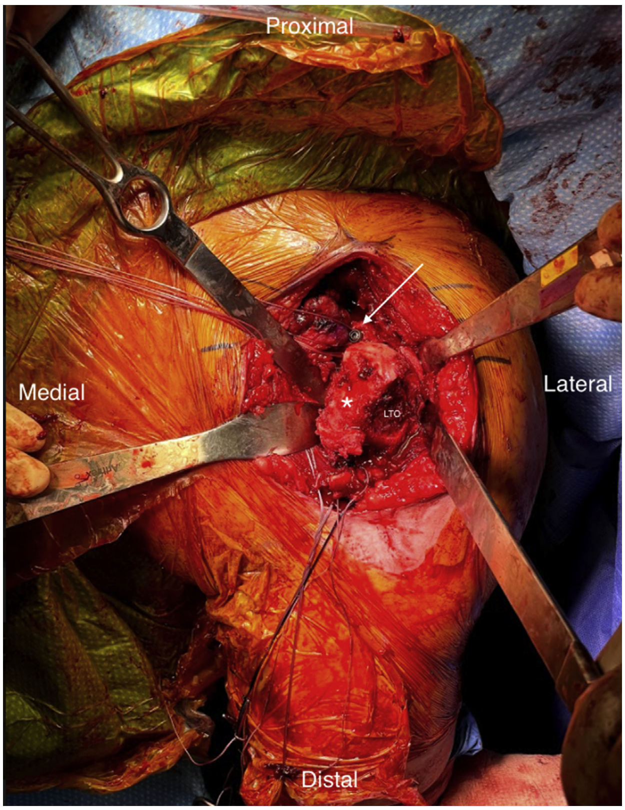

Fig 12. Humeral head flattening and significant bone loss. LTO, lesser tuberosity osteotomy site. *Asterisk* indicates humeral head dysmorphic lesion; *arrow* shows DTA.

Fig 13. Preparing the fresh humeral head allograft based off pre-planned measurements.

and osteophytes are resected with a rongeur (Figs 14 and 15). The humeral head is then reduced into the glenohumeral joint demonstrating smooth, near-anatomic articulation with the distal tibial allograft glenoid block in all ranges of motion (Fig 16).

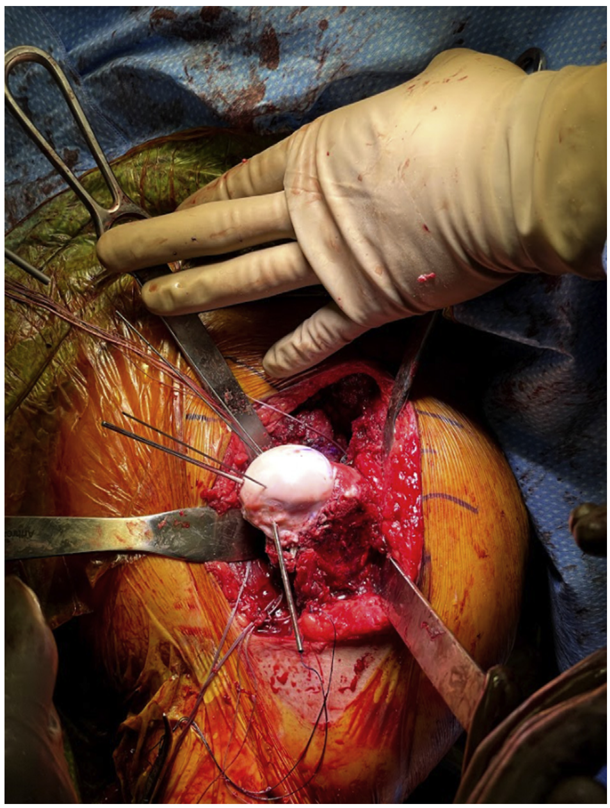

Fig 14. Provisional fixation of the lesser tuberosity osteotomy allograft using K-wires, ensuring flush articulation between native proximal humerus and allograft.

Fig 15. Final humeral head (HH) allograft construct using cannulated screws in a multiplane compression orientation.

Using this technique, the humeral offset is increased, conferring added stability with appropriate soft tissue tensioning.

