Technical Note

Microfracture in Linear, Isolated, Narrow, Engaging Hill-Sachs Lesion

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Abstract: Treatment of Hill-Sachs lesions is still controversial despite the frequent incidence in patients with recurrent shoulder dislocation. We report the use of arthroscopic microfracture for the treatment of recurrent shoulder dislocation with a linear, isolated, narrow, engaging Hill-Sachs lesion. Arthroscopic microfracture can be an alternative treatment option to obtain healing of defects and avoid external rotation limitation in young, active patients with recurrent dislocation with linear, isolated, narrow, engaging lesions.

In 1940, Hill and Sachs[1] reported a review of cases of humeral defects that occurred after traumatic shoulder dislocation, which are now well known by the name "Hill-Sachs lesions."[2] In 2000, Burkhart and De Beer[2] defined an "engaging" Hill-Sachs lesion on the basis of an arthroscopic finding of a humeral head defect engaged with the lesion when the shoulder is positioned in an abduction—external rotation position. The Burkhart and De Beer engaging Hill-Sachs lesion should be treated with an open procedure, including a bone graft if necessary, not only with an arthroscopic Bankart repair. In 2007, Yamamoto et al. introduced the concept of the "glenoid track" to understand recurrent dislocations.[3] In 2014, Di Giacomo et al.[4] reported the concept of "on-track/off-track" lesions and described a paradigm for addressing bone loss in instability. Di Giacomo et al. recommended that arthroscopic remplissage be added to the arthroscopic Bankart repair in cases with off-track Hill-Sachs lesions and glenoid bone loss of less than 25%.

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However, arthroscopic remplissage is not an anatomic surgical technique; hence, many authors have concerns regarding the theoretical adverse effect of loss of external rotation.[5] Through a review of 6 studies, Buza et al.[5] reported that the mean external rotation angle changed from 57.2° to 54.6° after arthroscopic remplissage.

Rarely, linear, isolated, narrow, engaging (LINE) Hill-Sachs lesions were detected. Whether arthroscopic remplissage should be performed in these cases is difficult to decide, especially if the patient is an athlete, who must maintain range of motion. Osteochondral defects of other joints such as the knee and ankle joints are more widely understood. Many treatment options have been applied, and arthroscopic microfracture presented good clinical outcomes with advantages including its less invasive properties, technical simplicity, low surgical morbidity, and cost-effectiveness when applied to young patients with small focal chondral defects.[6,7]

In this Technical Note, arthroscopic Bankart repair with microfracture of Hill-Sachs lesions for recurrent shoulder dislocation with LINE lesions is described. A summary of the key steps and techniques is provided in Video 1.

Preoperative Evaluation

A thorough history, physical examination, and radiologic evaluation are necessary to diagnose anterior shoulder instability. Recurrent anterior shoulder instability patients usually have an initial historical trauma and subsequent dislocations. The typical complaints of most patients are discomfort and instability in the abduction—external rotation position (apprehension

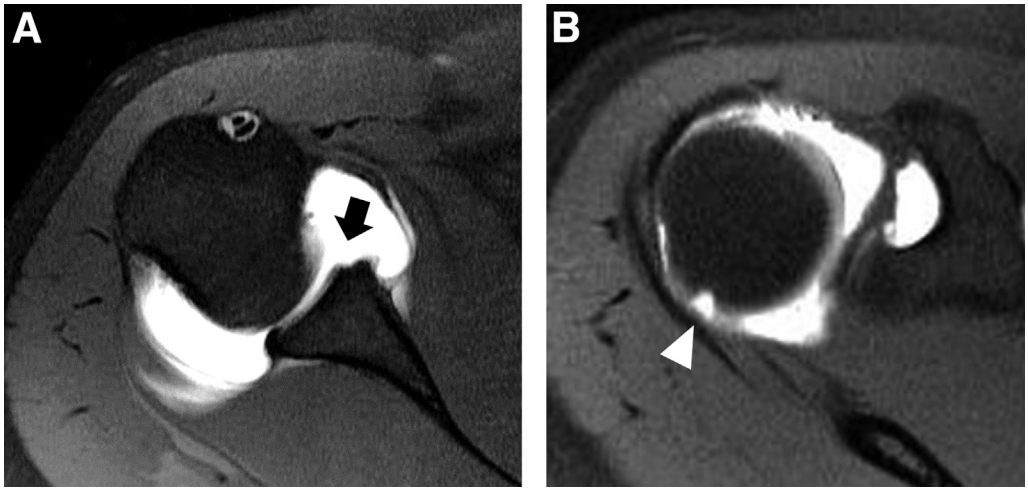

Fig 1. Patient in beach chair position, right shoulder, posterior viewing portal. Preoperative T2-weighted magnetic resonance image. (A) Anteroinferior labral tear (arrow). (B) Narrow Hill-Sachs lesion at posterior aspect of humeral head (arrowhead).

