Technical Note

Arthroscopic Sandwich Autografting Technique for Massive Glenoid Bone Defect Using Iliac Crest and Coracoid Process Grafts

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Abstract: Shoulder joint instability can lead to bone loss on both the glenoid side and the posterior part of the humeral head, known as bipolar bone loss. To restore glenoid defects, bone procedures like the Latarjet operation or free bone block transfer from the iliac crest are the primary options, restoring defects of up to 25% to 30%. However, in some cases, the glenoid defect may exceed 40%. This article discusses a unique technique for restoring glenoid bone defects up to 50%, using 2 bone grafts—a free graft from the iliac crest and the coracoid process with conjoint tendon complex. This technique is called "double block sandwich technique."

Anterior shoulder instability is a prevalent and socially significant pathology, affecting approximately 96% of shoulder girdle and upper-limb injuries.[1-8] Studies have shown that patients with shoulder instability are at a high risk of developing post-traumatic osteoarthritis. Even a single dislocation episode can lead to signs of osteoarthritis in 56% of cases over a 25-year observation period.[3-8] Conservative treatment is usually ineffective, and surgery is the gold standard for stabilizing the shoulder and preventing recurrence of the pathology. The Latarjet procedure and free iliac crest bone grafting are commonly used surgical options for recurrent anterior instability with a glenoid bone defect greater than 15%. However, the most effective technique for stabilizing the shoulder joint in cases in which bone loss exceeds 40% remains debatable.

Currently, both open and arthroscopic techniques are being used for Latarjet surgery or plastic surgery with a free bone block from the iliac crest. The arthroscopic technique is preferred, as it allows for precise graft positioning, correction of articular surface congruence, minimal soft-tissue trauma, and faster postoperative rehabilitation. Studies have shown that the arthroscopic Latarjet procedure provides excellent clinical results.[1-5] However, the main limitation of these methods is the significant glenoid defect that cannot be restored by isolated coracoid transposition or a free bone block. To address this, a technique called the "double-block sandwich technique" has been developed, which involves arthroscopic autografting of both the coracoid and free iliac bone grafts fixed to the glenoid with cannulated screws. Preoperative planning and surgical technique control are carried out using 3-dimensional printing technology.[2-8] This Technical Note describes a specific arthroscopic method for autografting massive glenoid bone defect (Video 1).

Surgical Technique (With Video Illustration)

The indication is chronic recurrent anterior instability of the shoulder joint, which is caused by of more than 40% glenoid bone defect. An important step is careful preoperative planning using computed tomography

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examination and 3-dimensional printing technology (Fig 1 A and B).

The operation is performed with the patient in a beach-chair position with their arm on a shoulder support. The shoulder is flexed at 20°, abducted at 15°, and internally rotated 45° to avoid any strain on the subscapularis tendon. The elbow joint is flexed at a 70 to 80° angle to decrease tension on the biceps tendon.

Bone autograft is harvested in the form of a quadrangular prism from the iliac crest using open access. The decortication and preparing the 2 bases of the autograft are performed on the manipulation table. The 2 parallel holes for the screws are drilled (Fig 2A).

After examination of the joint, a standard arthroscopic anterior working portal is established, through which all existing chondral bodies and scar tissue are removed (Fig 2B) using an electrocautery device (VAPR premiere ablation electrode; DePuy Mitek, Raynham, MA), and a motorized burr the bed for transposition and adaptation of bone grafts is prepared (Fig 2C). Coracoacromial ligament and the tendon of the pectoralis minor muscle are cut, thus isolating the coracoid process from the soft tissue.

Through a third anterolateral working portal, decortication of the lower surface of the coracoid process is performed. The split of the subscapularis tendon is formed under visual control of the musculocutaneous and axillary nerves. After this, using an additional fifth working supracoracoid portal, 2 parallel holes on the upper surface of the coracoid process are drilled and an osteotomy performed using a DePuy Latarjet chisel. Fixing the prepared bone iliac autograft on the cannula and through the fourth transpectoral portal and through subscapularis split, the graft is placed on the anterior surface of the glenoid and temporarily fixed with 2 pins through the graft and glenoid (Fig 3A).

The coracoid process, which has been osteotomized and fixed in the cannula, is then smoothed using a burr. The coracoid process is adapted to the autograft of the iliac crest and fixed this bony block to glenoid with 2 cannulated Latarjet screws through the split of the subscapularis muscle and the tendon complex (32 mm) (Fig 3B).

Rehabilitation

Postoperatively, the shoulder is immobilized in an abduction brace for 10 to 12 weeks. Movements of the hand and wrist immediately postoperatively are allowed. Passive activity of the shoulder starts from 2 weeks within the pain-free range of motion. External rotation with the arm at the side was limited to 0° within 2 weeks, 20° within 4 weeks, and 40° within 8 weeks' postoperatively. Active flexion of the elbow in the first 6 weeks is allowed. Active movement of the shoulder starts gradually at 6 to 8 weeks. The brace is removed gradually from 8 weeks to 12 weeks. Return to sports, throwing, or heavy labor activities are, in general, not allowed for 6 months.