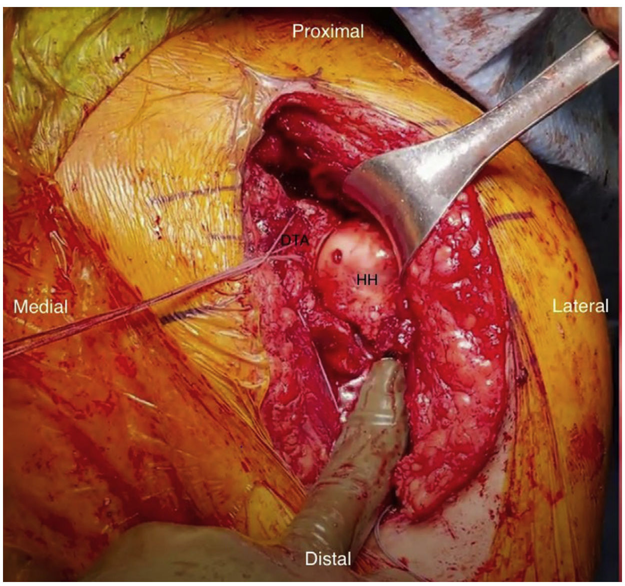

Fig 16. Final construct reduced demonstrating smooth articular congruency between DTA and HH allograft. HH, humeral head osteochondral allograft; DTA, distal tibia allograft.

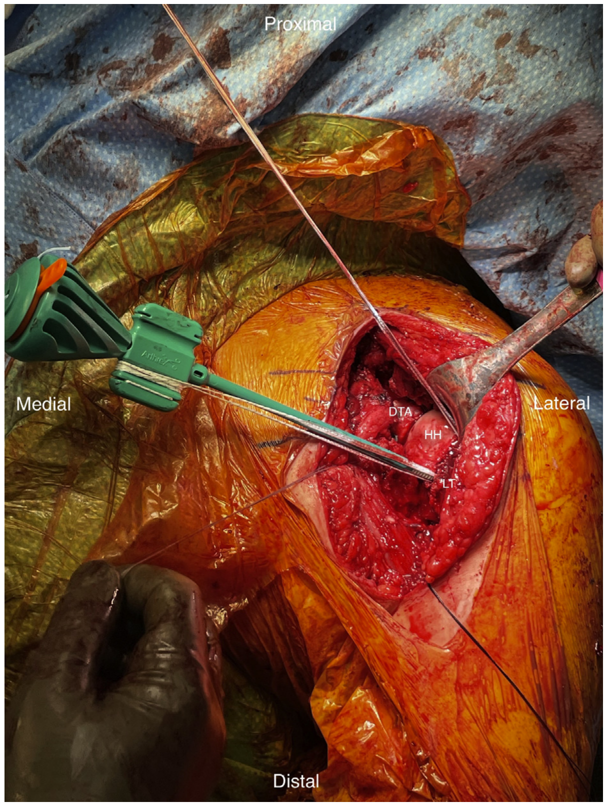

Fig 17. Double Row Arthrex Speed Bridge subscapularis lesser tuberosity osteotomy (LTO) repair, anchors placed within the bicipital groove. HH, humeral head osteochondral allograft; DTA, distal tibia allograft; LT, lesser tuberosity attachment site for subscapularis LTO repair with biceps tenodesis.

Soft Tissue Imbrication and Subscapularis Repair

The previously tagged conjoined tendon is sutured to the superior glenoid suture washer to recreate the sling mechanism. The inferior glenohumeral ligament and inferior capsule are sutured to the inferior glenoid block suture washer imbricating the attenuated soft tissues. Next, the subscapularis tendon with fleck osteotomy is repaired using the Arthrex SpeedBridge implant system (Arthrex) and a total of three 4.75 mm PEEK Swive-Lock suture anchors (Arthrex) (Figs 17 and 18). The anchors are tapped and placed within the bicipital groove, and the residual long head biceps tendon is tenodesed into the most inferior suture anchor. Finally, the rotator interval was reapproximated with FiberWire suture at appropriate soft tissue tensioning.

Closure

One gram of Vancomycin powder is placed into the joint. Deep closure is performed with 0-Vicryl and intermediate layers closed with 2-0 Vicryl. The superficial layers are infiltrated with 0.25% Marcaine with epinephrine for local anesthetic. The skin is closed with

