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Arthroscopic Glenoid Reconstruction With Iliac Crest Bone Block Transfer in the Beach Chair Position



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Abstract: Large anterior glenoid defects pose significant challenges for shoulder stability. Arthroscopic glenoid reconstruction techniques using distal tibia allograft have been proposed as alternatives to open or arthroscopic Latarjet procedures but can increase operating room costs. Iliac crest bone block autograft is a cost-effective option without concern for the graft being undersized. Previous techniques have described arthroscopic glenoid reconstruction in the lateral position, but the beach chair position provides ease of access to both the iliac crest bone graft harvest and arthroscopic bone transfer, as well as facilitates possible conversion to an open approach if necessary. We present our surgical technique for performing an arthroscopic glenoid reconstruction with iliac crest autograft bone block transfer in the beach chair position.

Recurrent anterior shoulder instability with concurrent loss of anterior glenoid bone is a technically challenging surgical issue. Since the introduction of the Latarjet procedure in 1954, the technique has continued to evolve.^{1,2} As open Latarjet procedures have demonstrated a 20% complication and nonunion rates in some series, arthroscopic Latarjet procedures have been advocated for by select surgeons.^{3,4} A common pitfall includes insufficient graft size when harvesting the coracoid process arthroscopically.⁵⁻⁷ In addition, alternative options are necessary for patients with a previous failed Latarjet procedure, more extensive glenoid bone loss, or previous coracoid fracture making coracoid transfer not feasible. The technique and outcomes of an arthroscopic bone block transfer for glenoid reconstruction using fresh-frozen distal tibia allograft in the lateral position have

been described previously.⁸ While using an allograft eliminates the risk associated with coracoid harvest, it does add significant cost to the procedure.

Another option is using iliac crest bone autograft (ICBG), which is a cost-effective option that avoids the risk of potential nerve damage or insufficient graft size associated with coracoid harvest. In harvesting ICBG, surgery set up in the beach chair position provides ease of access to the iliac crest as well as for subsequent transition to arthroscopic glenoid reconstruction. If conversion to an open procedure is needed, the beach chair position allows for easy conversion to an open deltopectoral approach without repositioning. While the benefits of arthroscopic shoulder stabilization in the lateral compared with the beach chair position remains a topic of debate among surgeons, arthroscopic glenoid reconstruction in the beach chair position has not been previously well-described.⁹

The purpose of this study is to describe the technique for arthroscopic glenoid reconstruction using an iliac crest autograft bone block transfer in the beach chair position. This positioning facilitates easy access for both autograft harvest from the pelvis and subsequent bone block transfer to the shoulder.

Preoperative Evaluation, Imaging, and Indications

Preoperative evaluation includes a thorough history for each patient, including the frequency of dislocations as well as etiology, direction, and severity. Physical examination to evaluate for shoulder range of motion

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and strength along with instability grading and apprehension/relocation tests are performed. Radiographic evaluation includes anteroposterior, Grashey, axillary lateral, Stryker Notch, and West Point views. Figure 1 A through E shows radiographs that demonstrate anterior glenoid bone loss, Hill–Sachs lesion, and a coracoid fracture that is seen on the Stryker Notch (D) and West Point (E) views. Magnetic resonance imaging and computed tomography scans (with 3-dimensional reconstruction) can be used for further assessment. Select magnetic resonance imaging slices (Fig 2 A–C) reveal a labral tear and anterior bone loss. Figure 3 A and B displays measurements consistent with anterior glenoid bone loss of 30%, using the Pico method.¹⁰

Surgical Technique (With Video Illustration)

Positioning

Video 1 demonstrates the complete surgical technique. The patient is positioned supine on an operating table with a beach chair extension (Fig 4). After induction of general anesthesia, the operative team safely

secures the patient in the beach chair position approximately to 80° erect, with neutral neck alignment and arm free. The majority of the scapula should extend lateral to the edge of the bed. With the assistance of the anesthesia team, the head is secured so that the neck remains in neutral alignment and the airway is accessible. The ears and eyes should be protected during positioning.

The operative extremity is examined under anesthesia before draping of the patient. Both the right iliac crest and right shoulder are prepped and draped. The iliac crest can be squared off with a large Ioban (3M, St. Paul, MN) taped over it. The shoulder drapes can be rolled above the crest for the initial harvest and then rolled back down the hip during arthroscopy. The operative arm is placed in an arm holder. It is important to drape far medial to the coracoid, to ensure adequate access for the Halifax portal.¹¹ Last, a strap is placed over the mid-humerus. This allows for the assistant to place posterior traction on the humeral head during arthroscopy to increase the working space and access to the anterior inferior glenoid.

