

Arthroscopic Glenoid Bone Grafting With Soft Fixation for Recurrent Anterior Shoulder Dislocation



Jinzhong Zhao, M.D., and Jin Tang, B.M.

Abstract: Glenoid bone defect is a common structural deficiency in cases of recurrent anterior shoulder dislocation. Glenoid bone grafting is an effective method to address glenoid defect and promote labrum regeneration. In most previous reports, firm fixation of the bone grafts was conducted, but with obvious inconvenience. Thus, we introduce a special glenoid bone-grafting technique in which the bone fragments are placed to the anterior side of the glenoid through the rotator interval, with 1 inferior graft free of fixation and 1 superior graft fixed to the glenoid by suture suspension. This technique is indicated in patients with recurrent anterior shoulder dislocation with glenoid defect or needing osseous stimulation for labrum regeneration. The critical point of this technique is the proper use of special glenoid bone grafting instruments. We believe this technique will provide a special choice in the treatment of recurrent anterior shoulder dislocation.

Glenoid bone defect is a main structural deficiency in a traumatic anterior shoulder dislocation, especially in recurrent cases.¹ Severe glenoid bone defect reduces shoulder stability from a biomechanical aspect² and is related to high recurrent rates after capsule labrum repair or reconstruction.³ Glenoid bone defect can be addressed with the Latarjet procedure⁴ and can also be addressed by pure glenoid bone grafting,⁵ in which firm fixation is considered a prerequisite to ensure graft–glenoid healing, and which is always technically demanding.^{6,7} Glenoid bone grafting with infirm fixation that can be easily performed and is effective to amend glenoid defects is needed.^{8,9} Thus, we developed a special glenoid bone-grafting technique, in which 2 graft fragments are used, with one is fixed through suture suspension and the other

receiving no fixation. Our clinical experience¹⁰ indicates that this technique can be conveniently performed and is effective to promote glenoid remodeling and labrum regeneration.

This glenoid bone grafting technique is indicated in a Bankart or bony Bankart lesion with obvious glenoid bone deficiency (>10% in diameter), or without obvious glenoid bone defect but needing glenoid remodeling and labrum regeneration. The contraindication for this glenoid bone grafting technique is a bony Bankart lesion without obvious glenoid bone defect, especially with a large bone fragment (Table 1).

Surgical Procedure

Glenoid bone grafting and Bankart repair are combined procedures to be performed. For glenoid bone grafting to have the best biological effect, reliable capsule labrum repair and rotator interval closing are critical steps (Table 2).

The patient is placed in a lateral decubitus position. Routine anterior, anterior superior, posterior, and posterior inferior portals are created.

Preparation of Bone Grafts

Two custom frozen dry biocortical iliac crest grafts are used, with one as a glenoid-surface graft and the other as a glenoid-neck graft. The most common graft size is 10 mm wide, 30 mm long, and 8 to 9 mm thick, to deal with a <40% glenoid defect. When the defect reaches or exceeds 40% of glenoid width, a 15-mm-wide graft is used.

From the Department of Sports Medicine (J.Z.) and Operating Theater (J.T.), Shanghai Sixth People's Hospital, Shanghai Jiao Tong University, Shanghai, China.

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Address correspondence to Jinzhong Zhao, M.D., Department of Sports Medicine, Shanghai Sixth People's Hospital, Shanghai Jiao Tong University, 600 Yishan Road, Shanghai 200233, China. E-mail: zhaojinzhong@vip.163.com or jz Zhao@sjtu.edu.cn

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Table 1. Indications and contraindications

Indications	
•	Bankart lesion or bony Bankart lesion with obvious glenoid bone defect
•	Bankart lesion without obvious glenoid bone defect but need for osseous stimulation
Contraindication	
•	Bony Bankart lesion without obvious glenoid bone defect

Two 2-mm-wide holes placed ~15 mm apart are made through each of the grafts along the midline of the surface. One absorbable suture is put through each hole in the glenoid-neck graft, with one suture as a traction suture and the other as a control suture (Fig 1).

Preparation of the Glenoid and the Capsule Labrum

A strip of freshened bone bed with a width of 3 to 5 mm is created at the anterior edge of the glenoid. The anterior inferior capsule-labrum complex is released from the glenoid neck and elevated to a plane as high as the glenoid surface (Fig 2). In case of an intact labrum-periosteum ring, the ring is broken at the 11 o'clock position to facilitate later graft placement. The subscapularis is pushed anteriorly with a switching stick to

Table 2. Step-by-step surgical procedure

1. Make 2 holes through each graft along the midline of the surface. Put 1 absorbable suture through each hole in the glenoid-neck graft.
2. Create a strip of bone bed at the anterior edge of the glenoid (left shoulder).
3. Release the anterior inferior capsule-labrum complex from the glenoid neck.
4. Drill 3 holes for later suture anchor placement at 7, 8:30, and 10 o'clock positions.
5. Place 1 guide suture through the inferior capsule-labrum at 5 o'clock position for later placement of the glenoid-neck graft. Place other 2 guide sutures through the inferior capsule-labrum at 6 and 7 o'clock positions for later capsule labrum repair.
6. Place the 7 and 10 o'clock position anchors into the glenoid.
7. Place a set of glenoid bone grafting instruments into the joint.
8. Pull the guide suture for the glenoid-neck graft out through the bone-grafting trocar. Pull the traction suture of the glenoid-neck graft back through the inferior capsule labrum.
9. Pull the glenoid neck graft to the anterior side of the glenoid neck.
10. Retrieve 1 suture limb from each of the 2 anchors through the trocar to serve as guide sutures.
11. Put the suture limbs through the corresponding holes in the glenoid-surface graft and those in the bone-grafting trocar.
12. Push the bone graft through the trocar into the joint, adjust its the position, and release it from the trocar to the anterior side of the glenoid surface.
13. Tie the guide suture limbs to their corresponding suture limbs to hold the bone fragment softly.
14. Repair the capsule-labrum structure over the bone fragment to the glenoid edge.
15. Close the rotator interval.