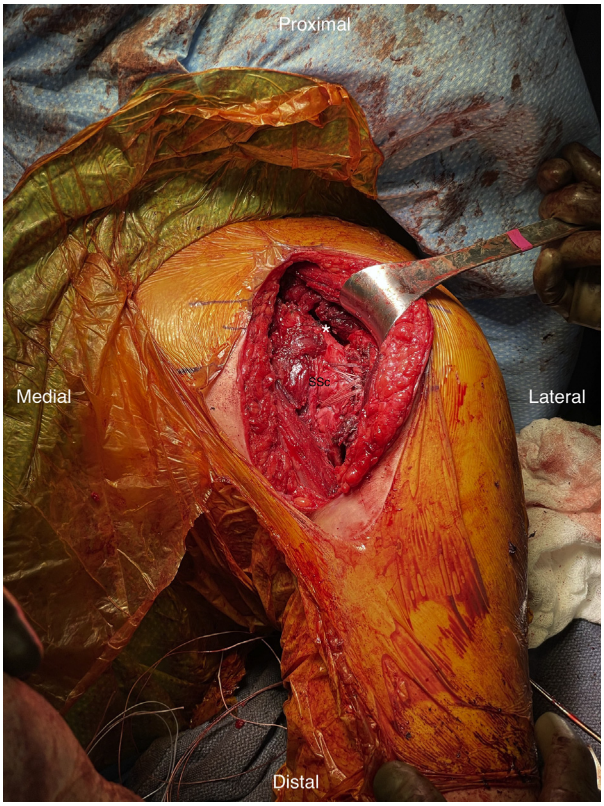

Fig 18. Final subscapularis lesser tuberosity osteotomy repair with biceps tenodesis, and primary closure of the rotator interval using FiberWire suture. SSc, subscapularis. *Asterisk* shows rotator interval.

3-0 Monocryl and Dermabond. An antimicrobial, watertight dressing is placed over the incision. The patient was given 1 of tranexamic acid at the beginning of the procedure, and an additional 1 g tranexamic acid was given in the post-anesthesia care unit.

Postoperative Protocol

Regarding immediate postoperative protocol, the patient is to remain non-weightbearing on the left upper extremity with no active range of motion of the left shoulder for 2 weeks. They are immobilized in an Ultra Sling at all times but allowed to come out of the sling for elbow range of motion.

Postoperative Imaging

Figures 19 to 21 show postoperative x-ray films, and Table 1 discusses the pearls and pitfalls of the Latarjet procedure.

Discussion

Glenoid reconstruction procedures are used for glenoid lesions involving greater than >20% or more of the articular surface. Historically, there have been many surgical techniques described to achieve glenoid restoration, but the most commonly used technique is the Latarjet procedure, where the coracoid, conjoined tendon, and coracoacromial ligament are transferred to the anterior glenoid. Despite favorable outcomes after primary stabilization surgery, recurrent instability has been reported from 3% to 25% and remains a challenging postoperative complication.[4,5] Nonunion,[6] malpositioning,[7] graft resorption,[8] symptomatic hardware,[9] and development or progression of glenohumeral osteoarthritis[10] are also reported complications after a Latarjet procedure. In the unfortunate circumstance of construct failure requiring revision, glenoid

Fig 19. Postoperative anteroposterior x-ray film.

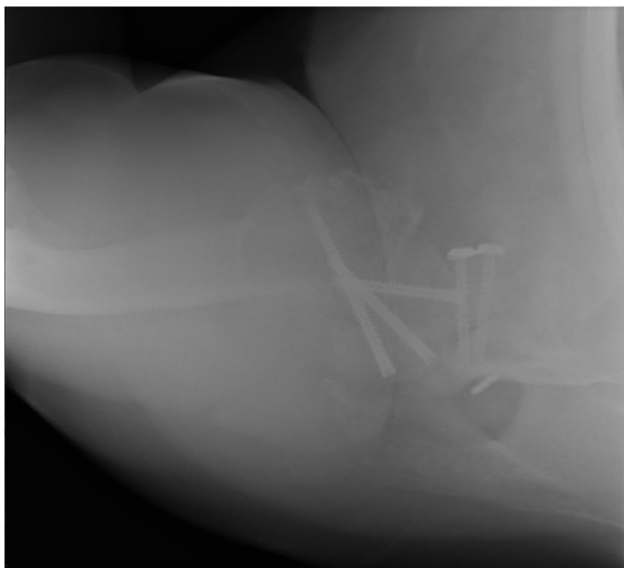

Fig 20. Postoperative axillary x-ray film.

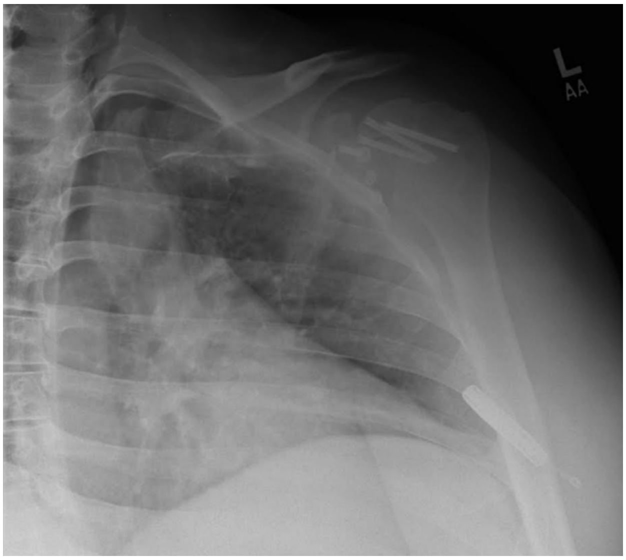

Fig 21. Postoperative scapular-Y x-ray film.

