Technical Note

Arthroscopic Autologous Iliac Bone Grafting With Double-Row Elastic Fixation and Double Antirotating Anchors for Recurrent Anterior Shoulder Dislocation With Massive Glenoid Bone Defect

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Abstract: The management of recurrent anterior shoulder dislocations with massive glenoid bone defects typically involves arthroscopic intervention. Autologous iliac bone grafting with double-row elastic fixation reportedly yields excellent outcomes. In this article, we introduce a specialized technique for iliac bone grafting that uses double-row elastic fixation and double antirotating anchors. Implementation of this technique prevents the occurrence of iliac graft rotation.

Surgical methods of bony reconstruction for treating recurrent anterior shoulder dislocation include the Latarjet, Bristow, and Eden Hybinette methods, which require open or arthroscopic surgery.[1-11] Exposing the anterior glenoid during open surgery is associated with an increased risk of muscle and nerve damage, affecting patient prognosis.[8,9,12,13] In contrast, arthroscopy allows for clear visualization of the bone block in relation to the glenoid, allowing the bone block to be precisely placed.[14] Fixation methods include rigid fixation, relying on screws, and elastic fixation, relying buttons.[1,15,16] Rigid fixation can cause hardware-related complications such as screw impingement, screw breakage, or suprascapular nerve injuries.[10-12,17] Elastic fixation, preferred by clinicians, mitigates these problems. However, in elastic fixation, using buttons to secure the free iliac bone can be problematic, leading to bone block rotation and displacement.[18-20] This issue is related to (1) the placement of the bone block during surgery, (2) the micromovement of the bone block in the early postoperative period, and (3) lack of conjoint tendon suspension during elastic fixation coracoid grafting.[8,10,21] Poor bone block placement may lead to increased bone block resorption or delayed rehabilitation.[22] While long-term patient impact remains unclear, precise bone block placement remains the primary aim of clinicians. Inexperienced surgeons often struggle with accurate graft placement. To address placement-related issues, several improvements have been implemented, such as using guides to accurately place the bone block and antirotation anchors to enhance stability.[1,7,23,24]

Herein, we describe our technique involving the use of a bone tunnel locator for precise bone tunnel and block placement. We preset the external lead and introduce the bone block under arthroscopy (Smith & Nephew), creating holes in both the south and north ends of the bone block. Two antirotation anchors (Johnson & Johnson) are threaded with sutures (Johnson & Johnson) to improve on the original surgical technique. Sutures on 2 additional anchors are used to facilitate Bankart repair, fixing the joint capsule while keeping the bone graft in the extra-articular position. This aids in late-stage healing, reducing resorption and bolstering joint stability. Our technique also reduces postoperative complications due to secondary resorption. No additional anchors are required.

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Step 1: Diagnostic Arthroscopy Examination

Surgery is performed with the patient under general anesthesia in the lateral decubitus position, and an interscalene block is administered. The affected shoulder is immobilized using a spider arm (Smith & Nephew). The arthroscope is inserted through the posterior portal, and additional anterior and anterosuperior portals are established using a needle (Johnson & Johnson) for instrumentation. A thorough intra-articular inspection of the glenohumeral joint is systematically conducted to assess the conditions of the labrum, long head of the labrum, subscapularis muscle, and supraspinatus tendon. Subsequently, the arthroscope is transferred to the anterosuperior portal to evaluate glenoid bone defects and determine the size of the iliac bone graft (Fig 1).

Step 2: Iliac Graft Harvesting Preparation

The iliac crest is incised 2 cm posterior to the anterosuperior iliac spine. A bone block measuring 2 × 1 × 1 cm is harvested from the anterior iliac crest and subsequently drilled. A double EndoButton (Smith & Nephew) is initially installed, and bilateral traction lines (Johnson & Johnson) are drilled to serve as fixation points for the antirotation line (Fig 2).

Step 3: Glenoid and Bony Tunnel Preparation

The arthroscope is inserted into the anterosuperior portal for visualization and then moved to the anterior portal for surgical procedures. The anterior glenoid is mobilized to the 6-o'clock position, followed by gentle traction on the anterior capsule-labrum complex until it can be easily reduced. Subsequently, the anterior glenoid is prepared and abraded using a rasp (Johnson & Johnson). A guide pin (Johnson & Johnson) is used to create a bone tunnel from the posterior to the anterior aspect of the glenoid, parallel to its articular surface, and positioned 1 cm below it. The exit point of this bone tunnel in the anterior aspect is located at the 4-o'clock position. Once the positioning is confirmed to be accurate, a 4.5-mm cannulated drill completes the preparation of the bone tunnel.

