



The Arthroscopic Bankart-Plus Procedure for Treatment of Anterior Shoulder Instability With Small to Intermediate Glenoid Defects

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Abstract: To date, specific surgical procedures are available for the treatment of anterior shoulder instability with substantial bony glenoid defects, as well as for patients without osseous lesions. However, specific treatment options are lacking for the frequently observed small to intermediate glenoid defects, which may not necessitate glenoid reconstruction surgery according to current guidelines but can still jeopardize the outcome after mere soft-tissue stabilization procedures. This article describes the so-called arthroscopic Bankart-Plus procedure for the treatment of anterior shoulder instability with small to intermediate bony glenoid defects. In addition to the conventional capsulolabral repair, an allogeneic demineralized spongy bone matrix is inserted between the glenoid neck and the labrum with the aim of compensating for the glenoid bone loss by increasing the volume of the labrum and thus its stabilizing effect.

Recurrent anterior shoulder instability is associated with varying degrees of bony defects of the anterior glenoid rim in more than 80% of cases.¹ Substantial osseous defects with resulting damage to the concavity of the glenoid significantly diminish the stability of the shoulder² and lead to a high failure rate after mere soft-tissue stabilization procedures.³ Therefore, it is widespread clinical practice to address substantial glenoid bone loss with a bony reconstruction procedure, for example, an iliac crest bone-grafting technique or a coracoid transfer procedure, whereas only patients without an osseous lesion are treated with soft-tissue stabilization procedures.⁴ In almost 90% of all cases with glenoid bone loss, however, the defect size is small to intermediate,¹ which—according to current treatment recommendations—does not require

a bony reconstruction but at the same time constitutes a biomechanically relevant defect that might jeopardize the outcome of conventional soft-tissue stabilization procedures.^{2,5} Although adequate surgical procedures are available for substantial glenoid defects, as well as for patients without osseous lesions, at present, there is no specific treatment concept to address small to intermediate glenoid defects.

The purpose of this article is to present the so-called Bankart-Plus procedure for the treatment of patients with anterior shoulder instability and small to intermediate glenoid defects. This technique includes an arthroscopic capsulolabral repair with an additional interposition of an allogeneic demineralized spongy bone matrix between the glenoid neck and the labrum to compensate for small to intermediate glenoid defects by increasing the volume of the labrum and thus its stabilizing effect (Video 1).

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Surgical Technique

Preoperative Planning

In addition to obtaining a careful patient history, performing a functional assessment, and performing a complete clinical examination to determine the type of instability, functional demand, joint laxity, and possible concomitant pathologies, a detailed radiologic assessment is required. Although magnetic resonance imaging is conducted to evaluate capsulolabral lesions and to identify potential concomitant soft-tissue pathologies, computed tomography currently still offers advantages

in the detection and quantification of glenoid bone loss.⁶ The size of the glenoid defect is best determined using en face 3-dimensional computed tomography reconstructions of the glenoid with subtraction of the humeral head.

Patient Positioning

After administration of perioperative antibiotics and induction of general anesthesia, the patient is placed in the lateral decubitus position. The affected arm is fixed in a traction device in 30° of abduction and neutral rotation with traction applied in the axial and lateral direction, which creates distension of the shoulder joint and thus improved intra-articular visualization.

Portal Placement and Diagnostic Arthroscopy

Three regular portals are required for this arthroscopic procedure: a standard posterior portal, an anterosuperior portal, and an anteroinferior portal. A diagnostic arthroscopy is performed through the standard posterior portal to identify the primary structural defects, as well as concomitant lesions. The anterior and anteroinferior glenoid rim, as well as the capsuloligamentous complex, can be best evaluated through the anterosuperior portal.