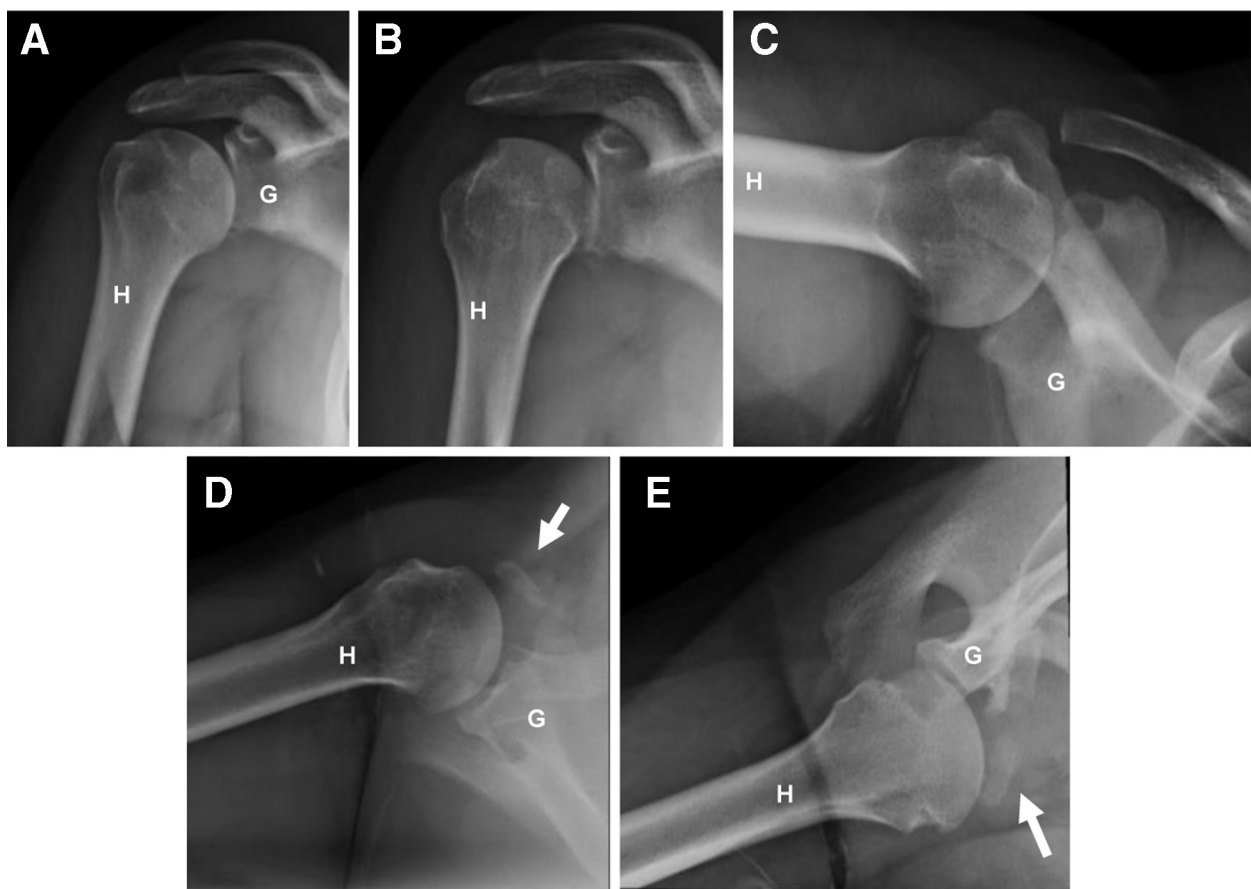


Fig 1. Right shoulder radiographs. Preoperative radiographs show the patient's coracoid fracture and Hill–Sachs lesion. Five views of the (right) shoulder: (A) anteroposterior, (B) Grashey, (C) axillary, (D) Stryker Notch view, and (E) West Point view. Note the fracture of the coracoid anteriorly and Hill–Sachs lesion. The fracture is best viewed in D and E and is labeled by white arrows. (G, glenoid; H, humerus.)

