Technical Note

Reverse Microfracture of the Hip Acetabulum: A Technique for the Wave Lesion

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Abstract: The long-term efficacy of the treatment of chondral lesions is very important to prevent hip osteoarthritis. Microfracture, autologous chondrocyte transplantation, and direct chondral repair, among others, are techniques that have shown good results in some cases. We propose a technique to treat wave lesions through reverse microfracture, with bubble decompression and adherence of the natural scar from the detached cartilage.

The treatment of chondral lesions is still a challenge in orthopaedic surgery. Microfracture, alone or augmented[1,2]; direct repair[3]; autologous chondrocyte implantation[4,5]; matrix-induced chondrocyte implantation; autologous matrix-induced chondrogenesis[6]; mosaicplasty[6]; osteochondral allograft transplantation; and implantation of stem cells in the matrix (i.e., stem cells in membranes or expanded stem cells)[6] are techniques that have shown good results in treating some specific lesions and unsatisfactory results in treating others.

Wave lesions or the wave sign is characterized by pre-delamination or profound delamination of the articular cartilage, also known as the labral-chondral complex without an intra-articular extent.[7] This type of lesion is difficult to diagnose preoperatively, often being noticed only during surgery.[7]

The presence of lesions in the cartilage can lead to serious problems in the hip, such as arthralgia, synovitis, loose body formation, and/or osteoarthritis.[6] In these cases, the greatest challenge is establishing the correct surgery indication associated with the clinical treatment that aims to heal the lesion.

Detachment of the chondrolabral junction with osteotomy of the acetabular rim and curettage of the subchondral bone, followed by reinsertion of chondral lesions using specific anchors, is a treatment option. A different approach is injection of a fibrin adhesive into the bubble formed by the wave lesion.[3,4] The goal of this work is to describe a simple treatment technique in which reverse microfracture is performed from the supra-acetabular bone toward the intra-articular space, decompressing the bubble generated by the wave lesion and promoting the adhesion of chondral displacement by the residual clot.

Surgical Technique

The patient is placed on the traction table and positioned in a horizontal dorsal decubitus position. The hip is prepared for the surgical procedure.

The step-by-step technique is as follows:

1. Traction of the lower limb is achieved through use of a traction table.
2. Radioscopic examination is performed to obtain at least 2 cm of hip joint space.
3. The anterolateral portal and midanterior portal are prepared (Fig 1).
4. Visualization of the intra-articular compartment is achieved through a 70° hip optic (70° autoclavable, direct view; Smith & Nephew).
5. The labrum across the acetabular margin is viewed and checked.
6. The articular cartilage of the acetabulum and femoral head is viewed and checked.

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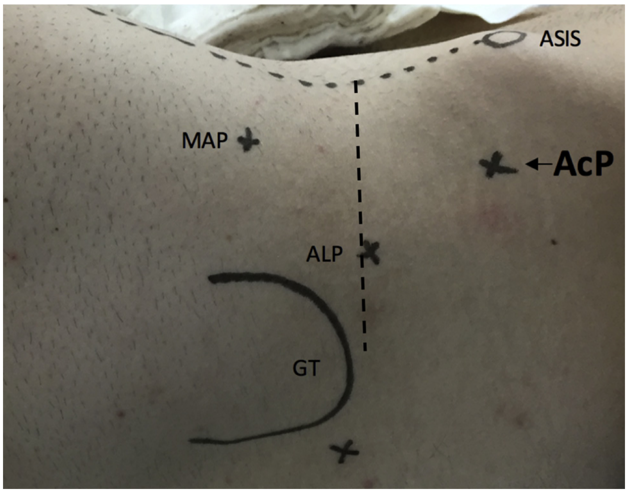

Fig 1. Intraoperative photograph of left hip. Landmarks for portal placement during hip arthroscopy are identified and marked on the skin. The anterior superior iliac spine and greater trochanter (GT) are drawn. An anterior line is drawn from the anterior superior iliac spine to the center of the patella. The anterolateral portal (ALP) is first placed slightly anterior and approximately 1 cm proximal to the top of the GT. The midanterior portal (MAP) is then located 45° distal and anterior to the ALP, and the accessory portal (AcP) is subsequently located 45° proximal and anterior to the ALP, between the iliac bone and a line perpendicular to the anterior line.