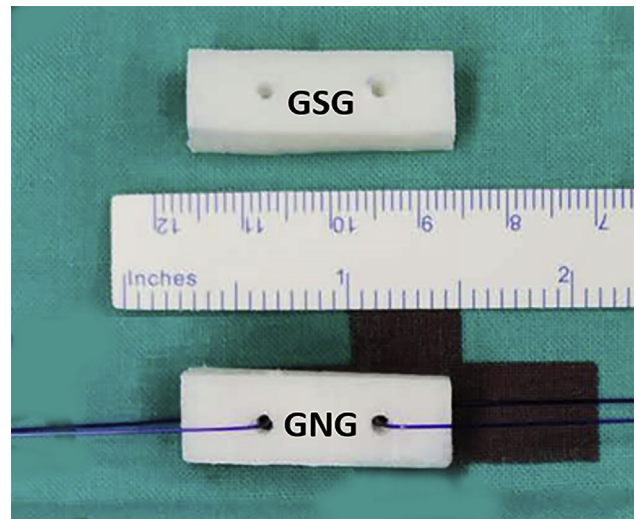


Fig 1. Customized allograft fragments. Two 2-mm-wide holes placed ~15 mm apart are made through each graft along the midline of the surface. One absorbable suture is put through each hole in the glenoid-neck graft, with one as a traction suture and the other as a control suture. Abbreviations: GNG, glenoid-neck graft; GSG, glenoid surface graft.

make sure that there is a 10-mm-wide space between the subscapularis and the glenoid to accommodate the bone fragments (Video 1). Three holes located at 7, 8:30, and 10 o'clock of the glenoid are first drilled at the posterior edge of the glenoid bone bed (Fig 3).

Placement of the Guide Sutures for Glenoid-Neck Graft Placement and Capsule Labrum Repair

One guide suture is passed through the inferior capsule-labrum at 5 o'clock (left shoulder) for placement of the glenoid-neck graft. The other 2 guide sutures are passed through the inferior capsule-labrum at 6 and 7 o'clock for later capsule-labrum repair.

Placement of the Suture Anchors

The 7 and 10 o'clock anchors are placed. The sutures from the 7 o'clock anchor are retrieved out through the posterior inferior portal (Fig 4). The sutures from the 10 o'clock anchor are retrieved out through the anterior superior portal (Fig 5).

Placement of the Glenoid Bone-Grafting Instruments

A set of glenoid bone-grafting instruments, which includes a guide pin, a core bar with 2 holes, and a trocar, is used (Fig 6). The guide pin is first placed in through the cannula in the anterior portal. The cannula is removed. The core bar is placed in along the guide pin, and the glenoid bone-grafting trocar is placed in over the core bar. The core bar is removed to leave the trocar in the anterior portal.

Fig 2. Release of the capsule labrum. The anterior inferior capsule-labrum complex is released from the glenoid neck (A) and elevated to a plane as high as the glenoid surface (B). Arthroscopic view of the left shoulder in a lateral decubitus position through the anterior superior portal. Abbreviations: C-L, the capsule labrum; G, glenoid; H, humeral head.

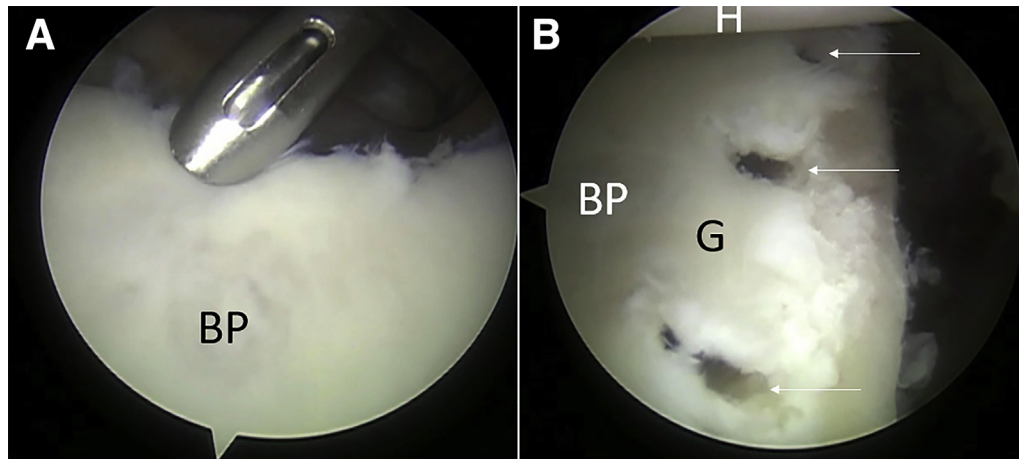
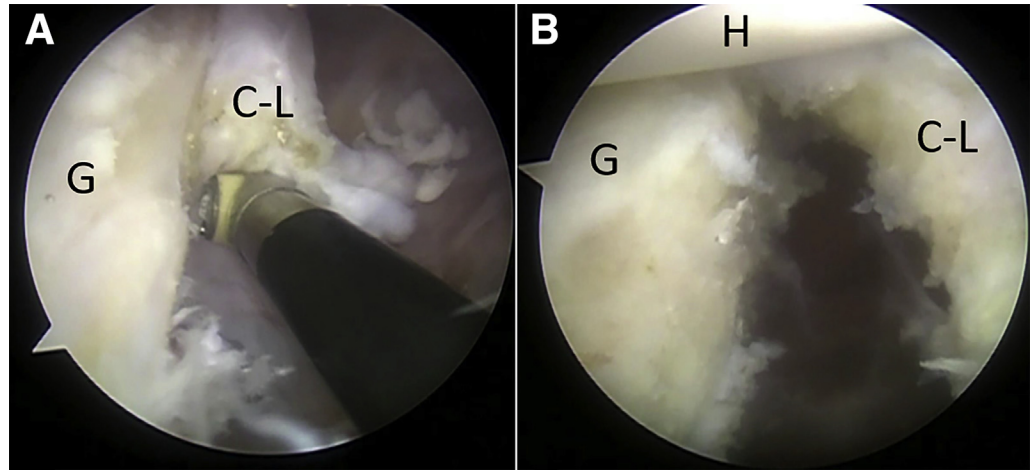