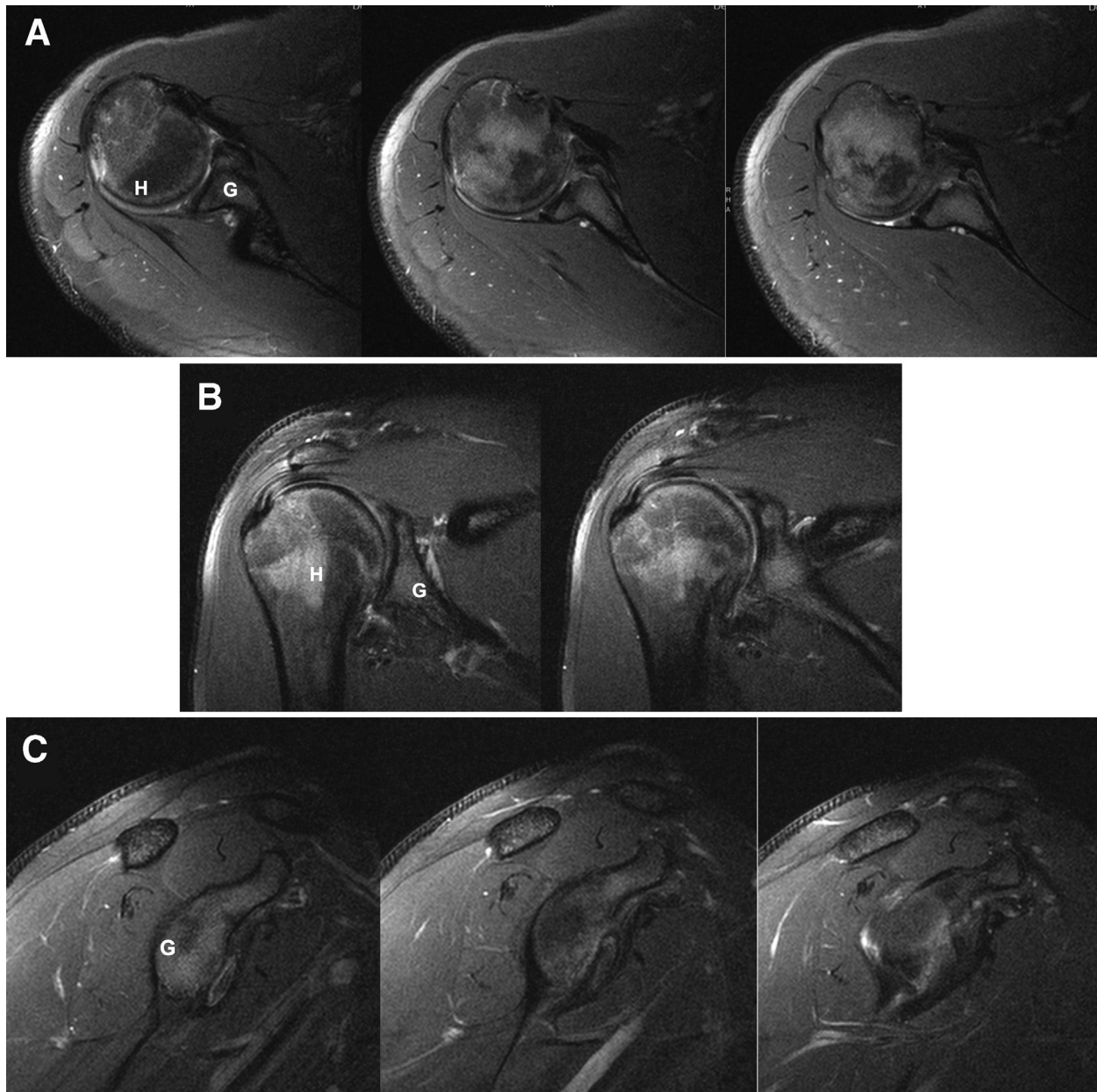


Fig 2. Right shoulder preoperative magnetic resonance imaging: (A) axial slices, (B) coronal slices, and (C) sagittal slices reveal anterior glenoid bone loss. (G, glenoid; H, humerus.)

Bone Graft Harvest and Preparation

The procedure begins with the head of the table at 30° to harvest the ICBG. A 4-cm incision is made starting 3 cm lateral to the anterior superior iliac spine. Dissection is continued down to the level of the periosteum. Electrocautery is used to achieve hemostasis. The periosteum over the iliac crest is incised with a knife. A periosteal elevator is used to release the periosteum from the inner and outer aspects of the iliac crest. A sagittal saw is then used to harvest a 2.5-cm length graft that is 15 mm in both depth and width. Exact dimensions of the iliac crest autograft may be adjusted based on the measured anterior glenoid bony

defect. The harvest site is irrigated, and bone wax is placed in the iliac crest to achieve hemostasis. A layered closure of the harvest site is then performed, and a provisional dressing is placed.

The ICBG is then brought to the back table and final measurements are made. A bone block of 2 to 2.5 cm in length by 1.5 cm in width and 1.5 cm in depth is used for proper fixation (Fig 5 A and B). Minimum graft length should be 2 cm to ensure adequate bone for screw fixation. Two guidewires are then placed with the 7-mm offset guide (Shoulder Instability System; DePuy Synthes Mitek, Chesterfield, MO). The drill holes should be made from the cortical side of the ICBG with

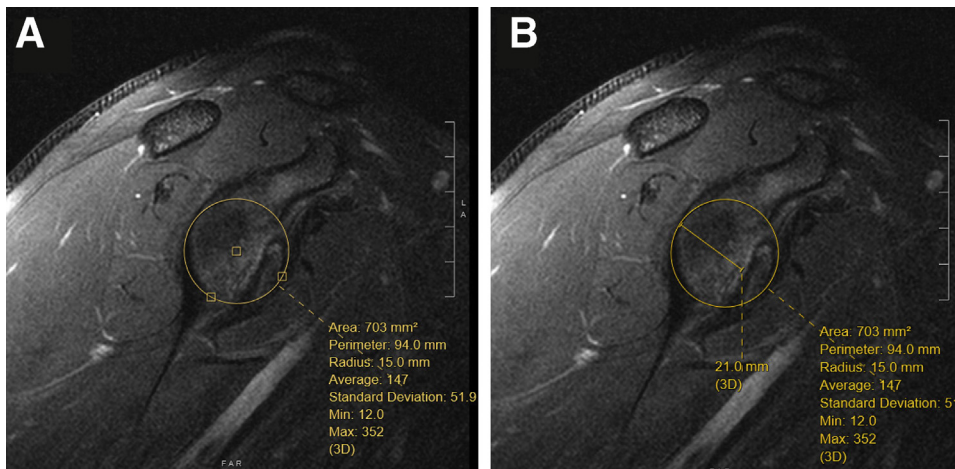


Fig 3. Preoperative magnetic resonance imaging with glenoid bone loss measured to be 9 mm and corresponds to 30% glenoid bone loss measured on sagittal images. (A) Circle drawn shows expected glenoid width measurement of 30 mm. (B) Actual width of glenoid measured is 21 mm.

orientation so the inner table of the crest is used as the articular portion of the graft. Two top hats corresponding to the 3.5-mm screws are placed into the ICBG and secured to the double cannula using two 3.5-mm coracoid screws locked into the top hats. This cannula secures the bone block and allows for manipulation and rotation of the graft as needed for positioning.