test); moreover, the relocation test is often positive. The findings of a simple glenohumeral joint anteroposterior radiograph are typically normal; however, the Stryker notch or axillary view can detect Hill-Sachs lesions or glenoid rim fractures. The diagnoses of Bankart and Hill-Sachs lesions are confirmed with magnetic resonance imaging showing an anterior-inferior labral tear and posterior humeral head impaction (Fig 1). Hill-Sachs lesions are evaluated according to the on-/off-track concept of Di Giacomo et al.[4] through a 3-dimensional computed tomography scan (Fig 2).

Operative Technique

The presented operative technique of arthroscopic microfracture for Hill-Sachs lesions may be indicated in recurrent anterior shoulder instability patients with LINE osteochondral defects of the humeral head. Moreover, arthroscopic microfracture can be an alternative treatment option for the patient who cannot accept the limitation of external rotation after remplissage.

Anesthesia, Positioning, and Portal Placement

Under general anesthesia, the patient is placed in the beach-chair position, with the affected arm brought into abduction and gentle traction by an arm holder (Trimano; Arthrex, Naples, FL). Diagnostic arthroscopy of the glenohumeral joint is performed to identify any intra-articular pathologies after a standard posterior portal is created. Anterosuperior and anteroinferior portals are then established in the rotator interval (Fig 3A).

Glenoid Preparation and Anterior Labral Repair

A bleeding bed for tissue healing along the glenoid neck is formed using a burr and Arthrocare device (Quantum 2; Smith & Nephew, Austin, TX) (Fig 3B). The drill guide of the suture anchor (JuggerKnot; Zimmer Biomet, Warsaw, IN) is positioned at the most

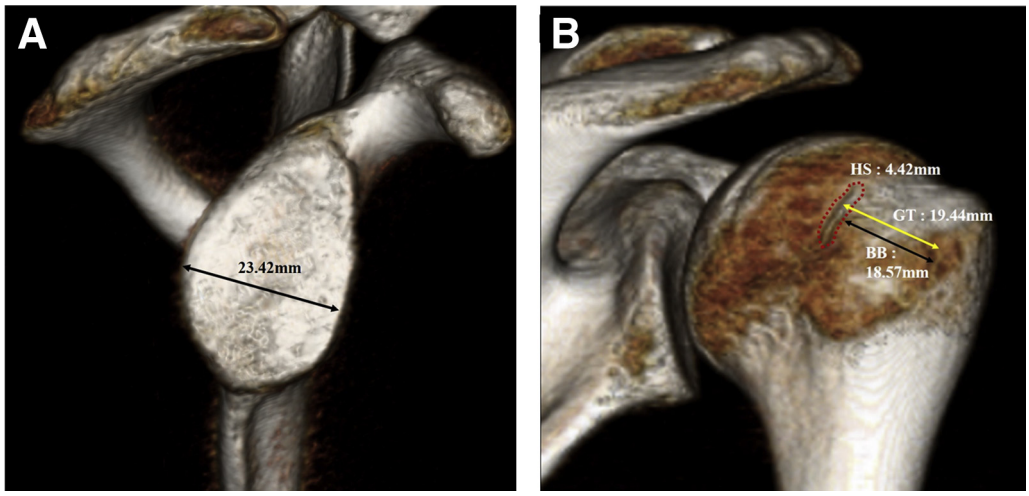

Fig 2. Patient in beach chair position, right shoulder, posterior viewing portal. Width of whole glenoid (A) and relation between Hill-Sachs lesion (HS) and glenoid track (GT) (B). (BB, bone bridge.)