Discussion

The treatment of shoulder joint instability has been a popular topic of discussion over the past decade due to its prevalence and social significance.[1-8] More than 300 surgical techniques have been developed to address this issue, including operations on the shoulder joint capsule, ligament creation, muscle grafting, and bone grafting.[1-7] Arthroscopic Latarjet surgery is an effective treatment for shoulder joint instability.[1,3,5,6] This surgery provides triple stabilization by creating an additional bone wall of the glenoid, restoring tension of the glenohumeral ligaments, and fixing the anterior capsule to the graft or glenoid. However, the surgery is

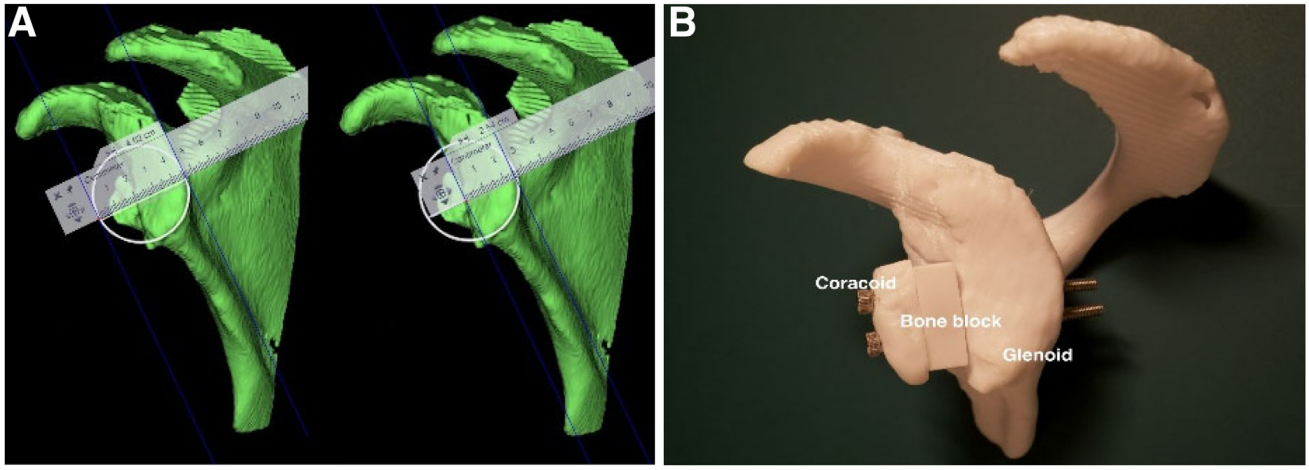

Fig 1. (A) Shown is a 3-dimensional (3D) model of the left shoulder joint. The ruler shows the percentage of bony loss, which is more than 40%. (B) Shown is preoperative 3D planning, especially 2 bony grafts inserted to the glenoid and fixed with cannulated screws. In the middle part is located the iliac crest bony graft/bone block/with the coracoid process located on it.

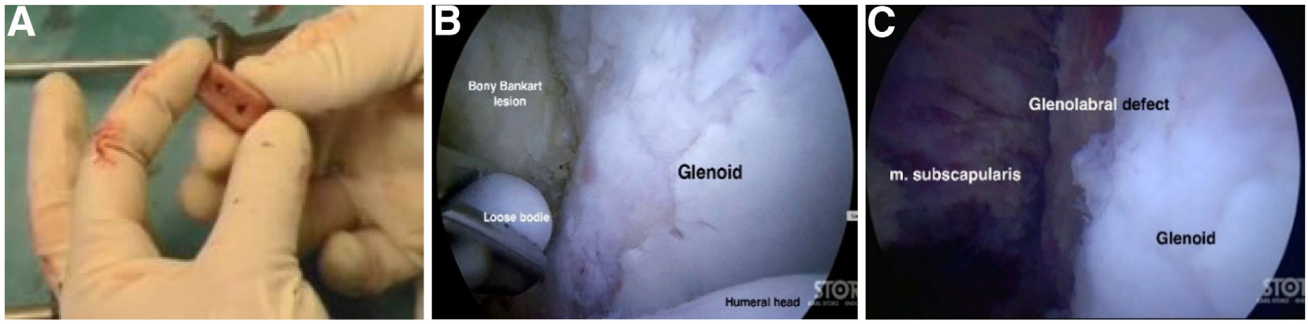

Fig 2. (A) Bone harvesting from the iliac crest in the form of a quadrangular prism, decortication of 2 basis of the autograft and formation of 2 parallel holes for screws. (B) A standard arthroscopic posterior viewing portal is created, and any existing chondral bodies and scar tissue are removed for excellent visualization of the bone defect. (C) Prepared anterior glenoid bed transposition and adaptation of bone grafts after using an electrocautery device and a motorized burr.