Fig 3. Drilling holes for the suture anchors. Three holes located at 7, 8:30, and 10 o'clock positions of the glenoid are first drilled at the posterior edge of the glenoid bone bed. (A) Drilling the hole for the 8:30 o'clock anchor. Arthroscopic view of the lateral shoulder in a lateral decubitus position through the posterior portal. (B) Three created holes. Arthroscopic view of the left shoulder in a lateral decubitus position through the anterior superior portal. Abbreviations: BP, bare point of the glenoid; G, glenoid; H, humeral head.

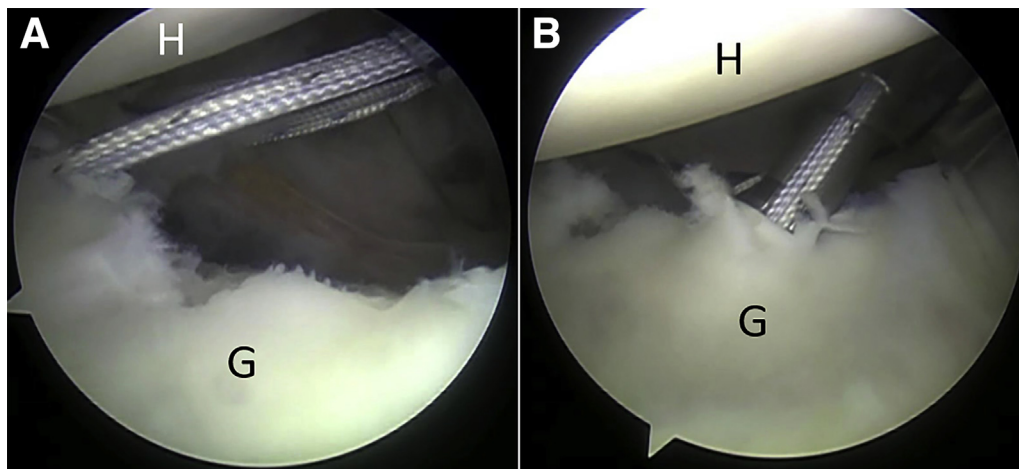


Fig 4. Placement of suture anchors at the 7 o'clock (A) and 10 o'clock (B) positions. Arthroscopic view of the left shoulder in a lateral decubitus position through the posterior portal. Abbreviations: G, glenoid; H, humeral head.

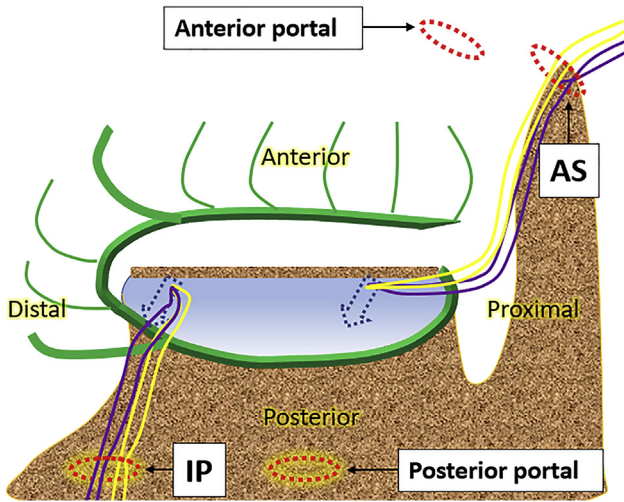


Fig 5. Illustration of the placement of suture anchors at the 7 o'clock (A) and 10 o'clock (B) positions. Left shoulder. Abbreviations: AS, anterior superior portal; IP, inferior posterior portal.

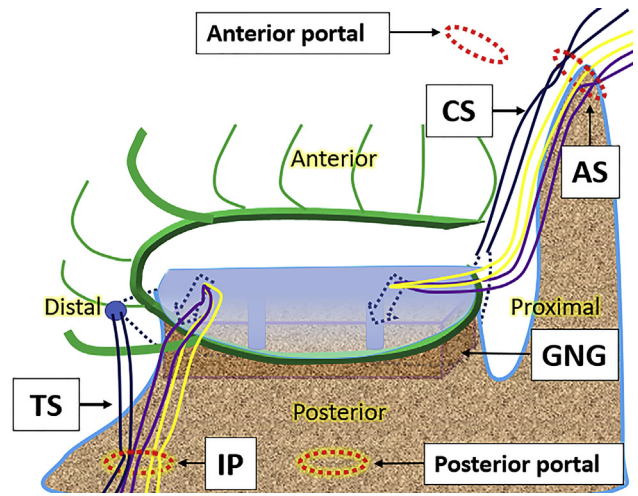


Fig 7. Illustration of the position of the glenoid-neck graft after placement. Posterior view of the left shoulder in a lateral decubitus position. Abbreviations: AS, anterior superior portal; CS, control suture; GNG, glenoid-neck graft; IP, inferior posterior portal; TS, traction suture.