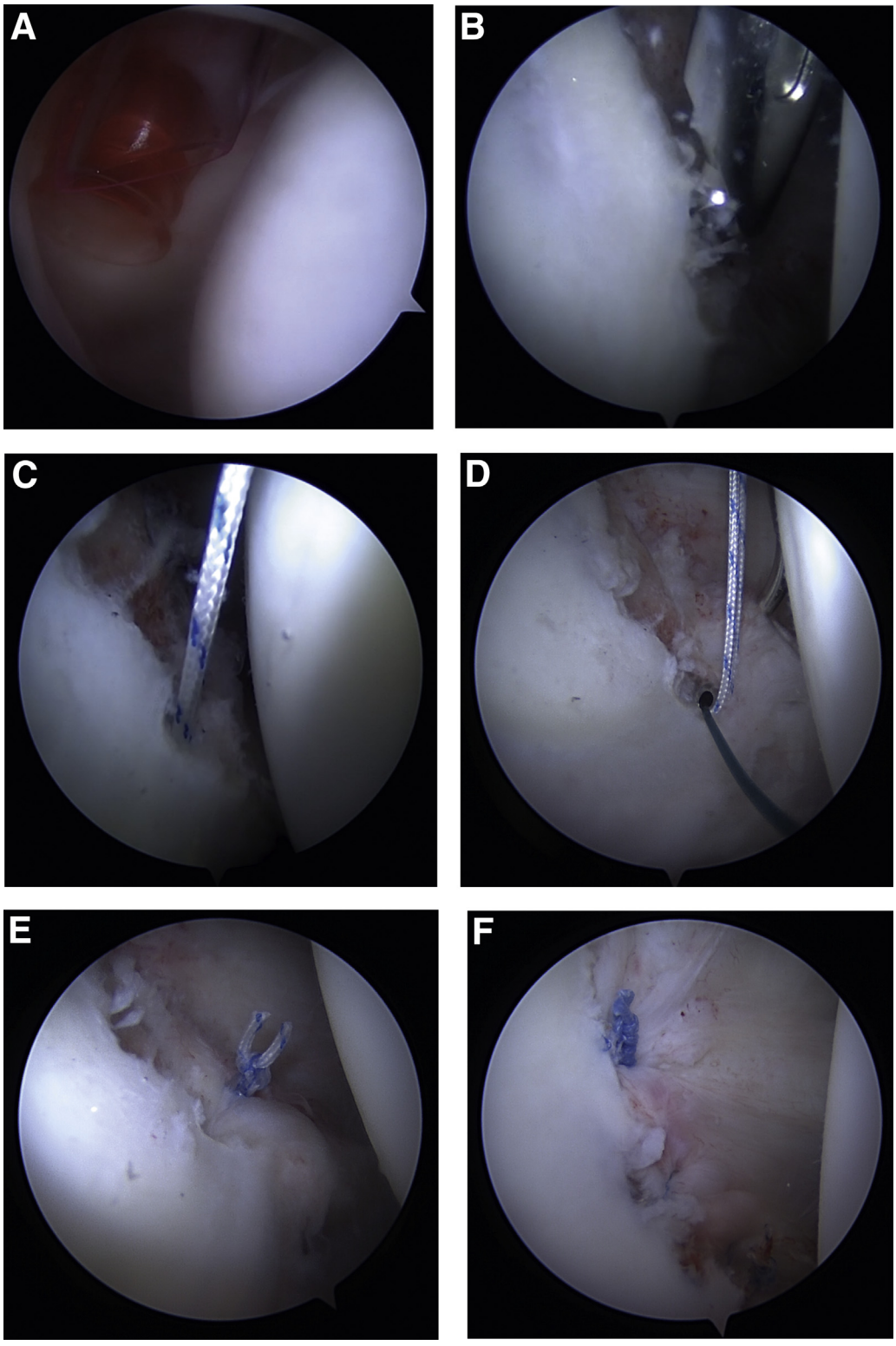

Fig 3. Patient in beach chair position, right shoulder, posterior viewing portal. (A) Standard posterior, anterosuperior, and anteroinferior portals are established. (B) Bone bed preparation is performed with a burr. (C) The suture anchor is inserted at the glenoid cartilage margin. (D) A suture passer is used to shuttle 1 of the suture limbs through the labrum and capsule. (E) Knots are tied using the SMC knot technique, with care taken to keep the knots away from the glenoid face. (F) Overall, 4 anchors are applied.

inferior point of the labral tear site, and a pilot hole is created. The suture anchor is tapped into the glenoid neck (Fig 3C). A suture passer is used to shuttle 1 of the suture limbs through the labrum and capsule with an attempt to bring adequately healthy tissue (Fig 3D). Knots are tied arthroscopically using the SMC knot