Capsulolabral Complex Release and Scapular Neck Preparation

With visualization through the anterosuperior portal, the glenoid rim and scapular neck are prepared for graft

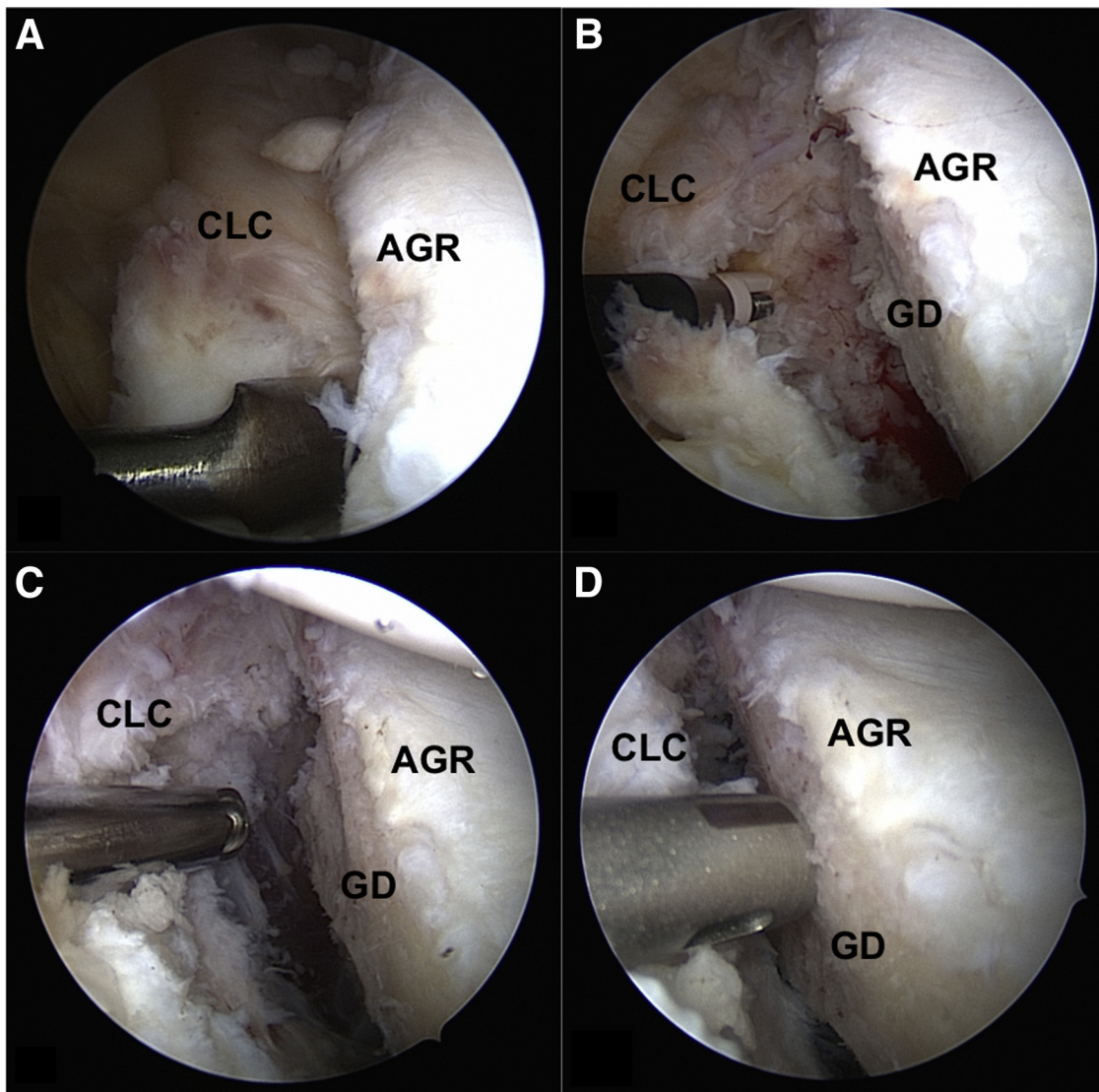


Fig 1. Arthroscopic visualization of the right anterior glenoid rim (AGR) from the anterosuperior portal with the patient placed in the lateral decubitus position. (A, B) Release of the capsulolabral complex (CLC) from the AGR with an arthroscopic periosteal elevator or an electrothermal instrument. (C) Preparation of the AGR using a motorized burr. (D) Subsequent insertion of an all-suture anchor into the middle of the glenoid defect (GD) approximately 4 mm medial to the articular surface.