Step 4: Graft Passing and Fixation

The anterior portal is slightly expanded to facilitate introduction of the bone graft into the joint. Subsequently, both the graft and prepared EndoButtons are inserted into the articular space. Next, we retract the posterior EndoButton from the bone tunnel toward the posterior aspect of the glenoid. After ensuring the proper positioning of the iliac graft, both EndoButtons are securely tightened and knotted. To prevent the graft from rotating, 2 double-wire anchors are placed at the 5-o'clock and 3-o'clock positions, and 1 wire is used to fix both the upper and lower ends of the graft. The remaining wires from these anchors are used for Bankart repair. Additionally, 2 extra anchors are positioned at the 4-o'clock and 2-o'clock positions to comprehensively address any anterior Bankart injuries (Fig 3). Consequently, successful centralization of the humeral head within the glenoid cavity is achieved using arthroscopic visualization (Video 1).

Rehabilitation

The upper limb is immobilized in a brace with the shoulder maintained at 30° of abduction for an initial 6-week period. After 2 weeks, passive pendulum exercises are initiated to promote shoulder mobility. After 6 weeks, the brace is removed, and an active rehabilitation program, supervised by a physical therapist, is

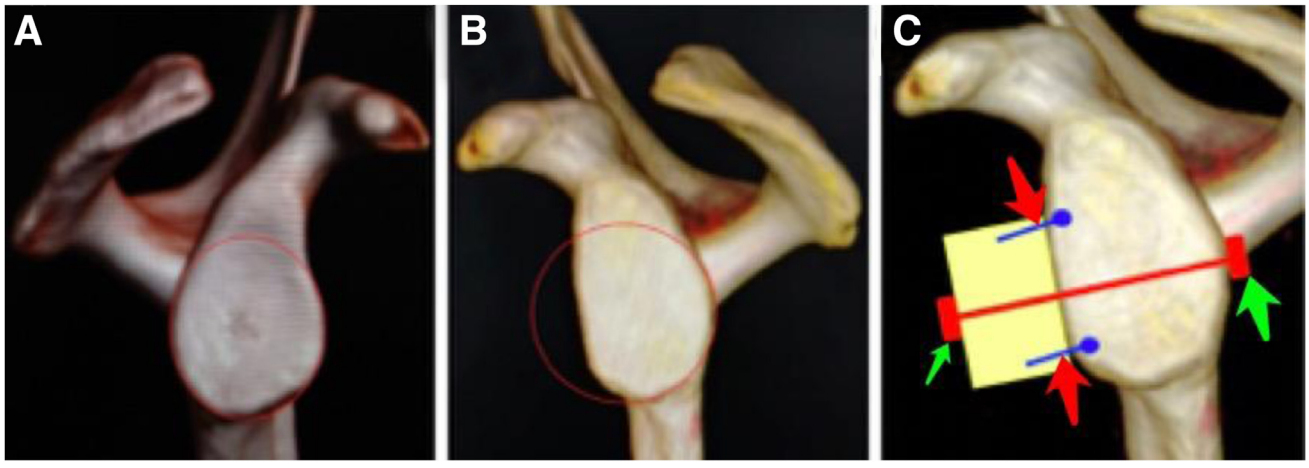

Fig 1. Preoperative computed tomography (CT) scan. The en face view of glenoid on 3-dimensional CT. A virtual circle (red circle) is drawn on the normal glenoid for reference (A). The same-sized circle on the contralateral glenoid shows the extent of the bone defect (B). Three-dimensional CT is used to simulate the placement of the iliac crest, antirotation anchors (Johnson & Johnson) (2 red arrows point), and EndoButtons (Smith & Nephew) (2 green arrows point). Three 2-mm wide holes, approximately 6 mm apart, are drilled through the graft (C).