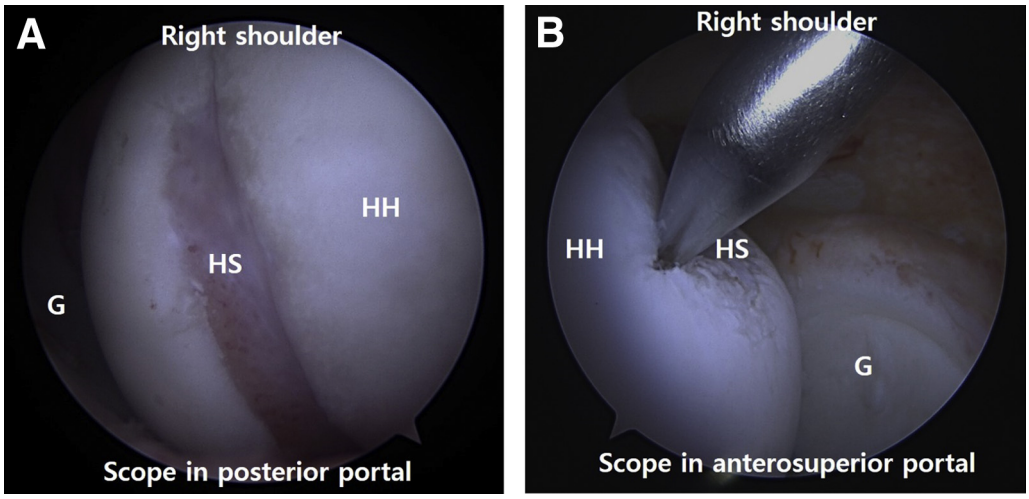

Fig 4. Arthroscopic images show a linear, isolated, narrow, engaging lesion (A) and a microfracture awl guided to penetrate the subchondral bone (B). (G, glenoid; HH, humeral head; HS, Hill-Sachs lesion.)

technique, with care taken to keep the knots away from the glenoid face (Fig 3E). Overall, 4 anchors are applied (Fig 3F), and the most superior anchor is tied with a modified Mason-Allen technique for reinforcement.[8]

Arthroscopic Microfracture

After the capsulolabral repair procedure, the Hill-Sachs lesion is handled (Fig 4A). A 70° arthroscope is introduced into the anterosuperior portal, and loose cartilaginous tissues are debrided using a ring curette and an arthroscopic shaver through the posterior portal. A microfracture awl (Linvatec, Largo, FL) is inserted through the posterior portal and guided perpendicular to the bony surface (Fig 4B). Each microfracture hole is separated by approximately 3 to 4 mm and penetrated to a depth of approximately 2 to 3 mm into the subchondral surface to expose the marrow elements. An arthroscopic shaver is used to remove any bony remains around the rims of the holes. An arthroscope is then introduced into the standard posterior viewing portal and marrow elements, and bleeding from microfracture holes is observed with reduced irrigation pump pressure (Fig 5, Table 1, Video 1).

Postoperative Rehabilitation and Postoperative Appearance

Use of a sling (UltraSling; DonJoy, Vista, CA) with a small abduction pillow was maintained for 6 weeks, with pendulum exercises starting 1 week after the surgical procedure. Passive and active-assisted forward flexion to 90° was started at 2 weeks postoperatively. At 4 weeks, passive and active-assisted external rotation to 20° was allowed. Active muscle-strengthening exercise with bands was started at 6 weeks. By 18 weeks, return to play was allowed. At 6 months after surgery, magnetic resonance imaging shows the