Implantation of Glenoid-Neck Graft

The guide suture limb passing through the 5 o'clock capsule-labrum is retrieved out of the bone-grafting trocar. The traction suture through the glenoid-neck graft is pulled into the joint through the capsule labrum. The control suture is passed through 1 hole of the core bar. The glenoid neck graft is pulled in and placed at the anterior side of the glenoid neck, ~1 cm below the glenoid surface. The fragment is adjusted to be as parallel as possible to the glenoid surface (Figs 7 and 8).

Implantation of the Glenoid-Surface Graft

One suture limb from each of the 2 anchors is retrieved out of the joint through the trocar to serve as guide sutures. The suture from the 7 o'clock anchor is is

put through the distal hole of the graft, and the suture from the 10 o'clock anchor is put through the proximal hole of the graft, both from the underside to the upper side (Fig 9). With tension on the suture, the graft is then pushed along the suture into the trocar. The suture from the distal hole of the graft is put through the anterior hole of the core bar, and the suture from the proximal hole of the graft is put through the posterior hole of the core bar (Fig 10).

With tension kept on the sutures, the graft is pushed using the core bar through the trocar into the joint. When most of the fragment emerges from the trocar and is placed in the desired location, the trocar is rotated to adjust the surface orientation of the graft and make the cortical layer parallel to the glenoid surface. After the final adjustments, the graft is completely released from the trocar (Fig 11). The 2 suture limbs through the graft are retrieved through the anterosuperior portal. Finally, the grafting instruments are removed, and the routine canula is put in their place.

Graft Fixation

The suture limbs passing through the bone fragment are tied to their counter suture limbs to hold the bone fragment softly, with the surface of the bone graft parallel and abreast to the level of the glenoid surface (Figs 12 and 13).

Capsule-Labrum Repair

The capsule-labrum structure is pulled over the bone fragment and attached to the anterior edge of the glenoid with the suture from the 7 o'clock anchor. The 8:30 o'clock anchor is placed, and capsule-labrum repair is performed. The rotator interval is finally

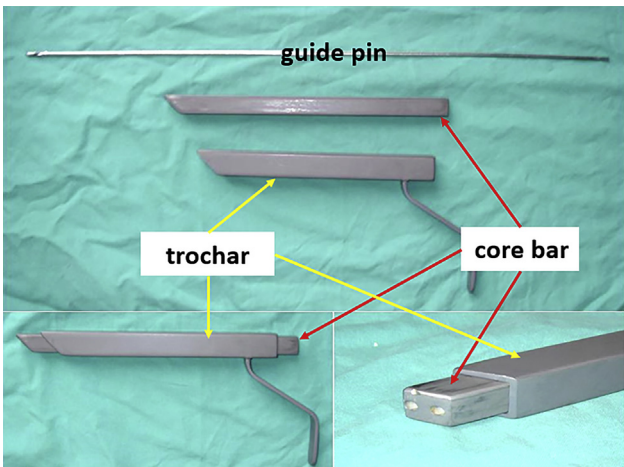
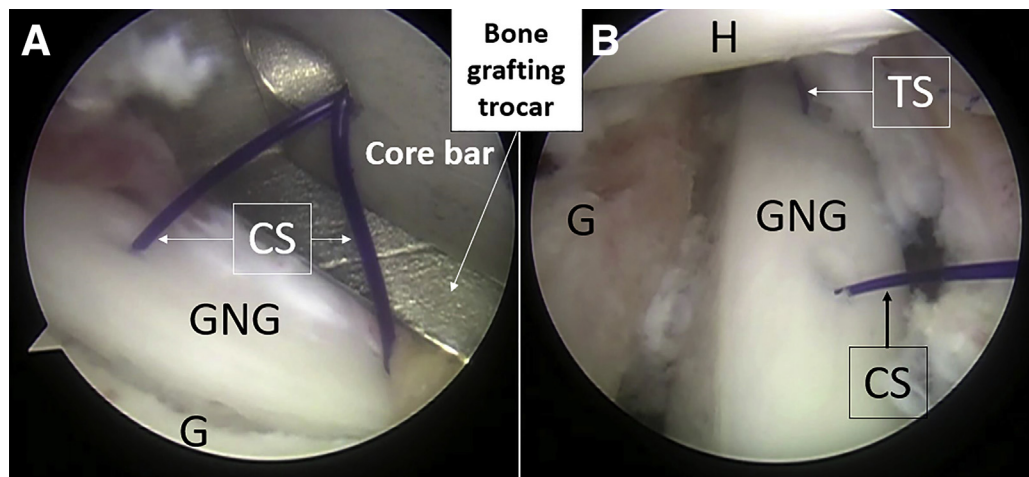


Fig 6. The glenoid bone-grafting instrument set.

Fig 8. Placement of the glenoid neck graft with the bone-grafting instruments. (A) The graft is released from the bone-grafting core bar. Arthroscopic view of the left shoulder in a lateral decubitus position through the posterior portal. (B) The graft is placed at the anterior side of the glenoid neck. Arthroscopic view of the left shoulder in a lateral decubitus position through the anterior superior portal. Abbreviations: CS, control suture; G, glenoid; GNG, glenoid-neck graft; H, humeral head; TS, traction suture.



closed using the left suture from the 10 o'clock anchor (Figs 14 through 19). The traction and control sutures from the glenoid-neck graft are pulled to elevate the grafts as much as possible.