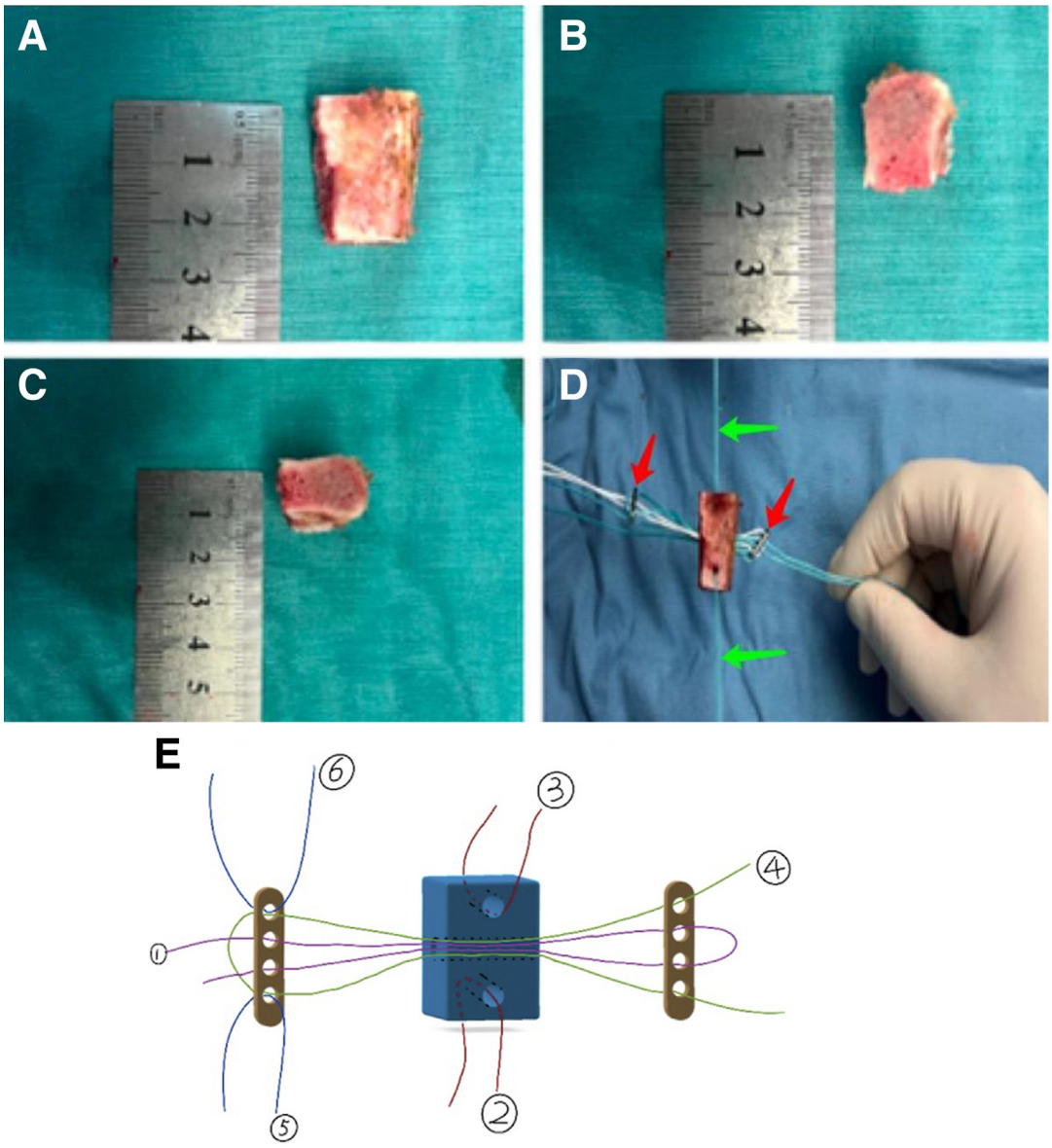

Fig 2. A 20 × 10 × 10-mm tricortical iliac crest graft is harvested from the anterior iliac (A-C). The bone block is bridged with the EndoButton (Smith & Nephew) (red arrows point) using high-strength sutures (Johnson & Johnson). The green arrows point to the sutures used to direct and tighten the antirotating anchors (Johnson & Johnson). (D) Sutures 1, 5, and 6 are used to pull the graft anteriorly to posteriorly, and suture 1 is used to tighten the bone. Sutures 2 and 3 are used to direct and tighten the antirotating anchors. Suture 4 is used to tighten the graft (E).

initiated. Participation in contact sports is prohibited for 6 months.