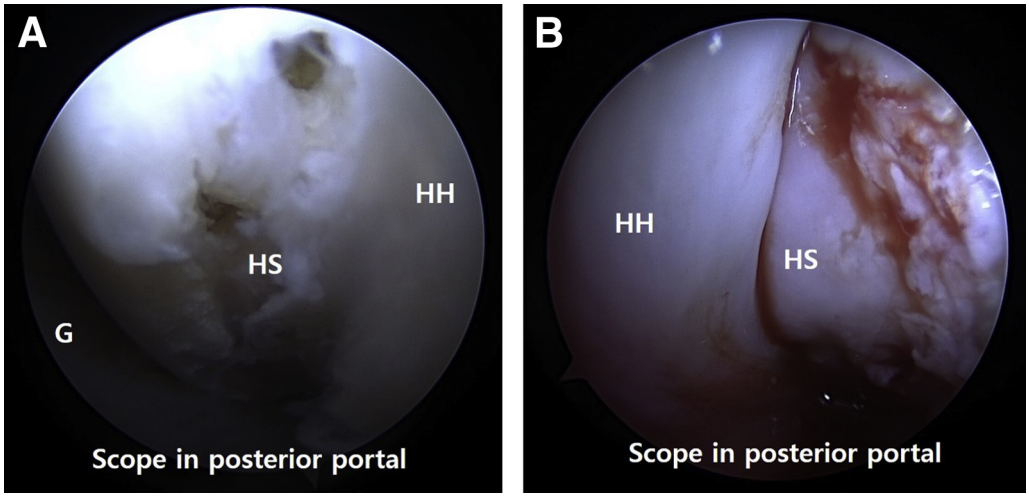

Fig 5. Patient in beach chair position, right shoulder, posterior viewing portal. (A, B) Arthroscopic images show marrow fat and bleeding occurring from the microfracture holes. (G, glenoid; HH, humeral head; HS, Hill-Sachs lesion.)

Table 1. Key Points and Pearls for Using Arthroscopic Microfracture for Engaging Hill-Sachs Lesion

Use of an anterosuperior portal as the viewing portal is optimal for arthroscopic microfracture for engaging Hill-Sachs lesions.
Use of a 70° arthroscope can improve visualization of the lesion.
A thorough assessment of bipolar lesions (glenoid defect and Hill-Sachs lesion) is critical to determine the optimal treatment strategy.
An isolated (lateral cartilage buttress) and narrow (<4 cm^2) lesion is good for defect healing.
Each microfracture hole is separated by approximately 3 to 4 mm and penetrated to a depth of approximately 2 to 3 mm into the subchondral surface to expose the marrow elements.

osteochondral defect is filled with regeneration of cartilage (Fig 6).

Discussion

Hill-Sachs lesions vary in width, depth, and orientation. The most common classification of the Hill-Sachs lesion is the Calandra classification.[9,10] However, this method determines only the depth and size of the lesion. Burkhart and De Beer[2] divided Hill-Sachs lesions into engaging and non-engaging lesions. Di Giacomo et al.[4] divided them into on- and off-track lesions. However, we think further classification is needed with consideration of depth, width, size, and location to determine more accurate management. We defined the LINE lesion as a Hill-Sachs lesion that is linear, isolated, narrow, and engaging.

In general, a small (<20%) osseous defect can be treated with nonsurgical management if it is a first-time dislocation.[11] However, it is essential to address the Hill-Sachs defect in the setting of an engaging lesion because multiple studies have shown increased recurrence rates of shoulder instability after arthroscopic repair when the Hill-Sachs lesion is not addressed at the time of surgery.[11] Shibayama and Iwaso[12] found that an engaging Hill-Sachs lesion is highly susceptible to recurrence if treated with a typical arthroscopic capsuloligamentous repair with no attention to the osseous defect. Boileau et al.[13] stated that it is not surprising that an untreated Hill-Sachs lesion leads to postoperative recurrent instability because the articular arc deficit still exists and will cause engagement with the anterior glenoid rim, thus resulting in failure of the repair over time. Even if the lesion was narrow, whether conservative treatment of the engaging Hill-Sachs lesion should be performed was difficult to decide.

Numerous treatment options have been introduced for managing Hill-Sachs lesions of the humeral head.[14] The arthroscopic remplissage procedure with filling of the infraspinatus tendon and posterior capsule into the osteochondral defect has been popular because of its relative simplicity and because it does not require an open approach.[5] However, it may limit range of motion, especially loss of external rotation, owing to its nonanatomic nature.[5] The advantages of humeral head bone augmentation are the anatomic nature of the reconstruction, the restoration of range of motion, and the avoidance of a replacement.[14] However, the technique is highly technically demanding, and the complication rate is as high as 20% to 30%, with a reoperation rate greater than 25% among the patients.[14] Romeo et al.[15] stated that autologous chondrocyte implantation may be an alternative plan. However, their technique was also a 2-stage open procedure with detachment of the subscapularis and capsule.