7. Diagnosis of the wave lesion is made with a probe (3-mm-long hip probe; Smith & Nephew).
8. Debridement of the supralabral and periosteal soft parts is performed, with correction using a pincer if necessary.
9. Visualization of the chondrolabral junction, which may be intact or ruptured, is performed (Fig 2).
10. A proximal anterolateral accessory portal (Fig 1) is created through a cannulated introducer (arthroscopy needles, 17 gauge and 6 in; Smith & Nephew), approximately 30° to 45° proximal and anterior to the anterolateral portal and between the iliac spine and perpendicular line that descends from the midline to the tip of the greater trochanter. The tip of the cannulated introducer is visualized through the 70° optic to determine the angulation and positioning necessary for microfracture of the acetabular bone, without injuring the chondrolabral junction.
11. The inner part of the introducer is removed and the external part is maintained after the proper positioning of the cannulated introducer is attained. Nitinol guidewires (1.2 mm × 18 in; Smith & Nephew) and a 4.5-mm cannula (4.5-mm Arthrogarde cannula and Green Crosstrac Hub; Smith & Nephew) are placed (Fig 3, Video 1).
12. The inner part of the cannula is removed, and a 2.3-mm drill bit (Twist drill for 2.3-mm anchor; Smith & Nephew) is placed; this is used in the 2.3-mm anchor placement technique (Osteoraptor 2.3-mm suture anchor; Smith & Nephew) after positioning of the 4.5-mm cannula. The cannula will thus serve as a guide to the microfracture. The guide and 2.3-mm drill bit should be positioned at a distance of approximately 2 mm from the chondrolabral junction to prevent its injury and observe the wave lesion throughout drilling to avoid drilling below it or drilling the cartilage (Table 1).
13. Microfractures are created under direct vision of the wave lesion with the drill in low-rotation mode (Fig 3).
14. The surgeon creates as many microfractures as necessary, keeping a distance of 2 to 3 mm between them and treating the entire region of the bubble (Fig 3).
15. The pressure from the pressure pump is removed, and the bleeding through the holes is observed after creation of the microfractures.
16. The integrity of the chondrolabral junction, cartilage, and labrum is checked, and if necessary, anchors can be placed to stabilize the chondrolabral junction or labral lesion.

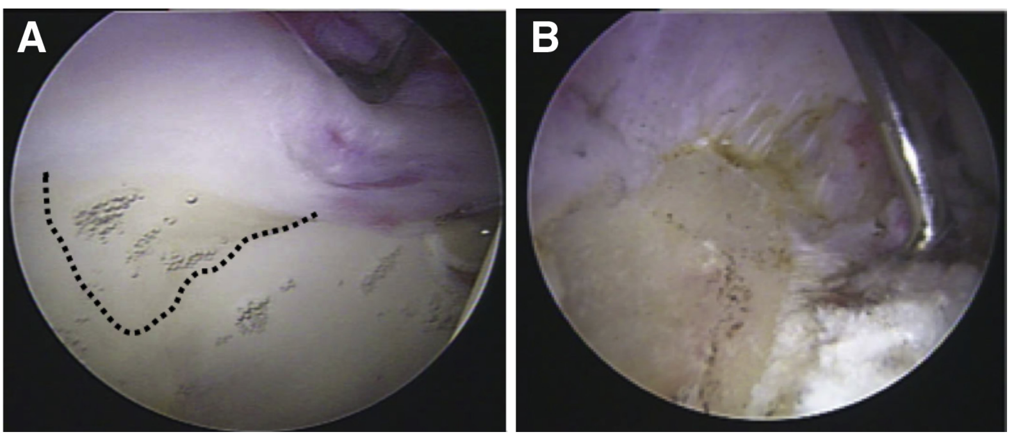

Fig 2. Intraoperative arthroscopic images of right hip viewed through anterolateral portal. (A) A wave lesion is highlighted (dotted line) using a probe. (B) Intact chondrolabral junction after debridement of soft supralabral portions and pincer-type osteochondroplasty.