Discussion

The depth of the cavity in the shoulder has been suggested to serve as a predictive factor for stability.[25-27] Sigrist et al.[25] introduced the bony shoulder stability ratio (BSSR), based on glenoid cavity depth and curvature, as a quantitative measure to assess shoulder stability. Previous studies have demonstrated that bone grafting procedures may improve BSSR. Furthermore, cases involving critical bone loss may necessitate the use of bone grafting techniques as the sole means of restoring shoulder stability.[28]

Recent cadaveric studies have reported that bone grafting can enhance shoulder stability and restore anterior glenoid bone loss.[29] Biomechanical research further suggests that autologous iliac bone graft procedures can improve long-term anterior shoulder stability.[30] Arthroscopic iliac bone grafting has also demonstrated excellent clinical and radiologic outcomes without significantly limiting external rotation.[1,31,32]

Compared with other fixation techniques, elastic fixation for iliac bone grafting offers advantages in

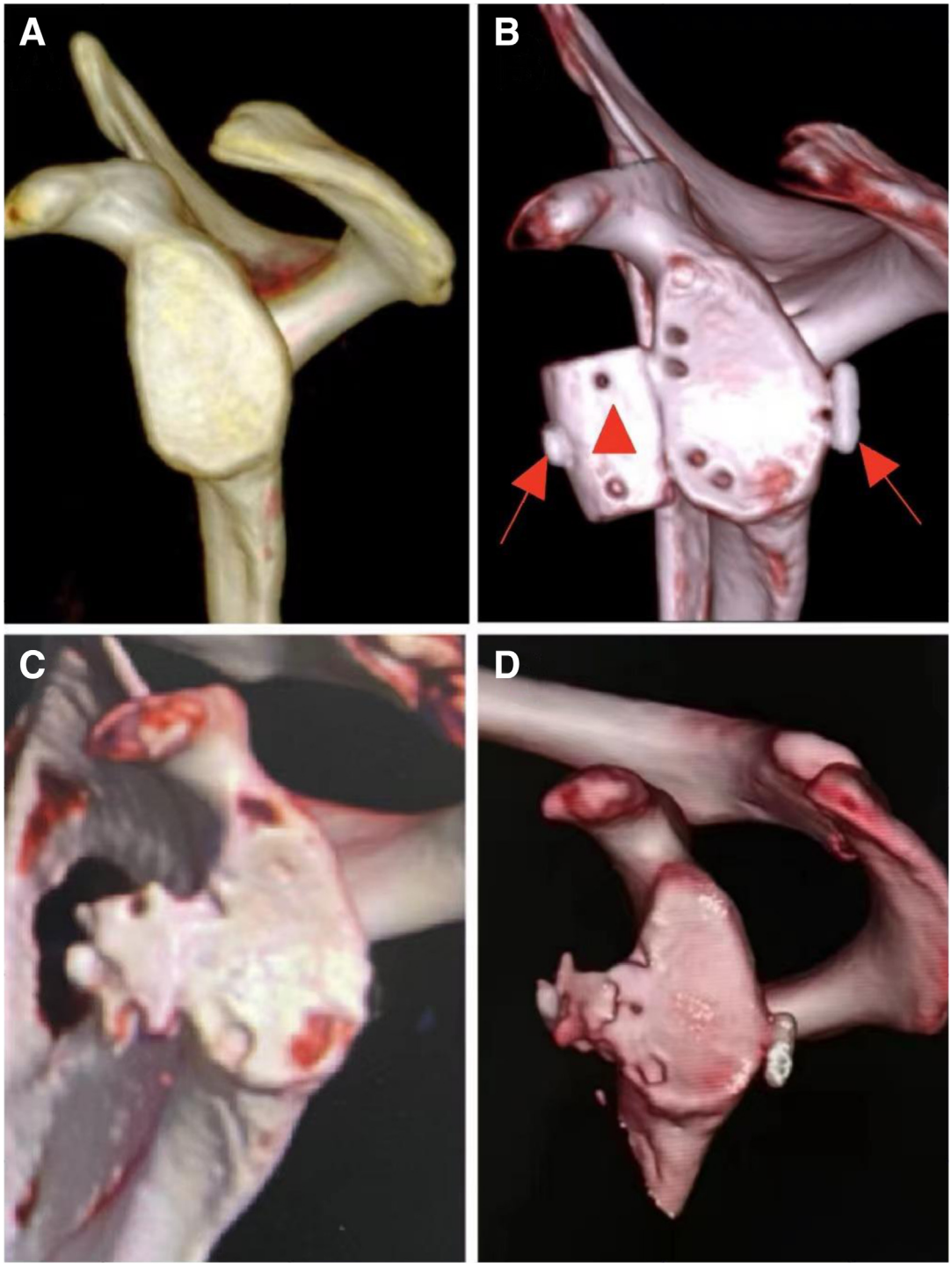

Fig 3. The en face view of a glenoid on 3-dimensional computed tomography (CT) images of the left shoulder preoperatively (A) and postoperatively (B). Follow-up CT showing the recovered pear-shaped structure (C, D). The red triangle shows the position of the iliac graft. The left red arrows point to the EndoButton (Smith & Nephew), which is anterior to the iliac bone graft (B). CT images taken 3 months postoperatively showing good position of bone block and EndoButton (C). CT images taken 7 months postoperatively showing a well-healed glenoid and well-positioned graft (D).

