Arthroscopic Decompression of a Type III Subspine Impingement

Víctor M. Ilizaliturri, Jr., M.D., Rubén Arriaga Sánchez, M.D., and Carlos Suarez-Ahedo, M.D.

Abstract: Extra-articular hip impingement refers to a variety of hip disorders causing pain and limited function in young, non-arthritic patients. Recently, there has been an increased focus on analyzing the degree of anterior inferior iliac spine (AIIS) dysmorphism and its correlation with subspine impingement (SSI), defined as abutment between a prominent distal aspect of the AIIS and the anterior aspect of the femoral head-neck junction. Arthroscopic decompression of the AIIS is recognized as an effective treatment for SSI. However, there may be some inherent risks of performing this procedure arthroscopically that require further investigation.

Extra-articular hip impingement refers to a variety of hip disorders causing pain and limited function in young, nonarthritic patients.[1] These disorders include psoas impingement, subspine impingement (SSI), ischiofemoral impingement, and greater trochanteric/pelvic impingement. They all are fundamentally different from traditional hip impingement.[2]

Recently, there has been an increased focus on analyzing the degree of anterior inferior iliac spine (AIIS) dysmorphism and its correlation with clinical impingement, as well as subsequent treatment modalities (Table 1). In fact, Hetsroni et al.[3] proposed a classification of SSI that identifies abutment of the prominent distal aspect of the AIIS over the femoral neck and acetabular rim (Table 2).

Arthroscopic decompression of the AIIS is recognized as an effective treatment for SSI.[1,4,5] The purpose of this report was to describe, in detail, arthroscopic access to the distal portion of the AIIS and basic principles for decompression of SSI produced by the protruding area of the AIIS (Figs 1-4).

From the Department of Adult Joint Reconstruction, National Rehabilitation Institute of Mexico, Mexico City, Mexico.

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Address correspondence to Carlos Suarez-Ahedo, M.D., Department of Adult Joint Reconstruction, National Rehabilitation Institute of Mexico, Av Mexico-Xochimilco No. 289, Col Arenal de Guadalupe, Mexico City CP 14389, Mexico. E-mail: drsuarezahedo@gmail.com

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Surgical Technique

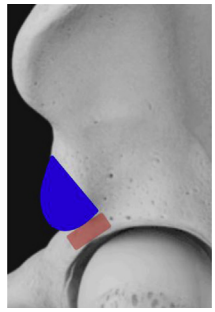
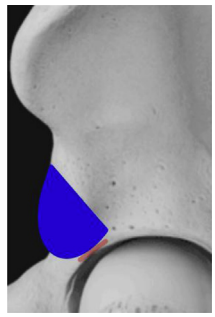
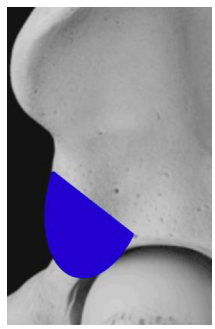
The patient is positioned in the lateral decubitus with the operative side upward. The foot of the operative side is fixed to the traction device (lateral distractor; Smith & Nephew Endoscopy, Andover, MA). The horizontal extra-padded oversized perineal post is positioned on the operative-side groin. The post provides lateralization of the traction forces, which results in a vector that is more in line with the femoral neck. The C-arm is positioned horizontally under the operating table to provide an anteroposterior view of the hip (operative side). A traction test is performed to confirm separation of the femoral head from the acetabulum of at least 10 mm as measured of the edge of the acetabulum to the proximal aspect of the femoral head. