Technical Note

Arthroscopic Posterior Bone Block Stabilization Using a Tricortical Autograft of the Ipsilateral Scapular Spine

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Abstract: Posterior bone grafting represents an emerging therapeutic approach for addressing recurrent instability in the posterior shoulder, particularly when coupled with substantial glenoid bone loss. Although not as prevalent as anterior instability, recent years have witnessed the development of numerous open and arthroscopic bony reconstruction methods. A technical gold standard for posterior bone grafting remains undefined, leading to ongoing advancements in bone grafting techniques. In response to past challenges associated with screw fixation, metal-free arthroscopic fixation procedures have been introduced to the realm of bone grafting. These metal-free methods often entail intricate transglenoid drilling, which poses potential surgical complexities and risks to both posterior and anterior soft tissues, as well as neurovascular structures. Therefore, we introduce an arthroscopic approach to posterior bone grafting using PEEK (polyether ether ketone) anchors with interconnected sutures and a scapular spine autograft. This method overcomes previous hurdles by facilitating the restoration of the posterior glenoid bone stock with precise positioning and secure fixation of the tricortical scapular spine bone autograft.

In recent scholarly works, a multitude of methods have been elucidated for arthroscopic bony stabilization of the anterior part of the glenoid. Given the relative infrequency of posterior instability compared with its anterior counterpart, there is a discernible scarcity in the literature concerning posterior bone block augmentation. Situations do arise, however, in which posterior bony stabilization becomes requisite, primarily in cases characterized by glenoid bone insufficiency. Conventional open surgical approaches often entail significant trauma to the infraspinatus tendon.

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The procurement of autografts from the iliac crest is the current gold standard and is associated with a low rate of complications. Nonetheless, patients potentially would like to avoid a second surgical site if possible. Allograft bone blocks, although a viable alternative, are susceptible to impaired healing, substantial bony resorption, and albeit with a low probability, the potential for disease transmission from the donor.[1] This is why our goal is to obtain an autograft that minimizes local morbidity in the donor area, leading to the use of a scapular spine autograft, which has been described for anterior stabilization already.[2] In this technical note, we describe the use of the scapular spine as a viable graft for posterior stabilization.

The use of metallic screws for bone block fixation carries the risk of profound cartilage damage, implant loosening, and consequent glenoid structural deterioration.[3] Simultaneously, achieving precise screw placement presents an intricate challenge. As described by Hachem et al.[4] and Boileau et al.,[5] metal implants can lead to accelerated bone resorption and residual pain, these being the main reasons for our attempt to use metal-free reliable implants that can provide stable fixation. The PEEK (polyether ether ketone) suture anchor meets our requirements. Moreover, transglenoid drilling can be avoided with these anchors.

Recently, Ameziane and Scheibel[6] published a technical note on anterior bone block stabilization with the interconnecting anchors described later. The use of the same method for posterior stabilization appears attractive in terms of a metal-free all-arthroscopic technique, with the difference of the use a tricortical scapular spine graft instead of an iliac crest allograft.

This article introduces an all-arthroscopic approach to posterior bone block augmentation, devoid of metallic components. This technique amalgamates the advantages of bony reconstruction while circumventing the disadvantages associated with iliac crest graft harvesting. It is important to note that this method is considered to be readily replicable within the realm of arthroscopic procedures.

Surgical Technique

A detailed description of the surgical technique can be seen in Video 1.

Indication and Preoperative Planning

The described technique is suitable for patients with recurrent posterior instability, in whom posterior bony glenoid rim deficiency can be found (type B2 instability according to Moroder and Scheibel[7]). Hyperlaxity and a reverse Hill-Sachs impression can also often be found in these cases. Preoperative imaging includes radiography and magnetic resonance imaging, as well as computed tomography (CT) scans (Figs 1 and 2). Sometimes, a malunited posterior glenoid rim fracture can be found. The scapular spine also needs to be imaged radiographically in terms of preoperative planning.

Patient Positioning and Operative Setup

For the arthroscopic procedure, the patient is administered general anesthesia, is examined to assess instability under anesthesia, and is placed in the lateral decubitus position with lateral (5 kg) and vertical (6 kg) traction to the arm. Standard preparation and draping are carried out. Figure 3 shows the intraoperative patient positioning.

