Technical Note

Arthroscopic Humeral Head Hill-Sachs Grafting With Talus Allograft

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Abstract: The presence of a Hill-Sachs lesion is a known risk factor for recurrent shoulder instability. Many procedures have been described for the treatment of off-track Hill-Sachs lesions; however, each of these techniques is fraught with potential disadvantages and complications. In this Technical Note and accompanying video, we describe our technique for arthroscopic treatment of a Hill-Sachs lesion with talus osteochondral allograft. This technique recreates native humeral head anatomy with a highly congruent graft without altering the biomechanics of the glenohumeral joint.

Anterior shoulder instability is a common reason for shoulder pain and dysfunction, usually caused by trauma to the arm in an abducted and externally rotated position.[1] Dislocations or subluxations of the glenohumeral joint often lead to bony lesions of the glenoid and humeral head.[2-4] The Hill-Sachs lesion is defined as the defect left in the posterolateral humeral head after it comes into contact with the more dense, cortical bone of the glenoid during an anterior instability event.[5] It has been shown that the presence of a Hill-Sachs lesion is a risk factor for recurrent shoulder instability.[6-9] A Hill-Sachs lesion is defined as "off-track" when its size and location cause it to engage with anterior glenoid rim, leading to a sensation of subluxation for the patient.[10] A variety of treatment options have been described for the off-track Hill-Sachs lesion, up to and including remplissage,[11,12] humeroplasty,[13] rotational humeral osteotomy,[14] and arthroplasty.[15] Each of these techniques can be successful in various clinical scenarios, although none are without considerable drawbacks.[1]

Reconstruction of the humeral head with osteochondral allograft has emerged as an intriguing option for the treatment of large, off-track Hill-Sachs lesions. The advantages of this technique are rooted in its capacity to restore of the native contour of the humeral head while maintaining normal shoulder range of motion. Although limited by sample size, several clinical studies suggest favorable outcomes for patients treated with this technique.[16-19] Although originally described as an open procedure, the development of the osteochondral autograft transfer system (OATS) procedure has afforded surgeons the ability to perform this procedure arthroscopically.[20,21] Furthermore, human talus allograft has shown promise as a highly congruent source for anatomic humeral head reconstruction.[22] In this Technical Note, we describe our preoperative evaluation, surgical technique, and postoperative rehabilitation protocol for the arthroscopic treatment of an off-track Hill-Sachs lesion with human talus allograft (Video 1).

Preoperative Evaluation

Initial workup for any patient with suspected shoulder instability should include a thorough history and physical examination. In most cases, patients report experiencing a dislocation event caused by trauma to an abducted and externally rotated shoulder.[23] Patient age, medical history, and activity level are all crucial considerations. Patients should be queried on the degree of their discomfort and the presence or absence of mechanical symptoms. The overall number and frequency of instability events is also useful in determining the severity of their pathology. A detailed examination of the appearance, range of motion, strength, and neurovascular status of the affected extremity should be

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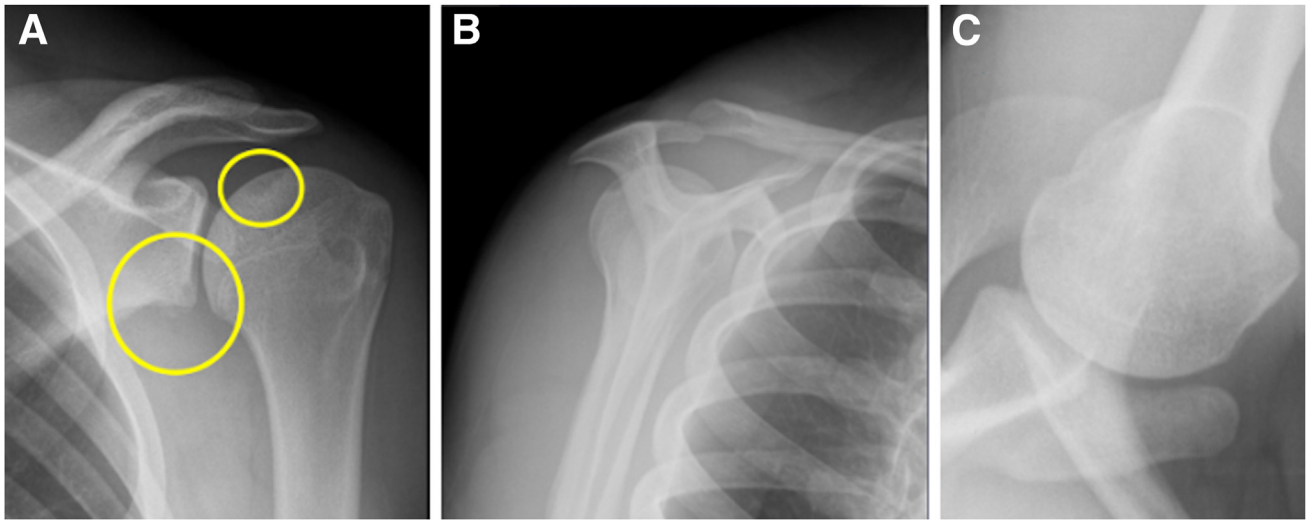