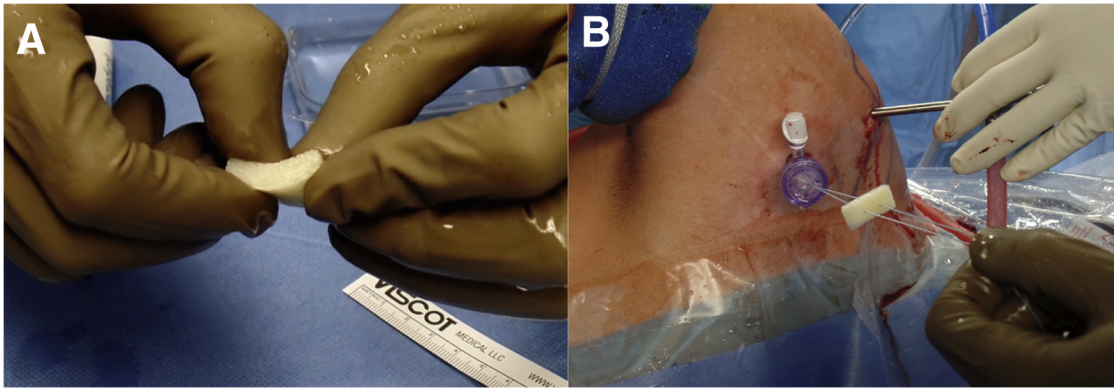


Fig 2. Flexible allogeneic demineralized spongy bone matrix (A) and passage of suture strands through the graft (B) for intra-articular insertion through the cannula of the anteroinferior portal.

placement. The capsulolabral complex is first carefully mobilized using an arthroscopic periosteal elevator or an electrothermal instrument with the goal to create a soft-tissue pouch for later graft placement (Fig 1 A and B). Loose, small osteochondral fragments are resected, whereas small fragments that are connected to the labrum can be reattached together with the capsulolabral complex against the bone graft at a later stage. The presence of larger fragments that can be used to reconstruct the anterior glenoid rim make the Bankart-Plus procedure unnecessary. The glenoid neck is then debrided with a rasp or motorized burr to create a plane surface and to create bleeding, which should facilitate the ingrowth of the graft (Fig 1C). Adjacent chondral defects are debrided with a shaver or curette and, if necessary, undergo microfracture at the end of the surgical procedure. Then, an all-suture anchor is

inserted into the middle of the glenoid defect approximately 4 mm medial to the articular surface (Fig 1D).

Graft Insertion and Fixation

An allogeneic demineralized spongy bone matrix (Flexigraft; LifeNet Health, Virginia Beach, VA) with the dimensions of $25 \times 20 \times 6$ mm is used for this procedure. The graft should already have been placed into warm physiological saline solution at the beginning of the surgical procedure to gain a flexible, sponge-like consistency of the graft (Fig 2A). Before insertion, the dimensions of the graft are adjusted to approximately $20 \times 10 \times 6$ mm. Next, the sutures from the all-suture anchor are extracted from the anteroinferior portal and passed through the middle of the graft, with a distance of approximately 6 mm between sutures (Fig 2B). Because of its flexible consistency, the graft can then