Discussion

There are several special features in the current technique. First, this is an arthroscopic glenoid bone

grafting technique. Second, the grafts are placed through the rotator interval to minimized disturbance of the subscapularis. Third, the grafts are fixed with soft fixation or without fixation. Compared with hardware fixation or glenoid fissure-insertion fixation, soft fixation is convenient and time sparing. Previous reports indicate that glenoid bone grafting without fixation can induce glenoid remodeling, and glenoid bone grafting with soft fixation results in satisfactory healing.¹⁰ Compared with previous reports, the addition of another free graft fragment in the current technique provides more bony tissue for glenoid remodeling.

The pearls, pitfalls, risks, and limitations are listed in Tables 3 and 4. The critical point during placement of

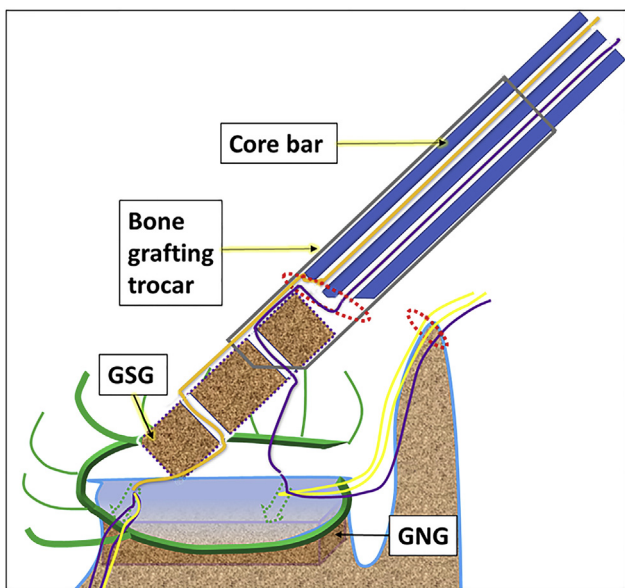


Fig 9. Illustration of placement of the glenoid surface graft. Posterior view of the left shoulder in a lateral decubitus position. The suture from the 7 o'clock anchor is put through the distal hole of the graft from the underside to the upper side, and the anterior hole of the bone-grafting trocar. The suture from the 10 o'clock anchor is put through the proximal hole of the graft from the underside to the upper side, and the posterior hole of the trocar. Abbreviations: GNG, glenoid neck graft; GSG, glenoid surface graft.

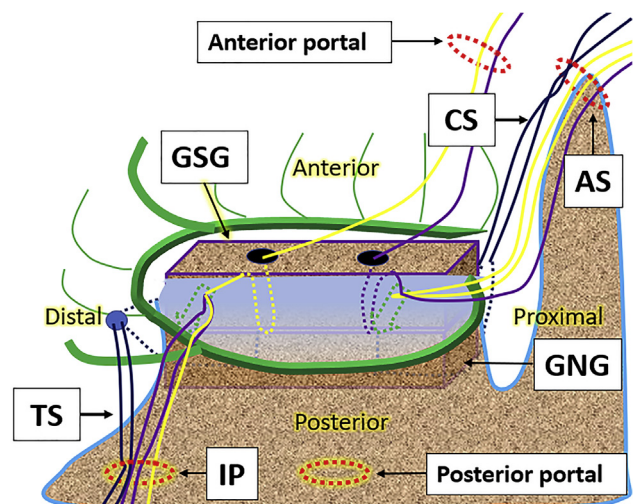


Fig 10. Illustration of the position of the glenoid-surface graft after placement. Posterior view of the left shoulder in a lateral decubitus position. Abbreviations: AS, anterior superior portal; CS, control suture for the glenoid-neck graft; GNG, glenoid-neck graft; GSG, the glenoid-surface graft; IP, inferior posterior portal; TS, traction suture for the glenoid-neck graft.

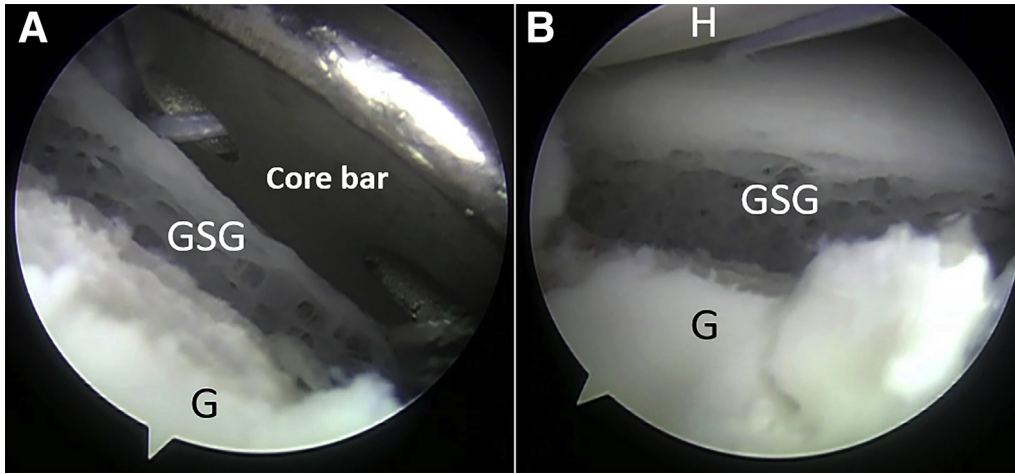


Fig 11. Placement of the glenoid-surface graft. (A) Release the glenoid-surface graft from the bone-grafting trocar with the core bar. (B) Placing the glenoid-surface graft to the same level of the glenoid cartilage surface. Arthroscopic view of the left shoulder in a lateral decubitus position through the posterior portal. Abbreviations: G, glenoid; GSG, glenoid-surface graft; H, humeral head.