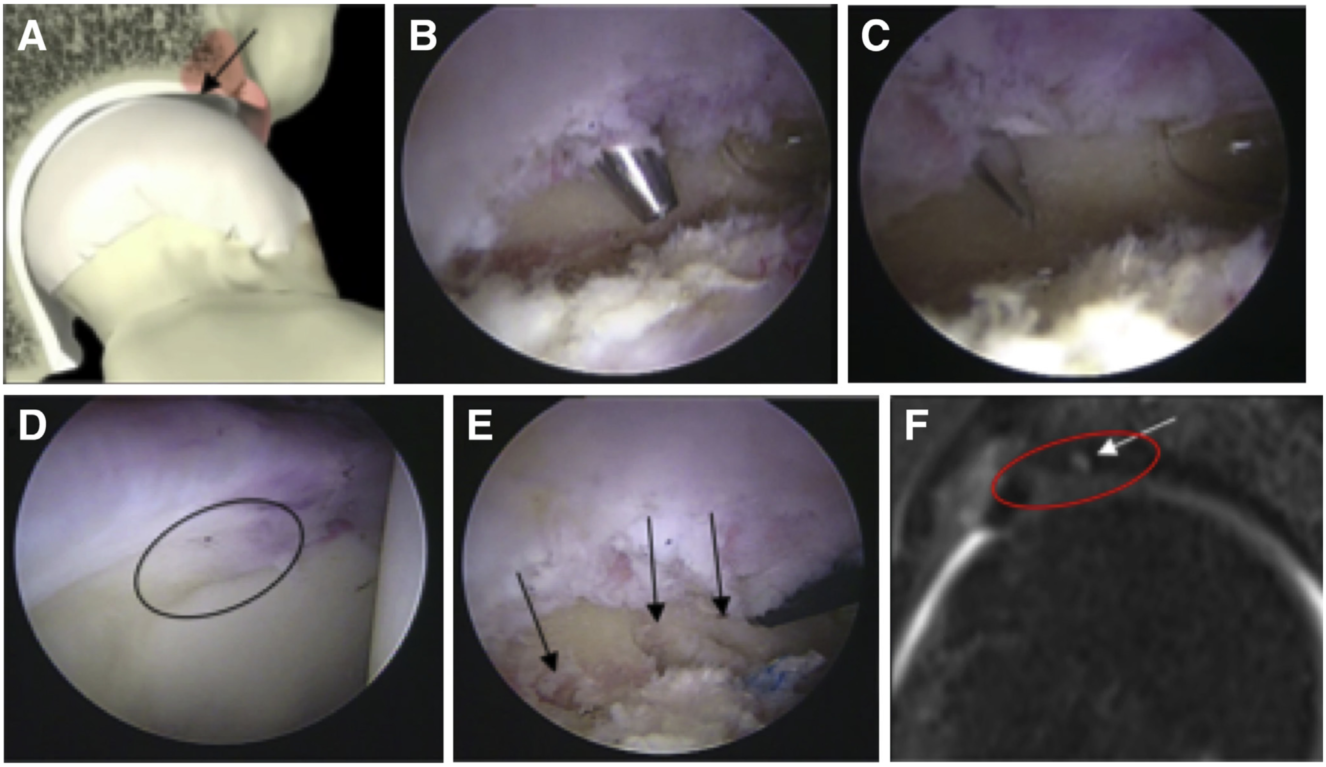

Fig 3. (A) Illustrative image showing direction of reverse microfracture (arrow) until osteochondral interface. (B) Intraoperative arthroscopic image of right hip showing 4.5-mm cannula. (C) Introduction of 2.3-mm drill for realization of reverse microfracture procedure. The drill angulation and a safe distance to the chondrolabral junction should be observed. (D) Intra-articular image showing drilling of the acetabular bone (ellipse) until contact is made with the cartilage. (E) The arrows indicate 3 reverse microfractures. (F) Coronal magnetic resonance image (fast spin echo T2) after surgery, showing a focus of increased signal along the surgical hole in the acetabular bone made by the reverse microfracture (arrow). The ellipse shows the underlying cartilage with characteristics similar to those of the femoral head, indicating the absence of significant cartilage degeneration.

In the postoperative analysis, we use the modified Harris Hip Score at 3 and 6 months. After 6 months, we perform a strong-gradient 1.5-T magnetic resonance imaging scan (Magnetom Aera; Siemens), with the patient in the dorsal decubitus position and with the lower limbs at 15° of external rotation, with a specific coil for the articulation under study. The following sequences are performed: coronal T2* coronal fat saturation (FatSat) and proton density (PD) with 3 mm, axial T1 and FatSat PD with 3.5 mm, axial T1 oblique longitudinal section to the femoral neck with 3 mm, and sagittal T2* FatSat with 3 mm. After intravenous injection of gadolinium contrast, T1-weighted coronal and axial images are reacquired with FatSat. The articular cartilage and labrum are directly evaluated on the preoperative and postoperative images with gadolinium and compared with the preoperative studies in all cases.