Fig 1. Preoperative radiographs of the left shoulder demonstrating Hill-Sachs lesion of the posterolateral humeral head (small yellow circle) with anteroinferior glenoid bone loss (larger yellow circle). Views include Grashey (A), scapular-Y (B), and axillary (C).

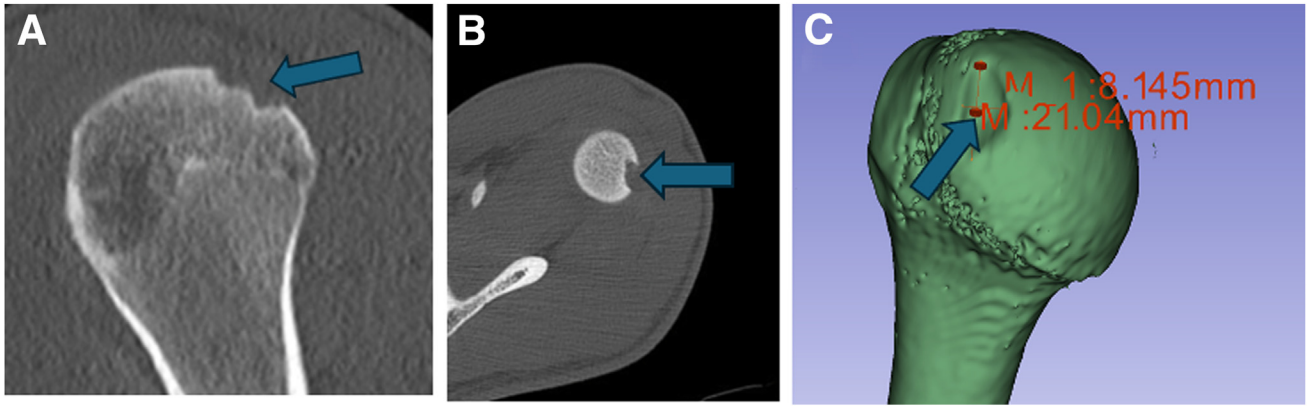

Fig 2. Preoperative computed tomography scan of the left shoulder further characterizing posterolateral humeral head bone loss on sagittal (A), axial (B), and 3-dimensional reconstruction (C) views. Arrows are pointed towards the Hill-Sachs lesion.

conducted and compared with the contralateral side. Providers should test for apprehension and evidence of baseline hyperlaxity.[24]

Several imaging studies can be useful in determining the degree of osseous deficiency and presence of concomitant pathology. Standard shoulder radiographs (anteroposterior, lateral, and axillary views) are obtained initially to assess for the presence of gross glenoid or humeral head bone loss (Fig 1). Computed tomography scans with 3-dimensional reconstructions typically provide the most accurate and measurable depiction of bony defects[25,26] (Fig 2). Magnetic resonance imaging also can be used to assess for bone loss while offering a more detailed assessment of concurrent soft tissue injuries.

Surgical Technique

A regional block is performed in the preoperative area. General anesthesia is induced, and the patient is placed in the lateral decubitus position with padding of all bony prominences. The upper extremity is then prepped and draped in the usual fashion. An examination under anesthesia is performed. Glenohumeral translation is quantified via the load and shift test, which is performed in the anterior-superior, anterior-middle, and anterior-inferior directions.