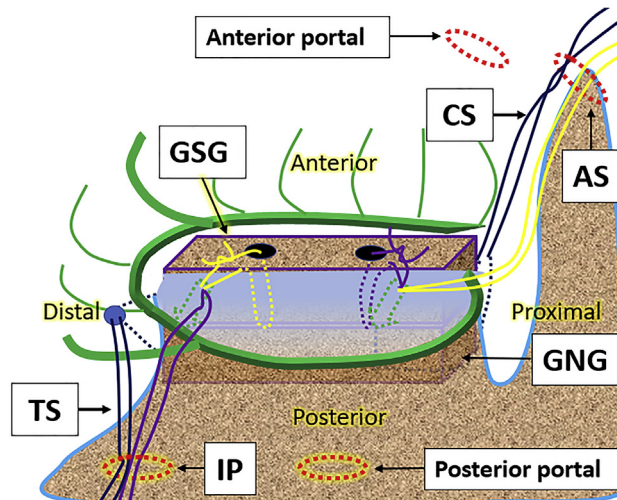


Fig 12. Illustration of suture fixation of the glenoid-surface graft. Posterior view of left shoulder in lateral decubitus position. Abbreviations: AS, anterior superior portal; CS, control suture of the glenoid neck graft; GNG, glenoid-neck graft; GSG, glenoid-surface graft; IP, inferior posterior portal; TS, traction suture for the glenoid neck graft.

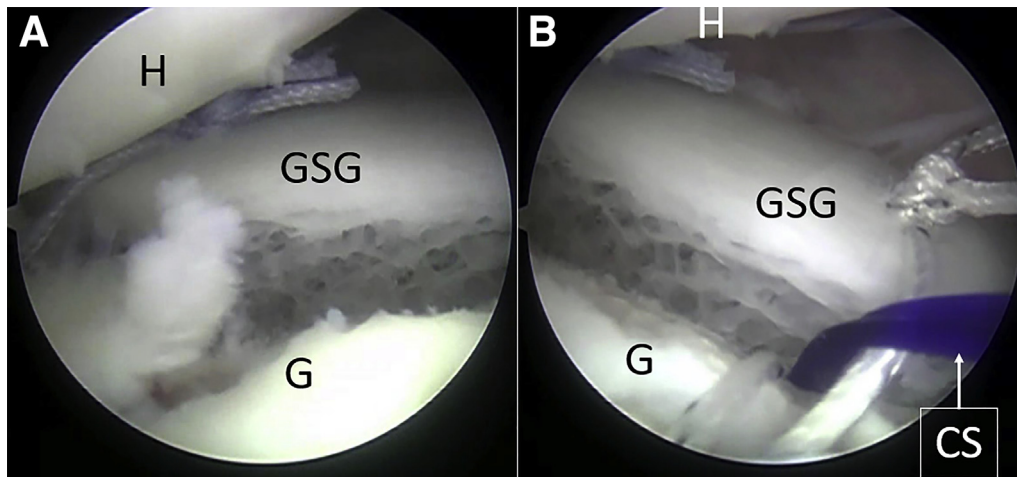


Fig 13. Suture fixation of the glenoid-surface graft. Arthroscopic view of the left shoulder in a lateral decubitus position through the posterior portal. Abbreviations: G, glenoid; GSG, glenoid-surface graft; H, humeral head.

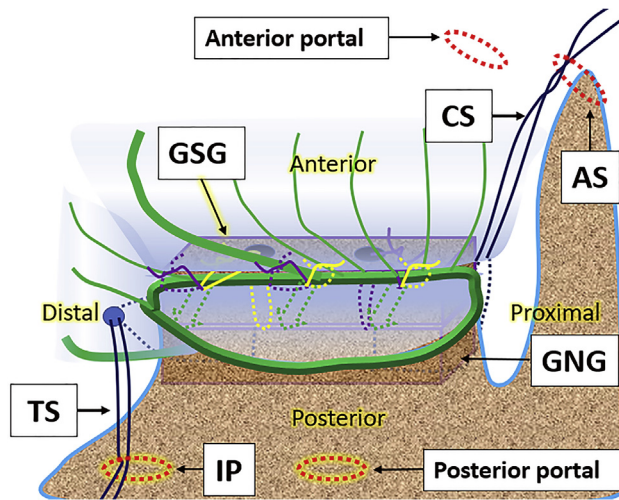


Fig 14. Illustration of reattachment of the capsule labrum across the bone grafts to the native glenoid edge. Posterior view of the left shoulder in a lateral decubitus position. Abbreviations: AS, anterior superior portal; CS, control suture of the glenoid neck graft; GNG, glenoid-neck graft; GSG, glenoid-surface graft; IP, inferior posterior portal; TS, traction suture for the glenoid neck graft.

Fig 15. Reattaching the capsule labrum across the bone grafts to the native glenoid edge (A) and closing the rotator interval (B). Arthroscopic view of the left shoulder in a lateral decubitus position through the posterior portal. Abbreviations: C-L, reattached capsule labrum; CS, control suture of the glenoid neck graft; G, glenoid; GSG, glenoid-surface graft; H, humeral head.