Portals and Diagnostic Arthroscopy

A posterior portal is used for primary access to the joint, and a diagnostic arthroscopy is performed. Usually, a posteroinferior bony glenoid defect, as well as a reverse Hill-Sachs impression in the usual location, can be seen (Fig 4A). If present, a posterior bone fragment healed in the wrong position can also be seen during the diagnostic arthroscopy. An anteroinferior working portal with a twist-in cannula and an anterosuperior viewing portal are established, and a second twist-in cannula is positioned posteriorly.

Glenoid and Bone Graft Preparation, Insertion, and Fixation

The remaining posterior labrum is detached and the scapular neck is prepared using a burr. A malunited fragment is left in place to provide an additional balcony support for the inserted bone graft (Fig 4B), if present. If the fragment does not allow a sufficient support, it is removed with a burr before the graft is inserted. The necessary size of the bone graft is measured (Fig 4 C and D) considering any present malunited fragments, to appropriately sculpt the graft. The graft is harvested as a tricortical bone block from the scapular spine via a short open approach using a saw and chisel. Care is taken to harvest the bone block from the widest part of the scapular spine, as shown in Figure 5. For graft harvesting and preparation, it is crucial to evaluate the morphology of the scapular spine on preoperative imaging (CT scan). The resulting defect

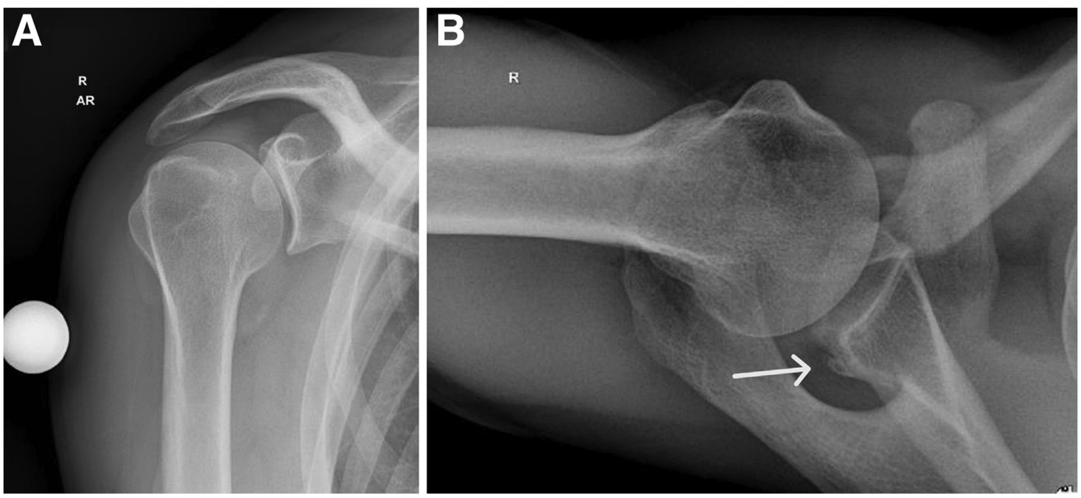

Fig 1. Preoperative radiographic imaging of right shoulder: anteroposterior (A) and axial (B) views. The mis-healed bone fragment (arrow) can be seen at the posterior part of the glenoid. AR, external rotation; R, right.