A diagnostic arthroscopy is performed with a 30° arthroscope through a standard posterior portal approximately 2 cm medial and 2 cm inferior to the posterolateral corner of the acromion. An anterior portal is created in the rotator interval with an outside-in technique by use of an 18-gauge spinal needle. Concomitant intra-articular pathology is treated in accordance with the preoperative plan adjusted for any new findings from the diagnostic scope.

Attention is then turned to the Hill-Sachs lesion (Video 1). The anterior portal is the viewing portal and

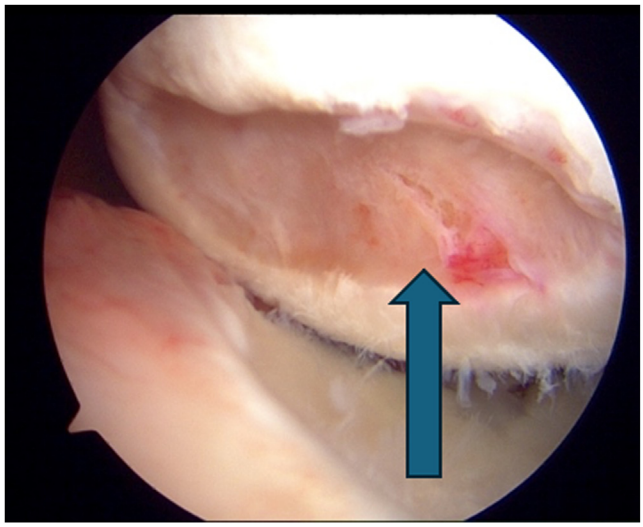

Fig 3. Arthroscopic photo of the left shoulder with camera coming through the anterior portal showing Hill-Sachs lesion of the posterolateral humeral head (arrow).

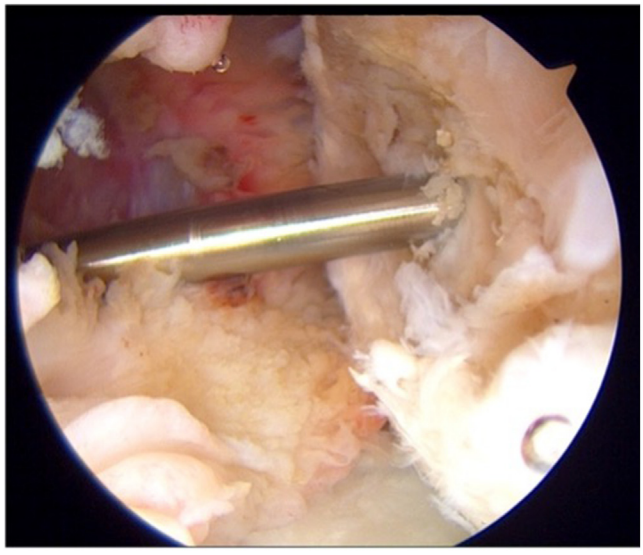

Fig 4. Arthroscopic photo of the left humeral head with camera coming through the anterior portal. A drill tip guide pin is placed through the posterior portal into the bone while staying perpendicular to the humeral head.

the posterior portal is the working portal. A chondroplasty is performed to debride the edges of the defect (Fig 3). The posterior portal is lengthened to accommodate instrumentation and placement of our plugs. Radiofrequency ablation is used to clear any soft tissue that could be interposed. The Small Joint OATS Kit (Arthrex, Naples, FL) is used for instrumentation. Sizers are used to measure the width and height of the recipient defect to determine the size of the plug(s) to be used. A drill tip guide pin is placed through the sizer into the bone while staying perpendicular to the humeral head (Fig 4). Great care should be taken to

Fig 5. Intraoperative clinical photo of the left shoulder in the lateral position showing that the surgeon has drawn the angle of the pin on the skin to ensure that later graft insertion does not deviate from this pin trajectory. Great care should be taken to maintain this trajectory so the plug recreates the native contour of the humeral head.

ensure that a plug placed in this trajectory will recreate the native contour of the humeral head. To ensure maintenance of this trajectory, the angle of the pin is drawn on the skin to ensure that later graft insertion does not deviate (Fig 5). A reamer is chosen on the basis of size of the plug to be used. The socket is reamed to the appropriate depth to reach subchondral bone (Fig 6).

The bone plug is procured from the fresh articular allograft talus on the back table (Fig 7). The plug is brought through the posterior incision and impacted into the reamed socket. This process is repeated if a second bone plug is required. When 2 plugs are required, the inferior plug is performed first as the superior plug can often obscure visualization of the inferior aspect of the defect. At this point, an assessment is made on the congruency of the humeral head and overall coverage of the defect (Fig 8).