limited by the presence of a large bone defect that occupies more than 40% of the glenoid.[2-8] In such cases, free bone grafting from the iliac crest is recommended, but it lacks the sling effect that provides additional stabilization of the humeral head. Therefore, maintaining the stability of the shoulder joint, anatomical congruence of the articular surfaces, and absence of recurrence of pathology are critical in patients with a massive bone defect of more than 40%. The article discusses a technique used in patients with chronic recurrent anterior instability of the shoulder joint with a bone defect of more than 40%. This technique uses a free bone autograft from the iliac crest and osteotomized coracoid process to restore a huge glenoid defect. The conjoint tendon complex provides additional stabilization, and the structure's fixation is ensured by 2 cannulated screws inserted through both grafts into the articular process of the scapula. The surgery is performed arthroscopically to maintain the congruence of the graft surfaces with the articular surface of the glenoid and the head of the humerus and to reduce the risk of complications (Table 1). The goal of this technique is to achieve effective biomechanical results and increase patient satisfaction.

Disclosures

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: A.A.V. reports equipment, drugs, or supplies provided by A M Nikiforov All-Russian Center of Emergency and Radiation Medicine and a relationship with A M Nikiforov All-Russian Center of Emergency and Radiation Medicine that includes: board membership. S.S.G. reports equipment, drugs, or supplies provided by FSBI Clinical Hospital N.1 and a relationship with FSBI Clinical Hospital N.1 that includes: consulting or advisory. H.H.A. reports

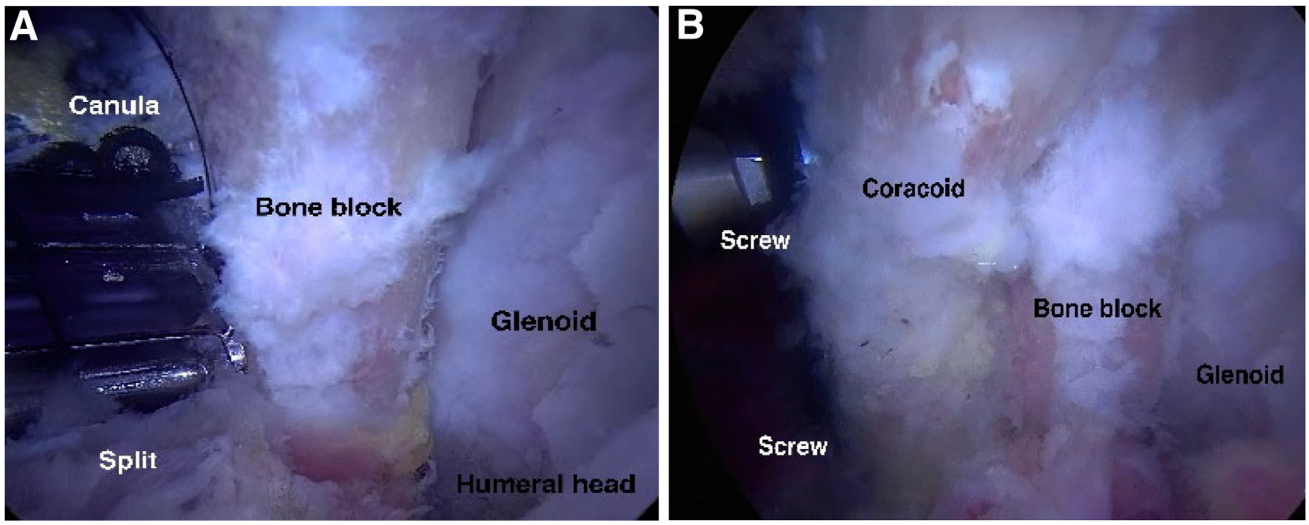

Fig 3. (A) The prepared bone iliac autograft is placed on the anterior surface of the glenoid through the subscapularis split and temporary fixed with the pins. (B) Final fixation of the osteotomized coracoid process with a complex of tendons and a graft from iliac crest to the anterior edge of the glenoid with screws.

Table 1. Advantages and Limitations

Advantages	Limitations
The presence of a "hammock effect" sling- effect limits pathologic anterior shift of the humeral head	Severe osteoporosis of the glenoid can increase the risk of migration of the construction
Compensates for bone defects of the anterior glenoid with more than 40% tissue deficiency	Adapting the contact surfaces of the glenoid and 2 autografts can be challenging
Precise positioning of grafts in relation to the glenoid articular surface	Risk of osteolysis and nonunion
Minimizes any trauma to the surrounding soft tissues, prevents scarring, and shortens the rehabilitation period	

equipment, drugs, or supplies provided by Mikayelyan University Hospital and a relationship with Mikayelyan University Hospital that includes: paid expert testimony.

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