The arthroscopic microfracture technique is easy and safe and is most widely used for osteochondral lesions. The arthroscopic microfracture technique performed in young athletes with a small, single osteochondral lesion in the knee joint led to favorable results at short- and

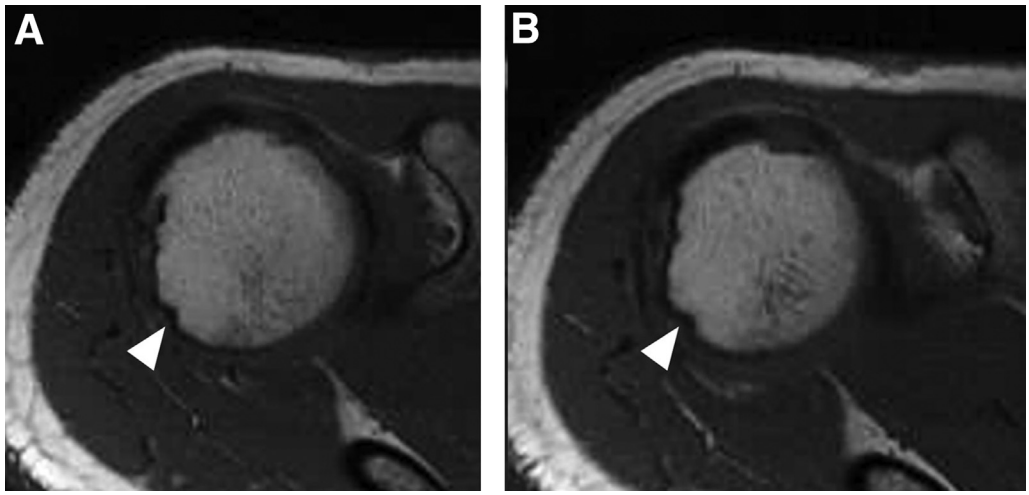

Fig 6. Patient in beach chair position, right shoulder, posterior viewing portal. (A, B) At 6 months after surgery, magnetic resonance imaging shows that the osteochondral defect is filled with regeneration of cartilage. The arrowheads indicate the black linear signal of cartilage regeneration.

Table 2. Advantages and Disadvantages of Arthroscopic Microfracture for Engaging Hill-Sachs Lesion

Advantages	Disadvantages
Decreased operative time	Defect is not completely filled
Less invasive	Lateral cartilage buttress is required to stabilize fibrocartilage analogue
Shorter learning curve	
Avoidance of external rotation limitation after remplissage	Difficult to obtain defect healing in large (>4 cm^2) Hill-Sachs lesions
Defect can be filled, although it is healed with fibrocartilage	

long-term follow-up.[16] Microfracture allows growth factors and pluripotent mesenchymal cells from the bone marrow space to gain access to the osteochondral lesion and create an environment prone to tissue regeneration. Full-thickness osteochondral lesions healed with composition of granulation tissue, fibrous tissue, fibrocartilaginous tissue, or tissues similar to hyaline cartilage.[17] Thus, the arthroscopic microfracture technique has proved to be a successful, minimally invasive surgical option. The literature has also shown excellent cartilage regeneration on second-look arthroscopic examination.[17] Lee et al.[7] reported good or excellent clinical outcomes in 89% of patients who underwent arthroscopic microfracture for isolated osteochondral lesions of the talus. Karthikeyan et al.[18] showed that arthroscopic microfracture is a safe and effective procedure for the treatment of full-thickness, isolated chondral lesions of the acetabulum, with a 95% success rate at second-look arthroscopic surgery. In this institution, LINE lesions of the humeral head were managed using the arthroscopic microfracture technique. As a result, the defects were healed without external rotation limitation and recurrence of dislocation.

Currently, the remplissage procedure is considered the most popular management for off-track Hill-Sachs lesions, and small, even off-track lesions can be successfully treated with conservative treatment. However, arthroscopic microfracture is technically easy, safe, and good for healing of osteochondral lesions (Table 2).

The recommended indications for arthroscopic microfracture are small, narrow, and isolated lesions. Many authors have recommended microfracture for small osteochondral lesions in other joints (Table 1).[19,20] Large lesions without a cartilage buttress are not proper for microfracture, given that osteochondral lesions of the talar shoulder are not suitable for microfracture.[21,22] However, further large-scale study is needed for the establishment of the exact indications. Nevertheless, we believe that arthroscopic microfracture can be an alternative treatment option to obtain the healing of defects and avoid external rotation limitation in young and active patients with recurrent dislocation with a LINE lesion.

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