Fig 4. Patient with right arm in in beach chair position in an arm holder with strap across mid-humerus for posterior traction on humeral head.

Arthroscopic Evaluation

The patient is returned to 80° erect in the beach chair position. A diagnostic arthroscopy is performed with a 30° arthroscopy using an inferior and medial posterior = portal made in line with the glenohumeral joint. An anterosuperior (AS) portal is placed under visualization superior and lateral in the rotator interval entering the shoulder along the trajectory of the superior border of the subscapularis. The diagnostic arthroscopy is performed to visualize the anterior glenoid bone loss and status of the labrum (Fig 6 A and B) as well as the presence of an engaging Hill–Sachs lesion (Fig 7A) and health of the articular cartilage.

Glenoid Reconstruction

The AS portal is used to release the rotator interval with radiofrequency ablation (Serfas; Stryker, Kalamazoo MI). The 30° arthroscope is then placed in the AS portal and the posterior portal is used to make the Halifax portal through an inside out technique with a switching stick as described by Wong et al.^{11,12} This portal is placed superior to the subscapularis and lateral to the conjoint tendon (Fig 8 A and B).¹¹ A working disposable cannula is placed in this portal and the radiofrequency ablation device and arthroscopic burr are used to prepare the bed of the anterior inferior glenoid for bone transfer (Fig 9 A-C). The portal is then expanded to 3.5 cm and blunt dissection is performed through the deltopectoral interval. Deep retractors, such as a low-profile slotted cannula, are placed to dilate the path for the ICBG. The bone block is then placed into the shoulder under direct visualization using the double cannula, to which the ICBG graft is secured (Laterjet Experience Shoulder Instability System; DePuy Synthes, Chesterfield, MO). A switching stick is used from the posterior portal to retract the subscapularis inferiorly during bone block placement.

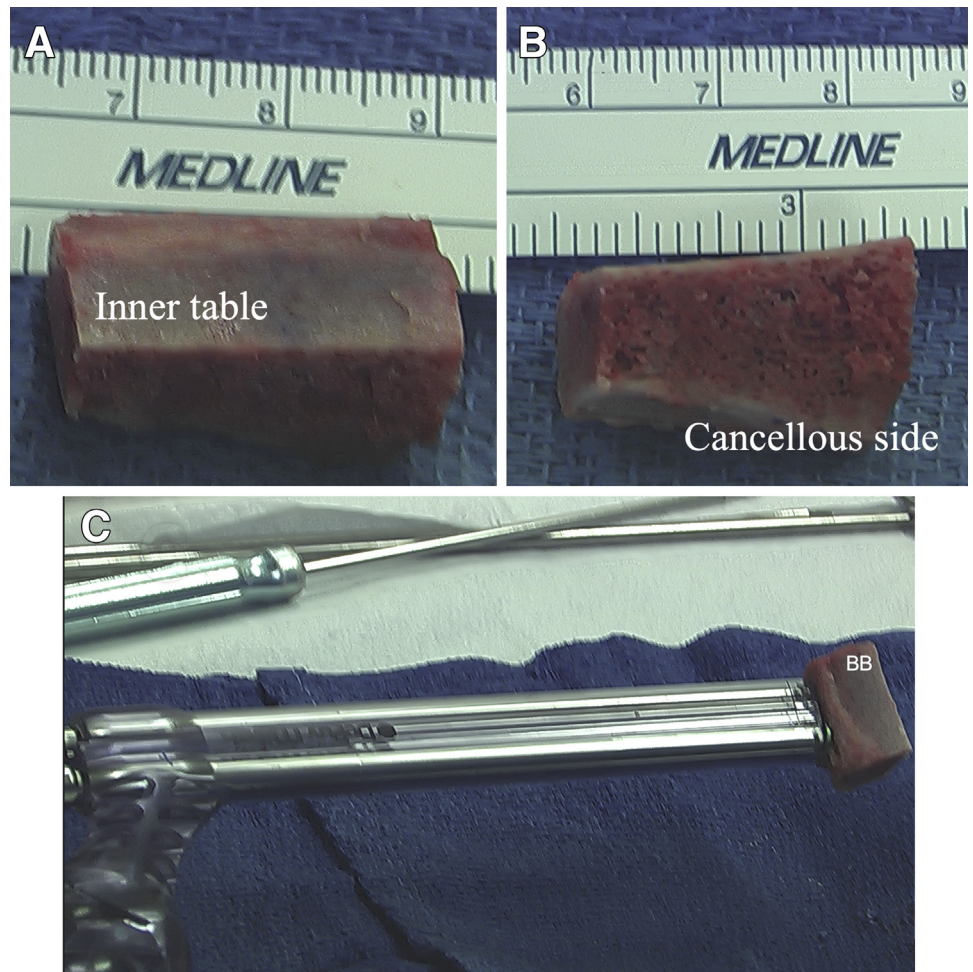


Fig 5. Iliac crest bone autograft (BB) taken from the patient, $23 \times 15 \times 15$ mm, and then attached to the delivery device. The inner table will be used as the articular side. Screws attached to the cortical side (not the cancellous side). (A) Iliac crest bone graft with smooth inner table. (B) Cancellous surface of iliac crest bone used for direct fixation to glenoid. (C) Iliac crest bone graft attached firmly to double cannula for delivery.