The shoulder is drained, the portal sites are closed in the usual sterile fashion, and a sterile dressing is applied. The patient is placed in an abduction sling and

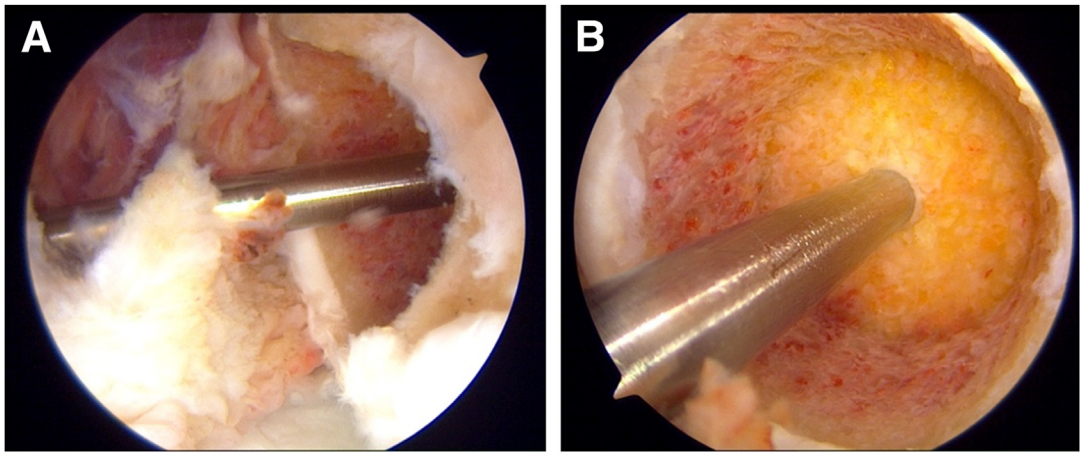

Fig 6. Arthroscopic photos of the left humeral head through the anterior (A) and posterior (B) portals showing the socket left by the reamer for graft insertion.

Fig 7. Clinical photos showing the talus allograft plug being procured on the back table. The surgeon can be seen securing the graft (A) and harvesting the plug (B).

taken to the recovery room. The patient is started in a standard anterior instability rehabilitation protocol. From 0 to 4 weeks postoperatively, patients are limited to pendulum exercises. From weeks 4 to 10, external rotation is allowed to 40° and slowly progressed to 60°. The sling is discontinued at 6 weeks and active range of motion is initiated. At week 10, full range of motion and strengthening is permitted. Provided full strength and range of motion is achieved, patients may return to noncontact sports at 3 months, followed by full-contact sports at 6 months (Table 1).

Discussion

Hill-Sachs lesions are a common finding after anterior shoulder instability and have proven to be a significant risk factor for recurrent instability. Many procedures have been described for the treatment of large, off-track Hill-Sachs lesions. However, each of these techniques is fraught with potential disadvantages and complications. Arthroscopic remplissage, although gaining in popularity because of its simplicity, has been shown to considerably limit external rotation.[27] Humeroplasty is theoretically intriguing, given its goal of restoring native anatomy; however, this procedure may only be possible