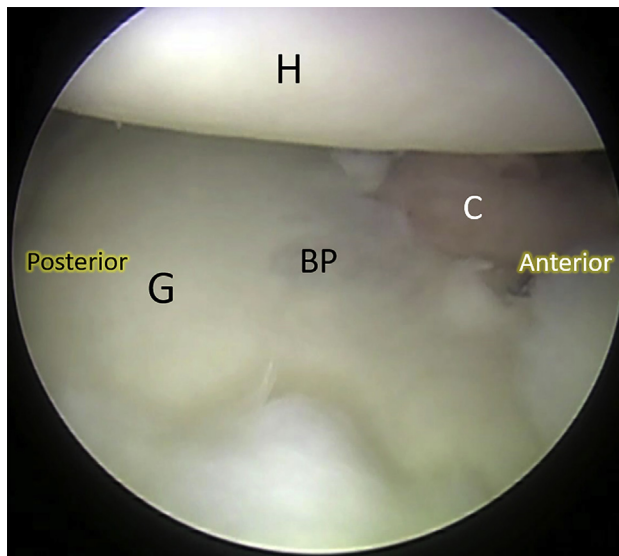
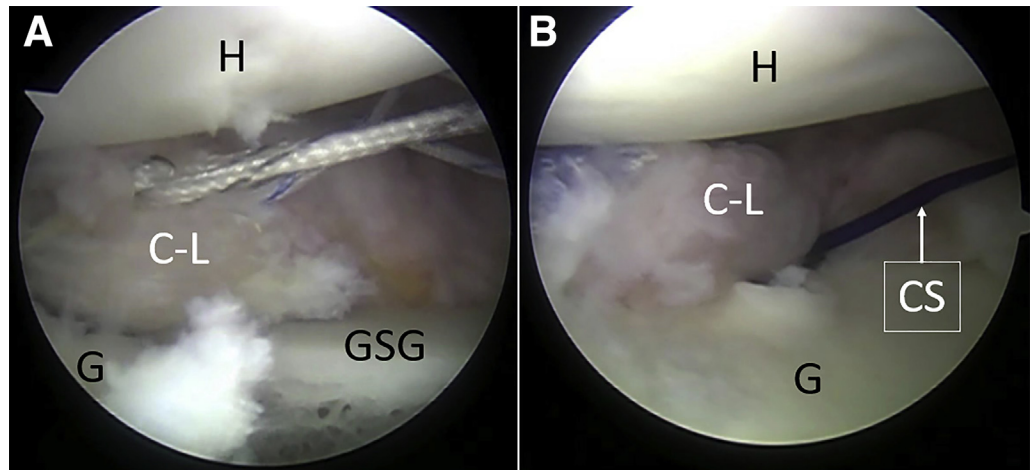


Fig 16. Position of the humeral head in relation to the glenoid after the capsule labrum repair. Arthroscopic view of the left shoulder in a lateral decubitus position through the anterior superior portal. Abbreviations: BP, bare point of the glenoid; C, the reattached capsule labrum; G, glenoid; H, humeral head.

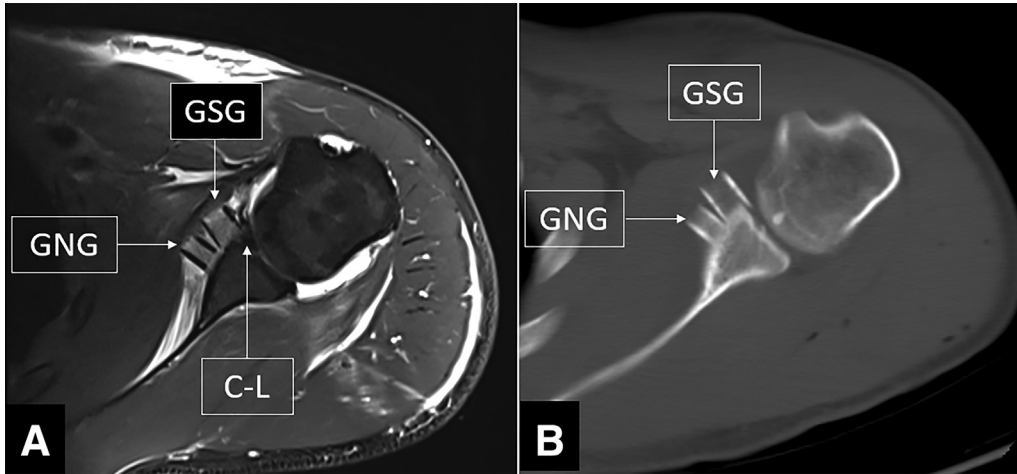


Fig 17. Postoperative transverse view of MRI (A) and CT (B) after glenoid bone grafting. Left shoulder. The glenoid-surface graft is placed at the same level of the cartilage surface of the glenoid (A) instead of the bony surface of the glenoid (B). Abbreviations: C-L, the reattached capsule labrum; CT, computed tomography; GNG, glenoid-neck graft. GSG, glenoid-surface graft; MRI, magnetic resonance imaging.