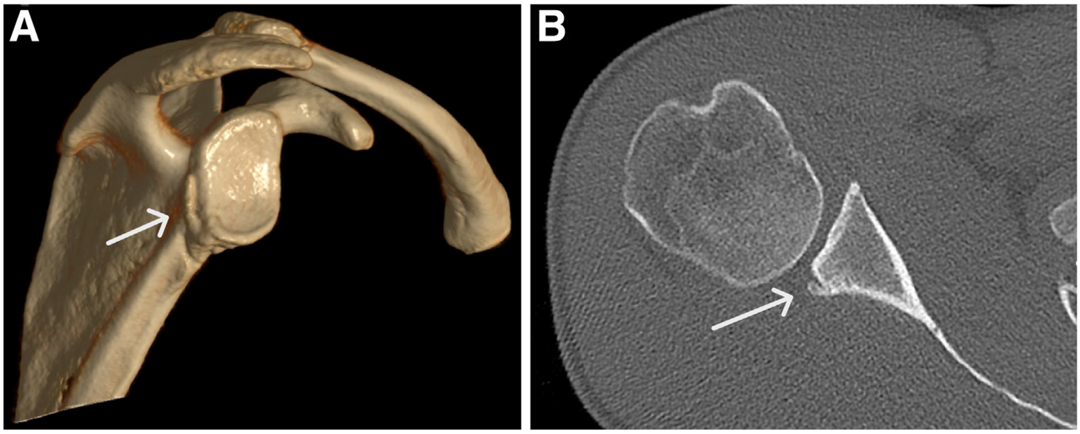

Fig 2. Lateral view of a 3-dimensional computed tomography image of the right scapula (A) and axial (B) view of the same scan. The mis-healed bone fragment (arrows) can be seen at the posterior part of the glenoid.

can be filled with an allogeneic iliac crest graft by a press-fit technique, and the wound is rinsed and closed by layers.

At the posterior rim of the glenoid, the insertion holes for 2 interconnecting knotless PEEK Corkscrew anchors (Arthrex) are prepared using a punch and tap. The anchors are then inserted, keeping a distance of 10 mm between the anchors and a 5-mm offset to the glenoid to ensure an optimal fixation strength to the bone graft (Fig 4E). Two holes at the same distance must be drilled through the graft. The cortical surfaces of the tricortical bone block should be positioned posteriorly and laterally so that the spongy surface faces the glenoid defect. This leads to optimal healing and will keep the sutures from cutting through the bone.

For insertion of the graft, the twist-in cannula must be removed. The portal is dilated using scissors, and the index finger test is used to confirm the appropriate size of the passage. Nitinol wires are used to shuttle the sutures through the bone block.

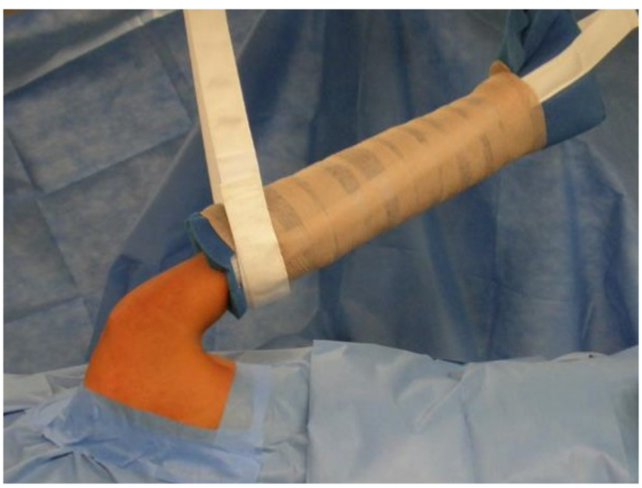

Fig 3. Intraoperative patient positioning in lateral decubitus position (right shoulder).

In the next steps, the anchors are being interconnected. The blue suture of one anchor goes through the black-and-white suture loop of the other anchor and vice versa. The bone block is being adapted to the glenoid by gently pulling the 2 sutures alternately. Finally, a wire tensioner is used to tighten the sutures up to 40 to 60 N to the bone, and the sutures are knotted as backup fixation (Fig 4F). The bone block is co-planed to the surface of the glenoid, and finally, the posterior labrum is readapted using 2 single-loaded all-suture anchors. This leads to an anatomic bony reconstruction and highly stable fixation without the use of any metal. Figure 6 shows a postoperative CT scan of an anatomic glenoid reconstruction.

Rehabilitation

Postoperatively, an external rotation brace (15°) is applied, and brace wear is recommended for 4 weeks. After 6 weeks, free passive range of motion is allowed and active range-of-motion exercises can be initiated. Further rehabilitation recommendations are shown in Table 1.

Discussion

Although the prevalence of posterior shoulder instability is lower than that of anterior instability, the management of posterior bony defects has become more and more subject to research during the past decade. The management of recurrent posterior shoulder instability has seen various approaches, with the use of iliac crest bone graft (ICBG) procedures gaining significant attention as a potential solution.