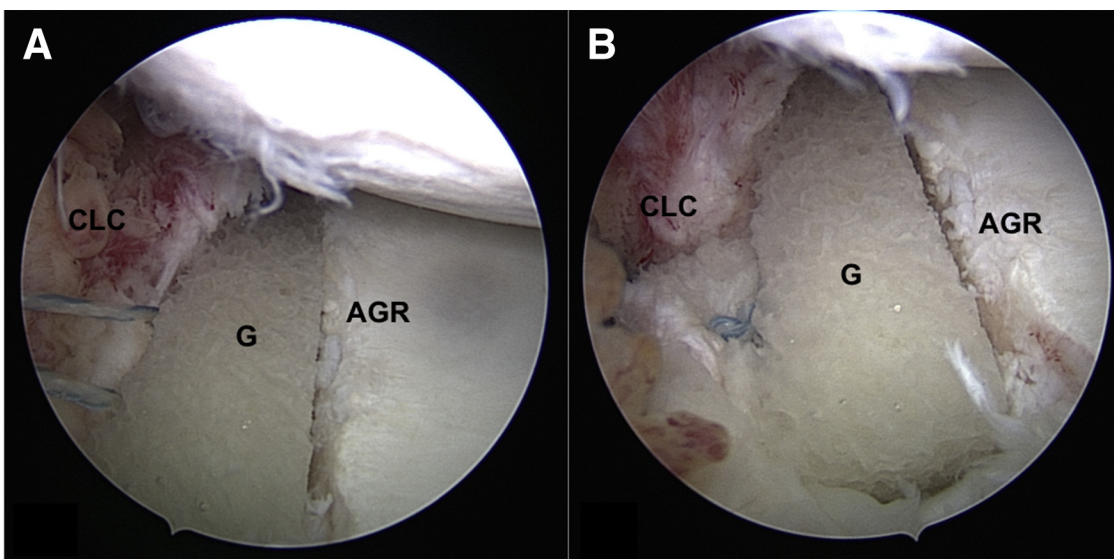


Fig 3. Arthroscopic visualization of the right anterior glenoid rim from the anterosuperior portal with the patient placed in the lateral decubitus position. Anatomic positioning of the graft (G) in the pouch between the anterior glenoid rim (AGR) and the capsulolabral complex (CLC) before (A) and after (B) the suture strands of the all-suture anchor are tied.

Table 1. Pearls and Pitfalls of Bankart-Plus Procedure

Pearls
Hydration of the graft with warm saline solution makes the graft soft and flexible.
Pushing the intra-articular end of the cannula into the capsulolabral pouch facilitates graft insertion.
Pitfalls
Lack of mobilization of the capsulolabral tissue leads to insufficient pouch formation.
Overly tight knot tying of the all-suture anchor can lead to ripping of the graft.

easily be inserted in the 8.25-mm twist-in cannula of the anteroinferior portal by use of a straight clamp. Once the graft is placed within the cannula, the blunt end of the shaver can be used to push the graft further into the joint. While this is being done, the intra-articular end of the cannula should be placed inside the anterior capsulolabral soft-tissue pouch created before. The position of the graft can be adjusted easily by use of a grasping device (Fig 3A). The graft is then loosely fixed to the glenoid neck by gently tying the suture strands (Fig 3B, Table 1).

Capsulolabral Repair

The capsulolabral complex is reattached to the glenoid with 3 single-loaded 2.9-mm knotless suture anchors and cinch stitches. Other configurations with other types of suture anchors, double-loaded suture anchors, or bridging techniques are possible as well.

First, the labrum is penetrated at the inferior end of the graft with a 25° angulated suture-passing device, and a No. 2 polyblend polyethylene suture is inserted as a loop to form a cinch stitch (Fig 4A). The surgeon then uses the cinch stitch to attach the capsulolabral complex to the anteroinferior glenoid using a 2.9-mm knotless suture anchor while paying attention to perform a caudocranial shift. The tension of the repair can be adjusted by altering the traction on the sutures during anchor insertion. The second stitch is then placed slightly superior to the first stitch in the form of a simple stitch. In addition to the labrum, the graft is penetrated by the suture-passing device (Fig 4B). The created simple stitch is again inserted at the anterior glenoid rim by use of a knotless 2.9-mm suture anchor (Fig 4C). Depending on the size of the Bankart lesion, 1 or 2