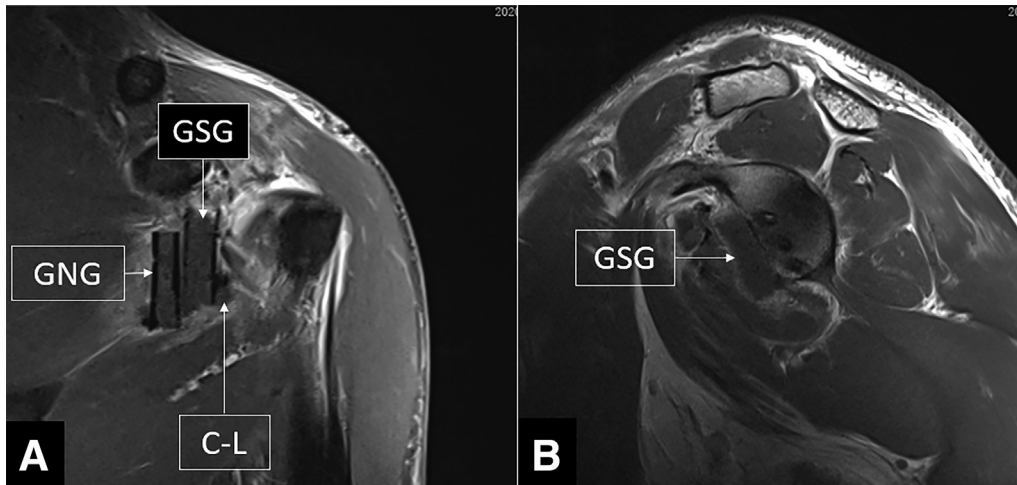


Fig 18. Postoperative oblique coronal view (A) and oblique sagittal view (B) of MRI of the left shoulder after glenoid bone grafting. Abbreviations: C-L, the reattached capsule labrum; GNG, glenoid-neck graft. GSG, glenoid-surface graft; MRI, magnetic resonance imaging.

Fig 19. Postoperative computed tomography indicating the positions of the grafts. Abbreviations: GNG, glenoid-neck graft; GSG, glenoid-surface graft.

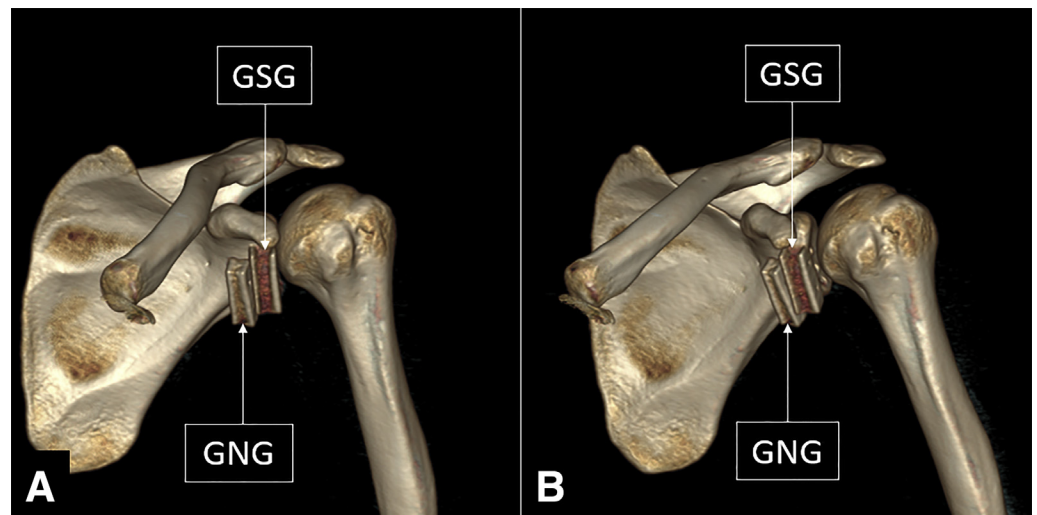


Table 3. Pearls and Pitfalls

1. It is best to customize the bone fragment according to surgical requirements. On-site fabrication of bone fragments is time consuming.
2. A thorough capsule-labrum release and subscapularis release should be conducted, first to create enough space to accommodate the bone fragment, and second to obtain enough exertion of the capsule-labrum to cover the bone fragment finally.
3. When pushing the glenoid-surface graft into the joint, the suture limb should always be tensioned, to prevent leaving loose sutures ahead of the graft and leading to entanglement.
4. When placing the bone graft into the joint, the rotation and position of the fragment should be adjusted to optimal status before releasing it from the bone grafting trocar. Otherwise it is somewhat difficult to adjust the bone fragment.
5. The purpose of suture fixation is to prevent too medial placement of the graft. Thus, soft fixation is enough. Too-tight fixation may result in cutting of the bone fragment with the suture.
6. The guide suture for capsule labrum repair should be placed before graft placement. Otherwise it will be very difficult to place the guide suture through the anterior inferior capsule labrum because of impediment of the graft.
7. Capsule-labrum repair and rotator interval closing are performed first for capsule-labrum-glenoid healing. The second purpose is to close the joint and leave the bone fragment out of the joint, to facilitate graft-glenoid healing and glenoid remodeling.
8. Pull the traction suture and control suture for the glenoid-neck graft to elevate the graft as much as possible.

Table 4. Risks and Limitations

This technique is limited to patients with slight or moderate glenoid defects. For patients with severe glenoid bone defects, such as >40%, a larger graft with firm fixation may be more suitable.

With 2 allograft fragments, enough osseous tissues are provided for glenoid remodeling. However, infection risks increase with the placement of a large volume of allograft.

There is a slight learning curve in using the glenoid bone grafting instrument. Once suture tangling happens, it may result in failure of graft emplacement.

Suture fixation of the bone fragment may result in suture cutting and graft breakage.

Total sealing of the glenohumeral joint by reattaching the capsule labrum to the glenoid over the graft may not be possible in some cases with capsule defect or severe fibrosis.

the glenoid-neck graft is to control the position of the fragment with both traction and the control sutures. The critical point during placement of the glenoid-surface graft is to put the guide suture limbs through the correct holes through the graft and the bone-grafting core bar, or suture tangling will result.

Acknowledgments

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