Two Kirshner wires are used to fix the ICBG to the glenoid and can be drilled through the double cannula and throw the fixation screws and top hats. Satisfactory alignment is confirmed. A cannulated 3.2-mm drill is

used, and screw length is measured off of the drill. After removing of the temporary fixation screws, two 4.5-mm cannulated Latarjet screws (DePuy Mitek, Chesterfield, MO) are then placed through the top hats

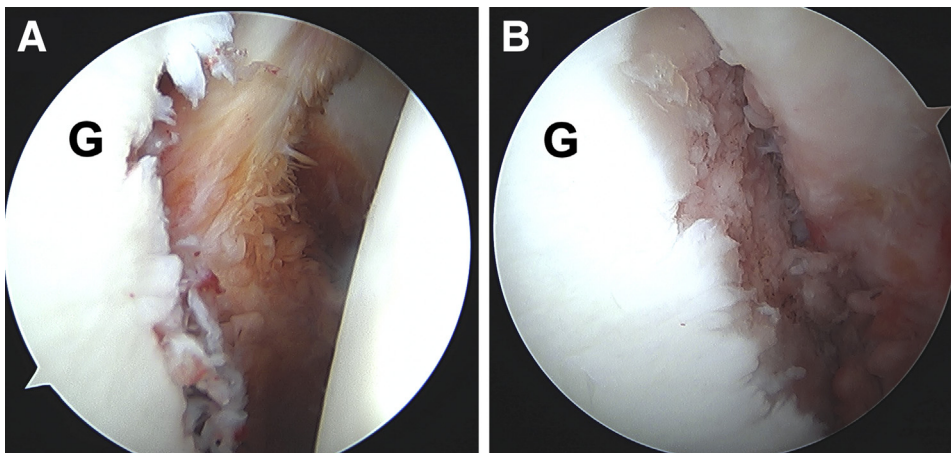


Fig 6. (A) An inferior and medial posterior portal made in line with the glenohumeral joint is used for diagnostic arthroscopy and viewing the anterior glenoid (G) of the right shoulder. (B) A 70° arthroscope can be used to view anterior glenoid bone loss from the posterior portal.

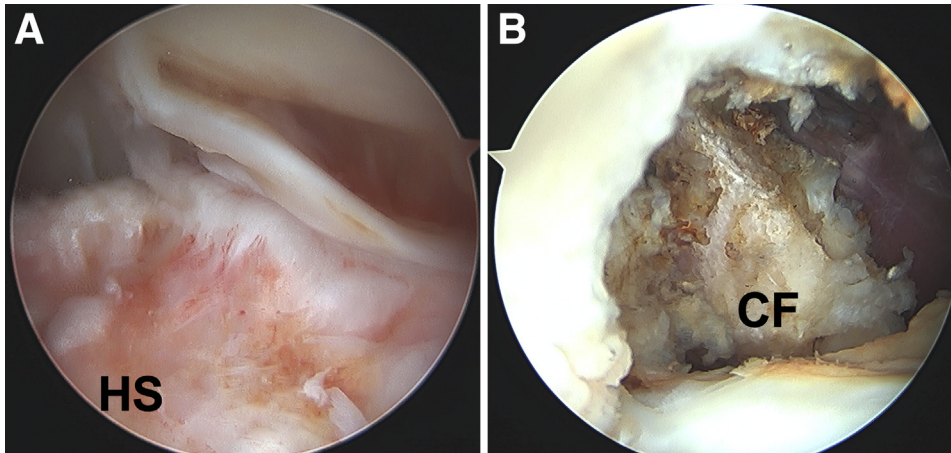


Fig 7. Posterior viewing portal with a 30° arthroscope is used to complete a diagnostic arthroscopy and view (A) Hill–Sachs lesion (HS) and (B) coracoid fracture (CF) of the right shoulder.

to fix the bone block in place, using sequential compression of the 2 screws (Fig 9 D-I). The bone block is seen to be flush with the articular surface.

Through the AS portal, an all-suture anchor (Iconix #1; Stryker) is placed at the lowest position on the glenoid rim (Fig 10 A-D). The anteroinferior capsule and inferior labrum is repaired by passing sutures with a curved suture shuttle (ACCU-PASS; Smith & Nephew, Andover, MA) and shifted superiorly. The tissue is tied down in the standard arthroscopic fashion to further reinforce the bone block construct. Fluoroscopic images are taken to confirm proper screw placement (Fig 11 A and B). An anterior load is placed on the shoulder and the humeral head is tested to ensure there is no translation anterior to the ICBG. The incisions are closed in a layered fashion and dressings are placed.