A spectrum of recurrent instability rates follow these procedures, with arthroscopic studies reporting rates ranging from 0% to 12.5% and open studies reporting rates ranging from 0% to 36.4%.[8] The authors of the quoted article could also find more evidence of functional improvements with arthroscopic procedures than

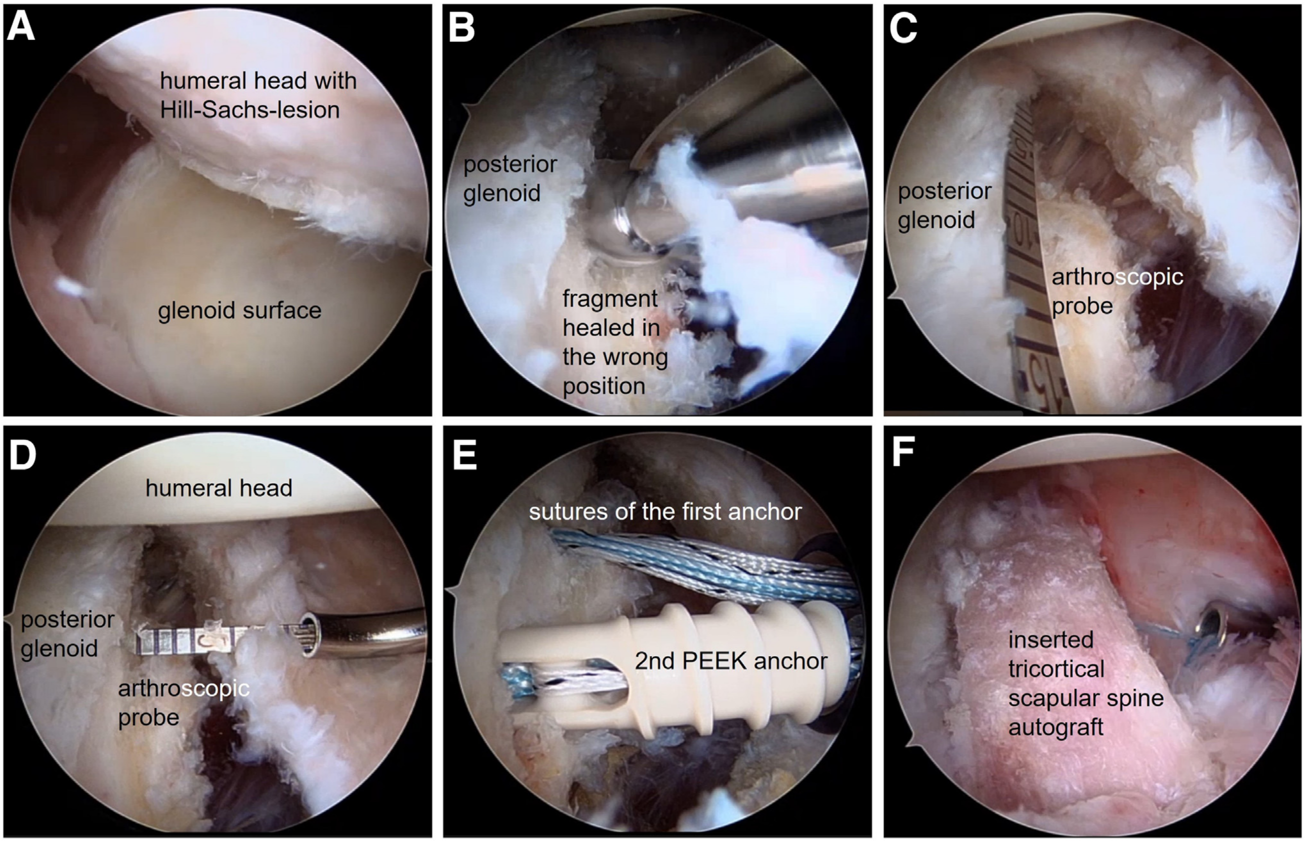

Fig 4. Arthroscopic images of right shoulder with patient in lateral decubitus position. (A) View from posterior. The glenoid surface and a Hill-Sachs impression in the typical position can be seen. (B) View at posterior part of glenoid. A mis-healed fragment is being debrided. (C, D) The defect at the posterior glenoid is measured in preparation of harvesting the graft. (E) The first anchor has already been positioned, the second PEEK anchor is being inserted. (F) The inserted tricortical scapular spine autograft is positioned at the posterior glenoid, and the interconnected sutures are tightened using a wire tensioner.