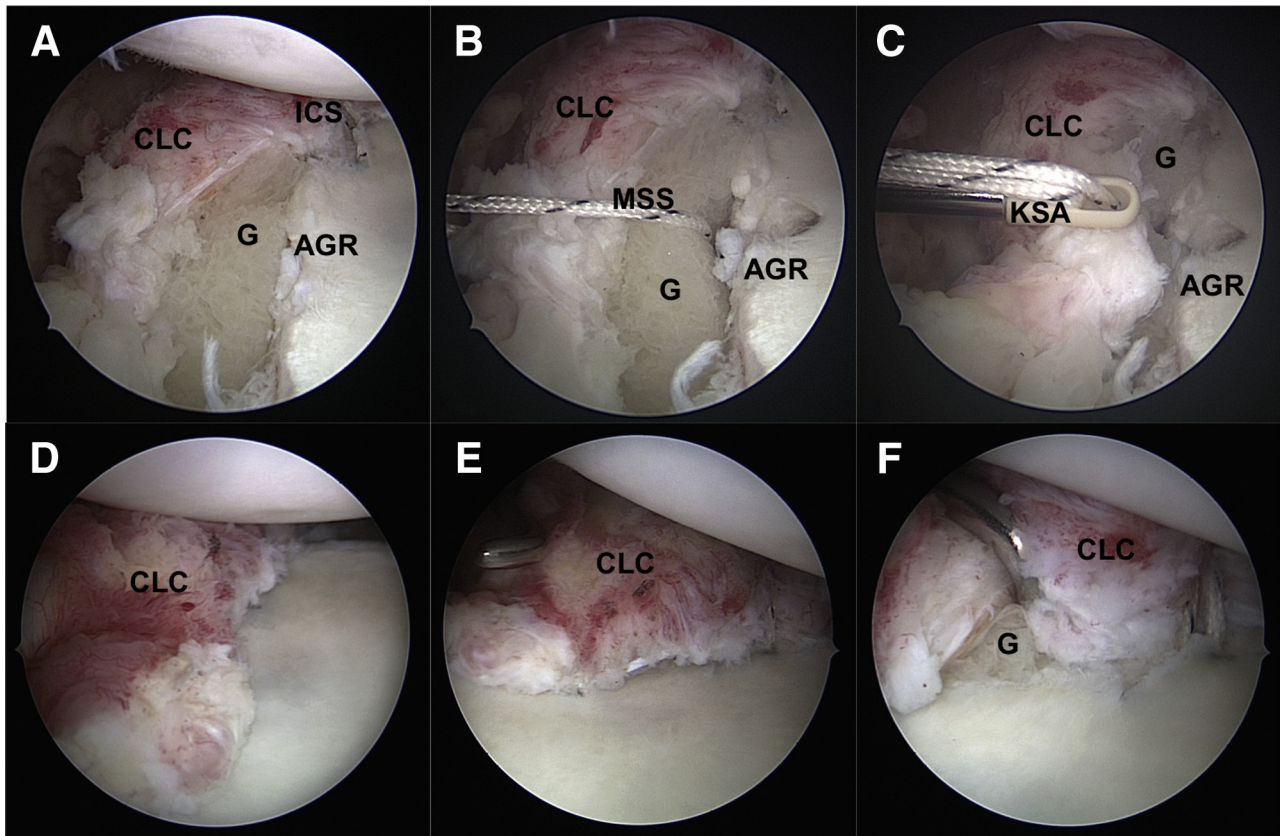


Fig 4. Arthroscopic visualization of the right anterior glenoid rim from the anteroinferior portal (A-D) and the posterior portal (E, F) with the patient placed in the lateral decubitus position. Refixation of the capsulolabral complex (CLC) to the anteroinferior glenoid using an inferior cinch stitch (ICS) (A), a middle simple stitch (MSS) passing the graft (G) (B), and 1 or 2 superior cinch stitches all inserted at the anterior glenoid rim (AGR) using knotless suture anchors (KSA) (C). Visualization of the anatomically reconstructed and augmented CLC from the posterior (D) and anteroinferior (E) portals. (F) The increased volume of the bump is created as a result of the graft (G) augmentation, which is situated extra-articularly right underneath the CLC.