Postoperative Rehabilitation

The patient was placed in an abduction sling and instructed to remain in the sling at all times, except for

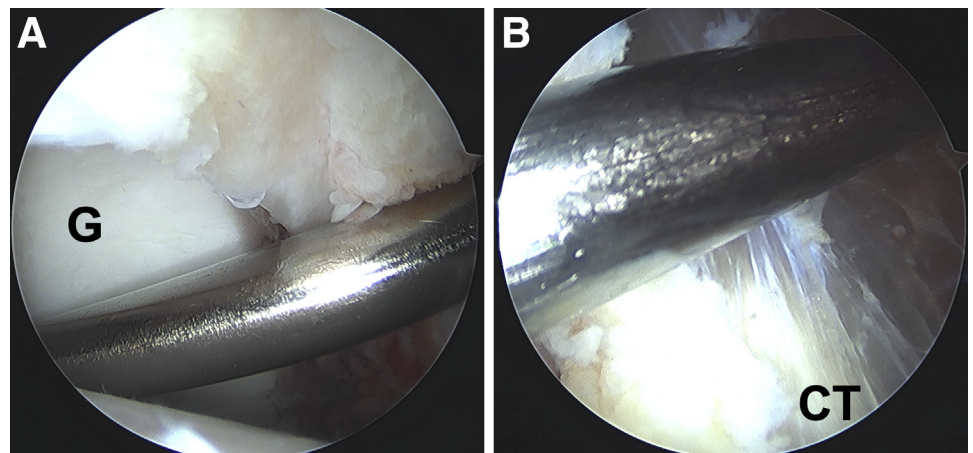
passive forward flexion to 90° and passive external rotation to 0° for the first 2 weeks. Formal post-operative radiographs are taken in clinic (Fig 12 A and B). Passive forward flexion is gradually increased to 120° during weeks 2 to 6. Full range of motion and gradual strengthening may begin at 6 weeks. The patient can start to incorporate sport-specific activities at 18 weeks.

Discussion

Although previous techniques have been published for arthroscopic glenoid reconstruction with distal tibia allograft for anterior glenoid bone loss,¹³⁻¹⁹ our technique offers alternative positioning and use of a local autograft for reconstruction. Iliac crest bone harvest and arthroscopic glenoid reconstruction can be readily achieved in the beach chair position. We describe the pearls and pitfalls of our approach in Table 1.

Beach chair positioning is advantageous because of the ease of setup, upright orientation of the patient, and

Fig 8. (A) The 30 arthroscope is placed in the right shoulder anterosuperior portal, which is superior and lateral in the rotator interval to view the anterior rim of the glenoid. The posterior portal is used to make the Halifax Medial portal with an inside out technique. A switching stick is placed from the posterior portal and directed lateral to the conjoint tendon (CT) as shown (B) and superior the subscapularis tendon. (G, glenoid.)