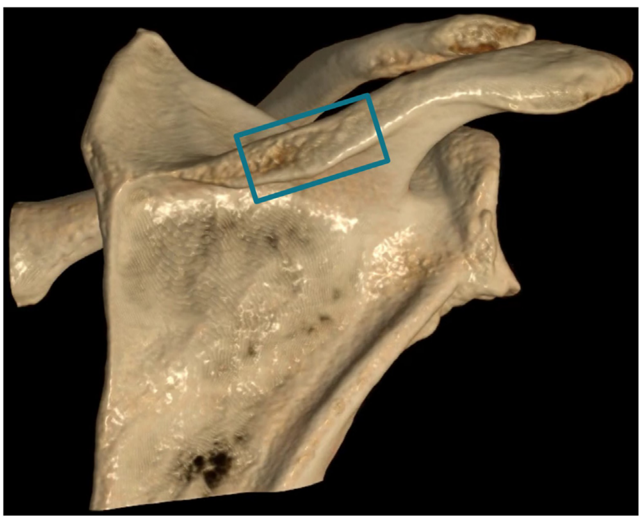

Fig 5. Three-dimensional computed tomography imaging of right scapula viewed from posterior. The rectangle marks the widest part of the scapular spine, which will be used as a tricortical bone graft.

with open approaches. This variability suggests that the choice of surgical technique may impact the risk of recurrent instability, indicating a favorable outcome after arthroscopic surgery, as used in our technique. However, it is important to acknowledge that patient selection and surgeon expertise may also play significant roles in these outcomes.

Furthermore, it is crucial to acknowledge the concerns raised regarding hardware complications, which were observed in a substantial portion of patients after ICBG procedures with screw fixation.[8,9] Specifically, the prominence of screws within the (partially resorbed) graft can be encountered in up to 67% of patients, which puts the infraspinatus tendon at risk and often requires hardware removal.[8,10,11] In accordance with this, Camenzind et al.[12] reported a high rate of reoperations due to symptomatic screw irritation (37%) in their minimum 5-year follow-up study after ICBG. This outcome emphasizes the need for careful postoperative monitoring and the consideration of alternative fixation methods to mitigate hardware-related complications.

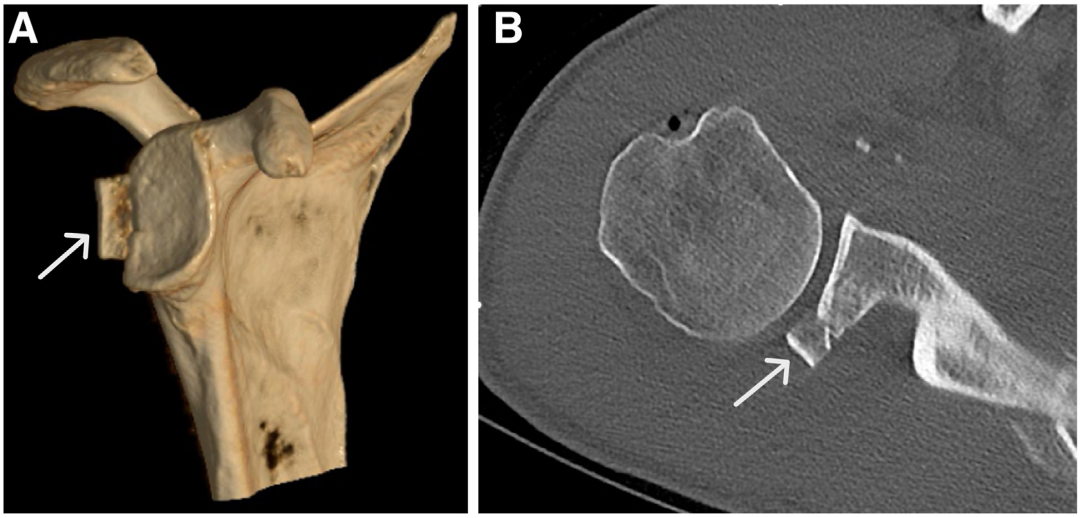

Fig 6. Postoperative imaging result. (A) Three-dimensional image of right glenoid. The bone block (arrow) can be seen at the posterior part of the glenoid. (B) Axial view of same computed tomography scan with bone block posteriorly (arrow).