reconstruction can be achieved using DTA or tricortical iliac crest autograft[8,11-14]

Hill-Sach lesions are a known risk factor for failure of glenoid reconstruction procedures. With recurrent shoulder dislocations, the rate of Hill-Sach lesions approaches near 100%.[15] Smaller Hill-Sachs lesions can typically be treated successfully with arthroscopic capsular imbrication procedures, such as the remplissage procedure. Larger lesions (>30% of the humeral head) have historically been a challenge for orthopaedic surgeons, and optimal management remains an area of interest. Osteochondral allograft transplantation has demonstrated successful results, with some studies demonstrating favorable clinical outcomes of nearly 95% at 2 years.[16]

Revision surgery for a failed Latarjet procedure, in the setting of significant bone loss, is a challenging scenario requiring stabilization techniques not routinely used. Shoulder arthroplasty, although correcting the inherent problem, is not a viable long-term solution for the young patient. The risks of implant infection, periprosthetic fracture, implant loosening and accelerated wear are significantly increased for younger patient populations and therefore not the optimal next step in treatment.[17] We recommend the combined use of fresh distal tibia allograft and fresh humeral head allograft because independently they have shown successful outcomes.[11,16] Provencher et al.[11] demonstrated a 92% DTA to native glenoid osseous union rate on CT imaging analysis for revision stabilization surgery at 2-year follow-up with excellent patient-reported outcomes. The risks of allograft rejection, infection, nonunion, and graft resorption are real and have been reported in the literature,[11,16] yet the benefits of the procedure outweigh the benefits of shoulder arthroplasty in the setting of a young, active patient. Performing the fresh allograft reconstruction also preserves the option of arthroplasty as a salvage procedure in the future, with the hopes of maintaining as much bone preservation as possible. Although this technique demonstrates promise, further studies are required to investigate reproducibility, as well as consistent short and long-term outcomes (Table 2).

Table 1. Pearls and Pitfalls

Pearls
Reconstruct the glenoid first as dysmorphic humerus to make the approach much easier with less retraction.
Use the conjoint tendon from prior Latarjet to recreate sling mechanism.
Have numerous fixation options including suture and screws to augment construct.
Lesser tuberosity osteotomy allows for maximal access to GH joint while preserving subscapularis tendon attachment to allow for robust healing potential.
Prepare anterior glenoid rim to a flat stable base to allow for maximal surface area contact for DTA.
When preparing the DTA and HH allograft osteotomies, err on leaving more bone allowing for subsequent fine adjustment resection.
Ensure the center of rotation of the HH allograft matches native morphology when securing the allograft into final construct position.
Perform multi-planer fixation using headless compression screws to maximize stability.
Identify and secure the conjoined tendon using the sutures from the cannulated screws with suture washer to reconstitute the sling effect.
Tenodese the biceps into the subscapularis repair to preserve long head biceps function.
Pitfalls
Do not over-resect the anterior glenoid rim, because it may result in graft mismatch with the fixation site and potential for incongruency or instability.
Use of the DTA resection jig may prevent the necessary size or shape to fit the unique morphology if the defect is very large.
Leaving excess bone or creating graft mismatch may alter the glenohumeral muscle balance and result in over tensioning the joint, resulting in excessive contact forces or strain on the rotator cuff tendons.
Failure to compress HH allograft in multiple planes may result in allograft instability leading to resorption and failure.
Failure to reconstitute the sling effect may result in instability and early failure of this construct.

DTA, distal tibia allograft; GH, glenohumeral; HH, humeral head osteochondral allograft.

Table 2. Advantages and Disadvantages

Advantages
Does not remove significant bone stock
Reuses original approach
Recreates cartilaginous articulation
Allows for traditional arthroplasty in the future if need be
Can reuse conjoint tendon for sling mechanism from prior Latarjet
Multiple fixation options including lag screws, suture suspension, and anchors can be used
Disadvantages
Implantation of cadaver tissue is a risk for disease transmission/ immunogenicity
Scarred tissue from prior surgeries can make dissection challenging and put important neurovascular structures at risk
Difficult to size matched donor
Technically demanding
Longer procedure under longer period of anesthesia with the patient in the beach chair position
Requires significant resources

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