more cinch stitches are placed superior to the graft by the same technique used for the first stitch. By following these steps, the capsulolabral complex is anatomically reinserted at the anterior glenoid rim and the volume of its bump is increased as a result of the graft augmentation (Figs 4D-F and 5).

Postoperative Rehabilitation and Treatment

The postoperative rehabilitation protocol follows general recommendations for soft-tissue stabilization procedures. The shoulder is immobilized in internal rotation with a regular sling for 6 weeks. During this period, guided passive mobilization exercises should be performed within a limit of 90° of forward flexion and abduction, as well as 0° of external rotation. Active range-of-motion exercises are initiated 6 weeks after surgery. Muscle strengthening is commenced 12 weeks after surgery. A return to shoulder-demanding or contact sports is usually possible after 6 months, always depending on a patient-specific assessment.

Discussion

Current surgical treatment strategies for anterior shoulder instability include the option of bony

reconstruction techniques for substantial glenoid defects or, alternatively, soft-tissue stabilization procedures for cases with no glenoid bone loss. To date, no specific surgical techniques are available to address small to intermediate glenoid bone defects.

Rather high long-term recurrence rates have been reported for soft-tissue stabilization procedures,⁷⁻⁹ and even “subcritical” glenoid bone defects seem to negatively affect the functional outcome after soft-tissue stabilization procedures, especially in young and active patients.⁵ An advantage regarding lower rates of postoperative recurrence of instability is why some experts recommend the more liberal use of bone-grafting techniques including the commonly used Latarjet procedure or iliac crest bone graft transfer. However, these techniques are more invasive and prone to complications including screw problems, pseudarthrosis, graft migration, nerve injury, and donor-site morbidity among others.^{10,11} In addition, it has been shown that if these grafting techniques are used in cases of a small amount of glenoid bone loss, an unnatural augmentation of the glenoid is produced with extensive bone graft resorption due to load-dependent bone remodeling.^{12,13}