In accordance with the trend leading toward metal-free fixation methods as promoted by Boileau et al.[13] and Hachem et al.[14] for posterior bone block stabilization, we avoided the use of metal and instead favored PEEK implants with interconnecting sutures as a reliable method for securing the bone graft to the glenoid defect. This approach aligns with the successful application of this method to address anterior shoulder instability by Ameziane and Scheibel.[6] The use of knotless PEEK anchors for monocortical fixation of the bone graft offers a safe and straightforward means of anchor insertion, all while maintaining direct visualization to reduce the risk of potential harm to soft tissues and neurovascular structures. Furthermore, by minimizing the suture distance between the anchors and the bone graft, we enhance the fixation's strength, thereby mitigating potential complications during any additional capsulolabral refixation procedures.

Despite the fact that iliac crest graft harvesting has an overall low complication rate, many patients wish to avoid a second surgical site distant from the shoulder, considering the possible complications associated with iliac crest autografts, such as donor-site infection, blood loss, nerve injury, pain, and immobility. One of the advantages of our technique therefore is the avoidance of a second surgical site. Moreover, striving to steer clear of stabilizations via allografts because of their drawbacks, we have applied the use of the scapular spine as a viable autograft option. This choice might carry a lower risk of complications and exhibits commendable anatomic qualities[14] and donor-site benefits, and it has been successfully administered before.[2,15] As Rohman et al.[16] were able to show, the scapular spine, when harvested from the widest part, approximately 5 cm laterally from the medial scapular margin, offers a sufficiently sized graft in most cases and has comparable dimensions to grafts that can be harvested from the coracoid and iliac crest.

Although the arthroscopic bone grafting technique provides a consistent and relatively less soft tissue—traumatizing approach for addressing posterior bone loss, it is essential to acknowledge the learning curve associated with arthroscopic procedures. Additionally, careful attention should be paid to the knotless tensioning mechanisms, which must be gradually tightened to prevent the formation of soft-tissue bridges and to avoid premature blockage, ensuring proper positioning and secure fixation of the graft. Pearls and pitfalls of our technique are presented in Table 2, and advantages and disadvantages are listed in Table 3.

Table 1. Postoperative Rehabilitation Protocol After Posterior Bone Block Stabilization

Time	Recommended Kind of Motion	Recommended Range of Motion
Weeks 1-4	Passive	60° of flexion and abduction Free external rotation 30° of internal rotation
Weeks 5 and 6	Passive	90° of flexion and abduction Free external rotation Free internal rotation

Table 2. Pearls and Pitfalls

Pearls
Measure the necessary graft size before harvesting.
Use the index finger test to ensure a sufficiently sized insertion portal for the bone block.
Use a wire tensioner to achieve maximum fixation strength.
Additionally perform a labral repair on top of the bone block to maximize stability.
Pitfalls
Pay attention to insert the PEEK anchors medially enough to avoid positioning the graft too laterally and to ensure that the cortical surface remains sufficiently intact after co-planing.
Be sure to tighten the interconnecting sutures sequentially and pay attention to careful suture management to avoid premature suture blocking.

Table 3. Advantages and Disadvantages

Advantages
Reduced donor-site morbidity by avoiding harvesting from second surgical site (e.g., iliac crest)
Impaired healing by avoiding allografts
Metal-free fixation technique
Smaller wounds and less soft-tissue damage owing to arthroscopic procedure
Avoidance of transglenoid drilling
Availability of graft close to surgical site
Disadvantages
Potential bone graft resorption as seen in most grafting techniques
Requirement for arthroscopic skills, with associated learning curve
Potential damage to infraspinatus muscle during graft insertion

In conclusion, the management of recurrent posterior shoulder instability through bone grafting procedures is a topic of ongoing interest and debate. With the surgical technique presented in this technical note, we hope to combine various benefits of the aforementioned procedures while avoiding several complications.

Disclosures

P.M. reports a consulting or advisory relationship with Arthrex. All other authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

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