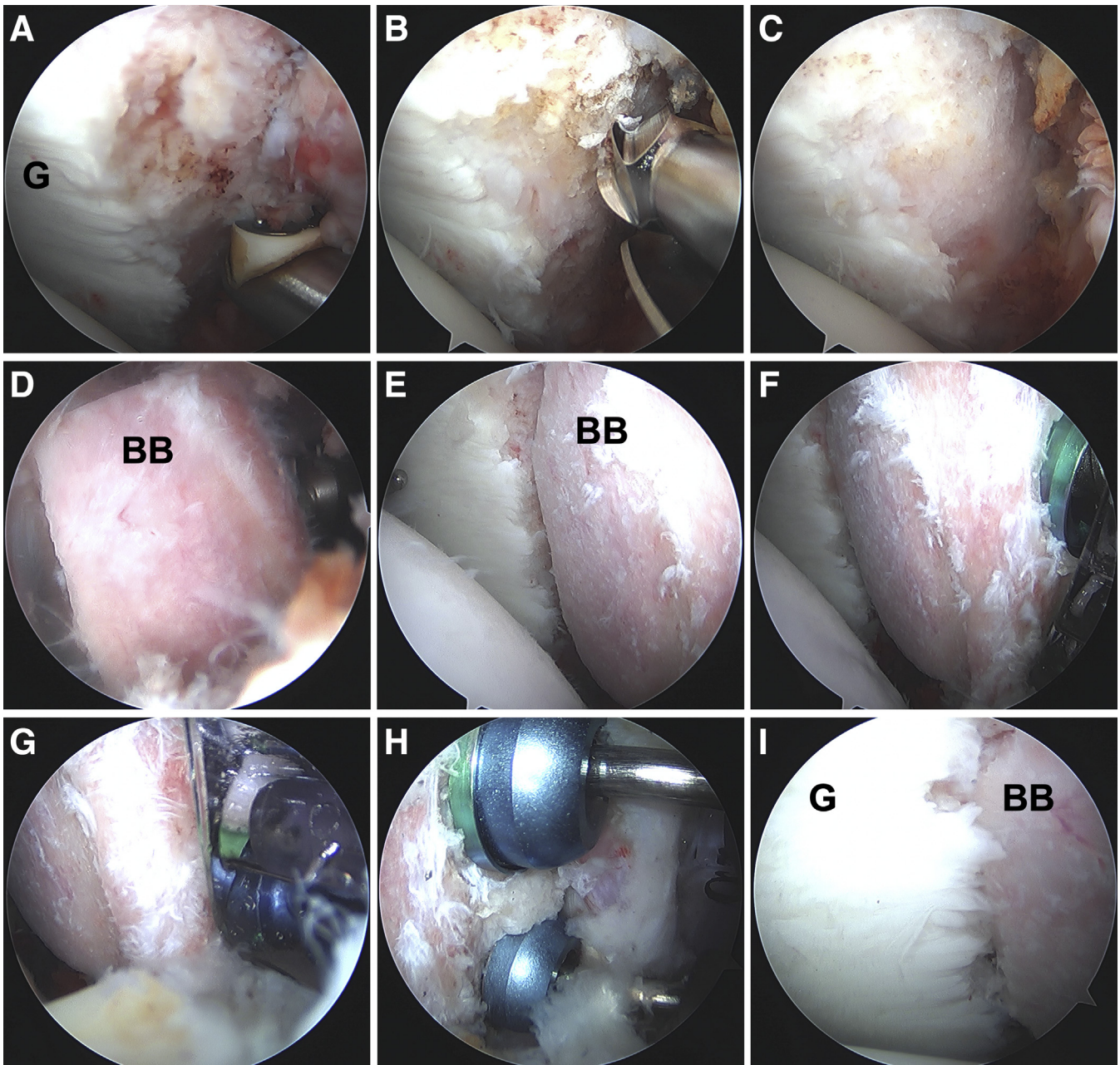


Fig 9. Intraoperative arthroscopic images with 30° arthroscope from the anterosuperior portal of the right shoulder showing glenoid (G) preparation with radiofrequency ablation and burr through the Halifax portal (A-C) and bone block (BB) transfer through the same portal (D-H). (I) Completed iliac crest bone block transfer.

decreased traction on the brachial plexus during a technically challenging procedure.²⁰ Our technique allows surgeons, especially those who primarily trained with beach chair positioning, to successfully complete a glenoid reconstruction without having to convert to a lateral position. Furthermore, should an open approach, such as the deltopectoral approach, become necessary during the procedure, this can easily be done in the beach chair position. It also allows easy access to the iliac crest for the harvest of a bone block, without having to change position or redrape the patient.

Iliac crest autograft is a cost-effective choice for reconstruction and the size of harvest can be adjusted to the needs of the patient. The risk of neurologic injury significantly lower than that of coracoid autograft transfer, which has been reported as high as 10% to 20%.^{4,21,22} While safer than coracoid harvest, distal tibial plafond allograft is nearly three times the cost of a Latarjet procedure.²³ The cost advantage must be carefully considered as we move toward value-based care. Lastly, in terms of graft choice, distal tibial plafond allograft also has increased potential for resorption.¹³

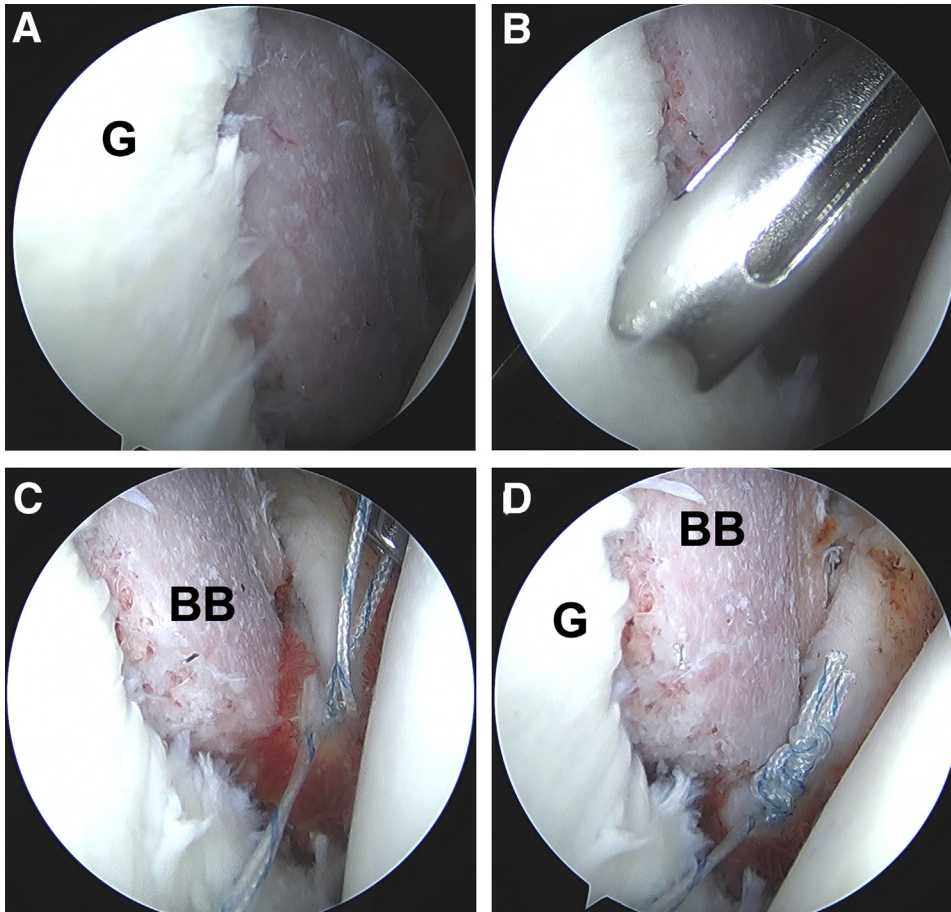


Fig 10. (A) Arthroscopic images from the posterior portal of the right shoulder while the anterosuperior portal is used for labral repair and capsular plication following securing of bone block. (BB, bone block; G, glenoid.)