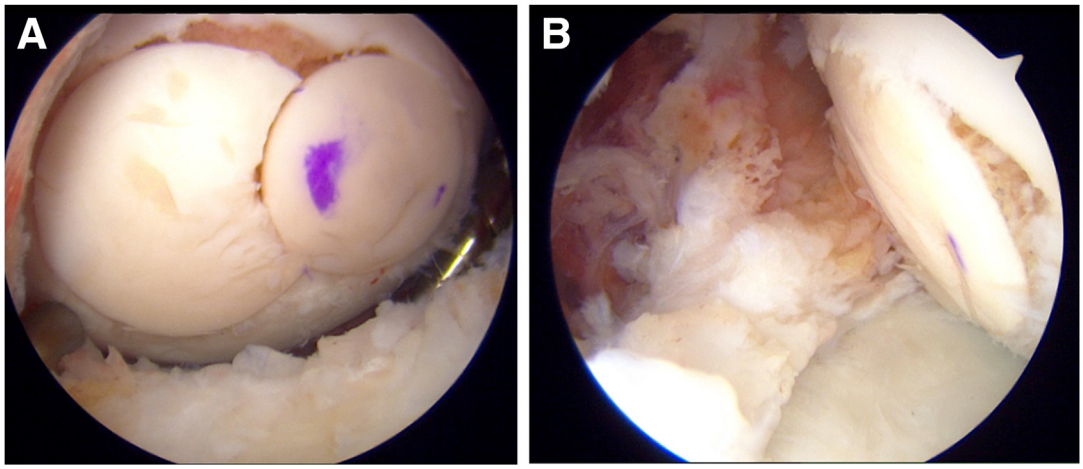

Fig 8. Arthroscopic photos of the left humeral head through the posterior (A) and anterior portals (B) demonstrating the appearance of the humeral head after 2 plugs are used to fill the Hill-Sachs defect. Once the graft(s) have been placed, it is important to make an assessment on the congruency of the humeral head and overall coverage of the defect.

Table 1. Pearls

- Placement of the guide pin should be as perpendicular to the bone as possible to ensure that the graft recreates the native contour of the humeral head.
- When 2 plugs are required, the inferior plug should be placed first, as the superior plug can often obscure visualization of the inferior aspect of the defect.
- Concomitant pathology (labral tears, glenoid defects) should be treated aggressively to further minimize the risk of recurrent instability.

Table 2. Advantages and Limitations

Advantages

- Osteochondral allograft recreates native humeral head anatomy without altering the biomechanics of the glenohumeral joint.
- Use of the OATS technique instead of a size-matched, en bloc graft facilitates a minimally invasive, arthroscopic approach.
- Talus osteochondral allograft offers a robust, highly congruent source of graft for treatment of humeral head defects.
- This technique does not require any hardware for fixation.

Limitations

- OATS for Hill-Sachs lesions has shown a high rate of graft resorption, although resorption has not been proven to affect clinical outcomes.
- Human talus allograft is expensive and may not be readily available to all providers.
- Use of allograft tissue carries the theoretical risk of disease transmission.

OATS, osteochondral autograft transfer system.

in the acute setting.[13,28] Rotational osteotomy comes with the considerable risk of nonunion or malunion.[14] Finally, arthroplasty is not a long-term solution for young patients because of the risk of prosthetic loosening over time.[29,30]

Osteochondral allograft of the Hill-Sachs defect restores native humeral head anatomy without disrupting glenohumeral biomechanics.[31] Several open techniques have been described for size-matched, en bloc allograft implantation.[32,33] Although this method has proven to be successful in limiting the risk of recurrent dislocation, the trauma caused by the open approach is a likely partially culpable for its relatively high complication and reoperation rate.[16] By using an OATS, our technique can be performed arthroscopically.

Historically, the use of allograft tissue for humeral head reconstruction necessitated a matched donor to recreate the recipient's natural articular contour. Because finding a donor match can often lead to prolonged wait times for potential recipients, recent interest has grown in the use of unmatched allograft tissue.[34] Talus allograft offers promise as a robust source of highly effective graft for the humeral head.[1] Computer modeling analysis has shown that the talar dome has a high degree of surface congruency to the humeral head.[22,35] Furthermore, the dense, weight-bearing surface of the talus allows for a more stable construct when contacting the glenoid.[36] For these reasons, talus allograft has been used for humeral head reconstruction for recurrent posterior shoulder instability.[36,37] However, to our knowledge, our study represents the first description of the use of human talus allograft to arthroscopically fill a Hill-Sachs lesion in the setting of anterior shoulder instability.

It should be recognized that this technique is associated with some disadvantages. In any procedure that uses human allograft, there is a theoretical risk of disease transmission. This procedure also carries the possibility of graft failure or nonunion. Furthermore, OATS for Hill-Sachs lesions has shown a high rate of graft resorption at 2 years, although resorption has not been shown to affect clinical outcomes[18] (Table 2).

In summary, this Technical Note outlines a simple and reproducible method for the arthroscopic treatment of

an off-track Hill-Sachs lesion using human talus allograft. Long-term studies with patient-reported outcomes are needed to assess the clinical efficacy of this technique.

Disclosures

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: S.W.T. reports consulting or advisory for Exactech and consulting or advisory and speaking and lecture fees for Smith & Nephew. All other authors (W.E.H., J.R.M.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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