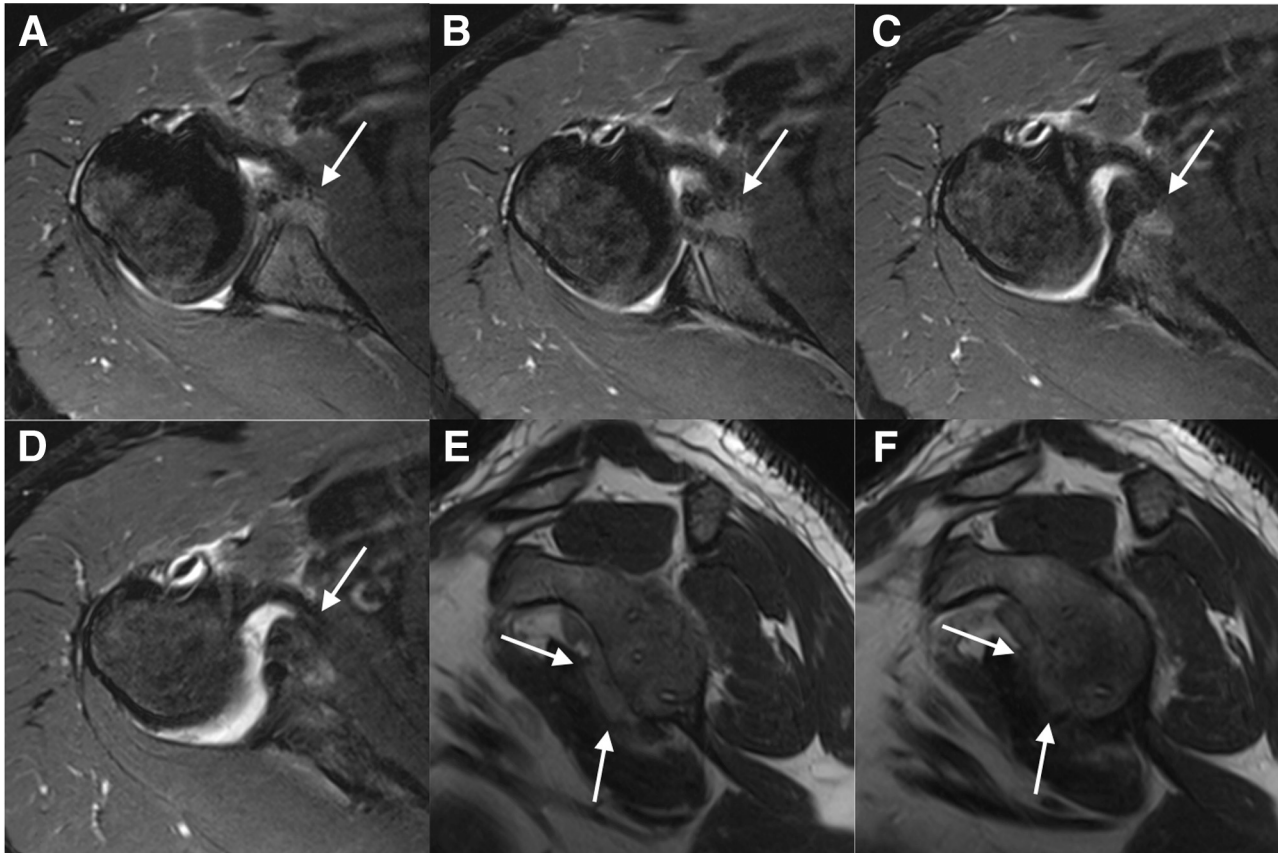


Fig 5. (A-D) Axial magnetic resonance imaging views at 2 weeks postoperatively showing graft placement (arrows) underneath the capsulolabral complex with the resulting large soft-tissue bump at the anterior glenoid rim. (E, F) Sagittal magnetic resonance imaging views showing the positioning of the graft (arrows) leading to an increase in the anteroposterior glenoid extension.

Table 2. Advantages and Limitations of Bankart-Plus Technique

Advantages	
Relatively easy bone-grafting technique	
Short duration of surgery	
Low risk of intraoperative complications	
Applicability in case of	
• Small to moderate glenoid defects	
• Capsulolabral tissue insufficiency	
• Flattened glenoid concavity	
Limitations	
Limited primary stability of bone graft fixation	
Lack of information on allograft integration	
No applicability in case of large glenoid defects	

The arthroscopic Bankart-Plus procedure has the potential to close the existing gap in treatment options for patients with anterior shoulder instability and small to intermediate glenoid defects. The technique is easy to perform because many steps are similar to the conventional arthroscopic Bankart repair. A technical advantage over conventional bone-grafting techniques is the flexible structure of the graft, which allows for effortless insertion through a cannula and easy fixation to the anterior glenoid rim without the use of hardware. The potential benefit over conventional Bankart repairs is the insertion of the allograft, which increases the volume of the generated capsulolabral bump. Whether the allograft develops into bony apposition because of its osteoconductive properties or turns into mere scar tissue, it is likely to enhance stability by increasing the volume of the capsulolabral complex and thus increasing the concavity of the glenoid.² Because of its properties, the Bankart-Plus procedure might be indicated not only in cases with a small to intermediate amount of bone loss but also in cases with a lack of sufficient labral tissue or with a constitutional flattened concavity, which have also been described to compromise the stability of the shoulder joint^{14,15} (Table 2).

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