terms of promoting good bone remodeling and preserving the original anatomic structure of the shoulder joint.[22,33,34] Numerous studies have reported favorable clinical outcomes and significant improvements in functional scores after elastic fixation for iliac bone grafting.[11,14,16,28,35] Therefore, we propose that nonrigid fixation (without screws) could be considered a safe and effective alternative for patients with

Table 1. Advantages and Disadvantages of the Technique

Advantages	Disadvantages
The iliac graft can provide sufficient glenoid coverage, ensuring favorable surgical outcomes.	The technique has a relatively long learning curve.
Using 2 antirotation anchors for iliac graft fixation ensures enhanced stability, antirotation, and effective promotion of iliac bone block healing.	The arthroscopy surgical procedure is challenging.
Using our specialized guide in our technique will significantly enhance the precision and convenience of surgical procedures.	Nonunion of the bone graft.
No residual hardware is observed following bone block healing, and no adverse effects on the surrounding tissues are noted.	Lesions around the iliac crest harvesting site.

significant glenoid bone deficiency. Moreover, elastic fixation demonstrated satisfactory bone graft healing and osseous incorporation (Table 1).[36]

Table 2. Pearls and Pitfalls

Pearls	Pitfalls
The size of the iliac bone block should be determined based on the extent of the glenoid defect observed on preoperative computed tomography scans. Intraoperatively, an appropriately large iliac graft can be harvested to ensure sufficient bone coverage and prevent postoperative graft resorption and reduction of glenoid function.	The excessive size of the graft will pose challenges to intraoperative procedures.
The precise placement of the bone tunnel should be meticulously verified.	The placement of the guide pin can be confirmed through fluoroscopy, even after insertion. A specific guide designed for bone tunnel preparation should be used.
Due to the extensive number of sutures involved, we advise using distinct colors for facilitating intraoperative identification and manipulation. Effective suture management plays a pivotal role in ensuring the success of this procedure.	If the sutures are indistinguishable, achieving graft fixation becomes challenging.
Three to 4 anchors can be positioned anteriorly to the glenoid, with adjustments based on the dimensions and placement of the iliac graft as well as bone tunnel orientation.	Particular attention should be paid when positioning the anchor at the 4-o'clock position, to prevent inadvertent penetration of the bone tunnel and inadvertent disruption of the EndoButton (Smith & Nephew) suture.

Regardless of the type of graft used, nonrigid fixation with a bone block resulted in minimal instability and revision recurrence rates.[1,18,23,28,32,36-38] Martinez et al.,[32] who used 2 cortical suture buttons, achieved satisfactory clinical results and a low recurrence rate. However, postoperative dislocation and subluxation may still occur if the bone graft rotates in the joint.[22] Using antirotation anchors can prevent the movement of the iliac bone graft within the joint, providing firmer fixation that reduces the incidence of subluxation and dislocation.[28] Currently, most surgeries use a single antirotation screw for reinforcement.[16,23] Our technique introduces a method using 2 antirotation screws to better reinforce the graft on the glenoid rim while preventing rotation more effectively than a single anchor. At the same time, the sutures in the bone tunnel fixed with the antirotation anchor are perpendicular to the sutures in the bone tunnel through the EndoButton. This may prove beneficial for subsequent bone graft remodeling.

In this study, we introduce an arthroscopic autologous iliac bone grafting technique with double-row elastic fixation and double antirotating anchors for the management of recurrent anterior shoulder dislocation with massive glenoid bone defects. We propose that the additional antirotating anchors can effectively reduce the recurrence of anterior shoulder dislocations, leading to favorable long-term outcomes. The use of elastic fixation both mitigates hardware complications and minimizes potential risks such as tissue damage and neurovascular injury. Moreover, performing the procedure arthroscopically circumvents the limitations of open surgery (Table 2).

Disclosures

The authors report no conflicts of interest in the authorship and publication of this article. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

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