Despite the advantages, there are several risks and limitations remain using this technique (Table 1). The lateral femoral cutaneous nerve can be damaged during bone block harvest if the harvest site is too anterior and too close to the anterior superior iliac spine. Making the harvest site at least 3 cm lateral to the anterior superior iliac spine can avoid this complication. The musculocutaneous nerve can be injured if the Halifax portal is

placed too medial. This can be avoided by making the inside out portal with the portal on the lateral side of the coracoid. The subscapularis also can be injured during bone block placement. A switching stick from the posterior portal can be used to push the tendon distally and avoid injury. Screws can be oriented too medially and achieve poor bony purchase if the bone block is not parallel to the face of the glenoid. The bone

Fig 11. Final intraoperative fluoroscopic views following bone block placement of the right shoulder. (G, glenoid; H, humerus.)

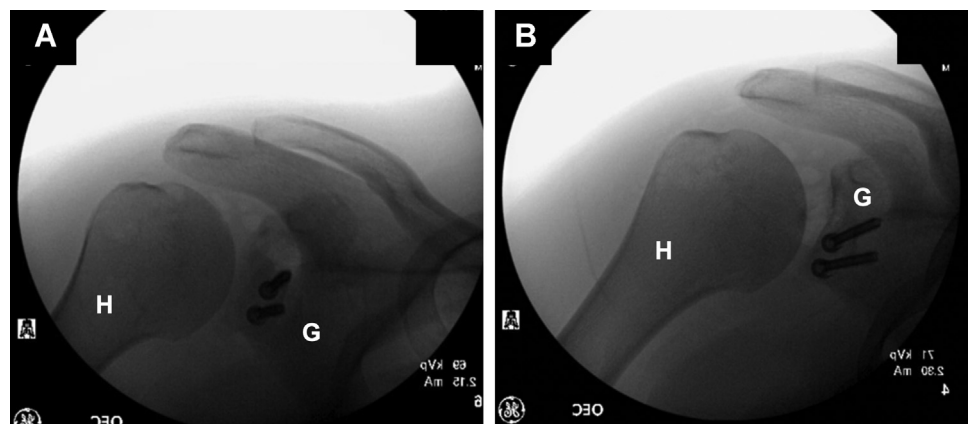
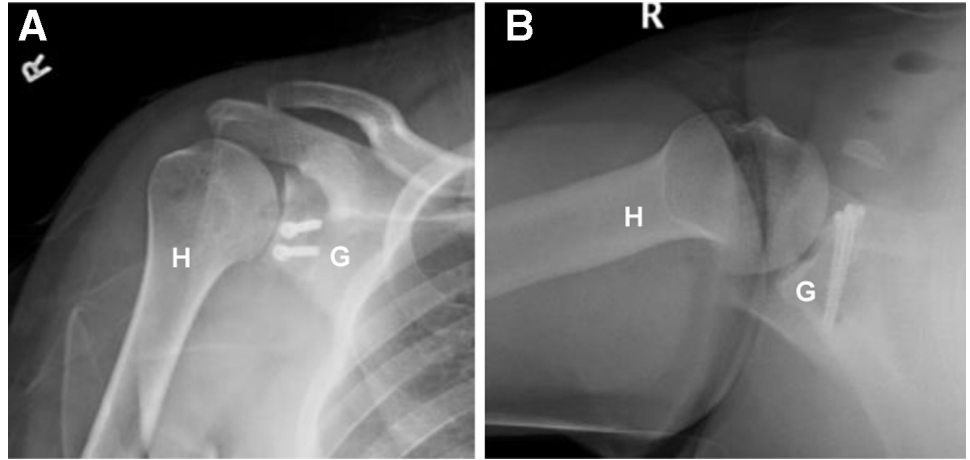


Fig 12. Postoperative antero posterior (A) and axillary (B) radiographs of the right shoulder with intact hardware and well-placed screws 2 weeks postoperatively. (G, glenoid; H, humerus.)



block must be pushed medial and guidewires directed as parallel as possible to the glenoid face.

Conclusions

We present an approach for patients with large glenoid defects using a combination of techniques not previously reported in the literature: beach chair positioning and autograft with iliac crest bone harvest. This strategy is a cost-effective and reliable option for

shoulder instability surgery in patients with large glenoid defects.

Table 1. Pearls and Pitfalls of Arthroscopic Glenoid Reconstruction in Beach Chair Position

Pearls

- Take the arm out of the arm holder during iliac crest bone graft harvest.
- Overestimate the amount of bone graft to taken.
- Use bone wax to help achieve hemostasis following harvest.
- Use the inner table surface of ICBG for articular side of glenoid.
- Use min-humerus arm strap for posterior traction on the humeral head to increase anterior/inferior access to the glenoid.
- Anterosuperior portal made high and lateral in the rotator interval.
- Ensure the Halifax portal is large enough for easy passage of the graft and use low-profile slotted cannula to help with entry.
- Use a switching stick from the posterior portal to retract the subscapularis inferiorly during bone block placement.
- Repair labrum and plicate capsule inferior to bone block.

Pitfalls

- Injury to the lateral femoral cutaneous nerve if bone harvest is too anterior and close to the ASIS.
- Bone block is too large to fit in the rotator interval.
- Bone block injures subscapularis during placement, use switching stick to guide placement.
- Halifax portal is placed too medial, leading to risk of injury of the musculocutaneous nerve.
- Bone block is smaller than $2.0 \times 1.5 \times 1.5$ cm and fragments with screw fixation.
- Drape is not medial to the coracoid and Halifax portal is contaminated.
- Bone block is too superior on the glenoid.
- Bone block is too medial to face of the glenoid.

ASIS, anterior superior iliac spine; ICBG, iliac crest bone autograft.

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