Table 1. Pearls and Pitfalls of Reverse Microfracture Technique

Pearls
Check the position of the arthroscopy needle before making the accessory portal and achieve a good position for drilling.
Drill at a slow speed, always visualizing the cartilage in order not to damage it.
Make as many microfractures as necessary, keeping a 3- to 5-mm distance between them.
Whenever possible, repair the labrum if any instability or injury is noticed.
Pitfalls
To prevent accidental cartilage damage, do not apply too much pressure while drilling.
Keep a distance of 1 to 2 mm from the chondrolabral junction to prevent any accidental injury to it while drilling.

The goal of drilling is to reduce the internal pressure of the bubble generated by the wave lesion. This promotes bleeding, bone marrow cell migration, and the scarring reaction, allowing for adhesion of the chondral detachment (Table 1).

Discussion

In the past few decades, the prosthetic treatment of hip osteoarthritis has undergone a great evolution. However, an effective conservative treatment is still necessary, and hip-preservation surgical procedures should be developed.

The cartilage lacks blood vessels. Its supply is instead provided by the synovial fluid and subchondral bone.

Table 2. Advantages and Disadvantages of Reverse Microfracture Technique

Advantages	
	Can be performed with readily accessible instrumentation
	Has no additional cost
Disadvantages	
	Requires initial learning curve to master technique
	Requires additional intraoperative time

Detachment of the cartilaginous tissue of the subchondral bone will impair successful nutrient supply and mechanical sustentation, leaving the cartilage fragile and susceptible to rupture and tissue loss.[8]

Hip arthroscopy is a less invasive method of treatment for intra-articular lesions, such as femoroacetabular impingement, labial lesion and chondral lesion. In cases of wave-type chondral lesions, cartilaginous debridement or conventional microfracture may worsen the lesion and disease prognosis. Fibrin glue is a treatment option[3]; however, its additional cost and unavailability during surgery may restrict its use. Besides, studies are being conducted regarding medium- and long-term outcomes. The detachment of the chondrolabral junction may cause iatrogenic outcomes such as chondral cleavage or worsening wave lesions. In some cases, the condition can even become more severe than the initial lesion.

An important step in this technique is to position the 4.5-mm cannula properly, which will serve as a guide for the drill, because improper positioning can damage the chondrolabral junction or result in drilling below the wave lesion. To avoid this, we should always look at the positioning of the cannulated introducer together with the location of the bubble and keep a safe distance from the chondrolabral junction. If the labrum or joint breaks, it can be fixed with anchors. We use a 4.5-mm cannula and 2.3-mm drill bit because we have these instruments in our hip arthroscopy box, and these do not increase the cost of the procedure. Thus, additional instruments are not required to perform the procedure. We opt to place the drill in screw mode, as the rotation speed is lower, protecting the adjacent bone from possible thermal lesions and preserving perfusion and bone bleeding. The perforating movement should be delicate and well controlled to prevent cartilage perforation.

A limitation of this technique would occur in patients with a small acetabulum or acetabular ridge. In this case, an instrument with a 1.5-mm drill bit can probably help overcome the limitation. Another problem would occur with a highly medial wave lesion, located between the 3- and 6-o'clock positions, because we would have to place the cannula medially, exposing the medial femoral cutaneous nerve to the risk of lesion development. Fortunately, this did not occur in any of our cases, probably because the area involved did not have the highest load on the hip.

The learning curve was short for the hip arthroscopist, and the increase in surgical time was minimal with the procedure (Table 2). The reverse microfracture technique proposed in this study proved to be a simple and reproducible procedure, without any additional associated costs or the need for additional instruments or materials. The goal of this procedure was to reduce the pressure generated by the bubble of the wave lesion, and the clot created by the perfusion associated with the scarring reaction of the bone plays the role of natural glue, joining the cartilage to the bone.

Magnetic resonance imaging, a noninvasive and nonradiation imaging technique, has been used in our routine as a tool to evaluate the characteristics of the acetabular cartilage submitted to the arthroscopic approach. The articular cartilage and labrum are evaluated directly on the images before and after injection of gadolinium and compared with the preoperative images. In addition, maps of the articular cartilage are made by the delayed gadolinium-enhanced magnetic resonance imaging of cartilage (dGEMRIC) technique. Although these sequences have not been taken into account in the diagnostic accuracy of this study, the data under statistical evaluation in our service will help **to determine if the use of dGEMRIC will have an impact on the diagnosis and** prognosis of cartilage quality. We hope to soon determine the correlation of these findings with the clinical evolution of the patients and the direct visualizations in arthroscopic reassessments that may be necessary.

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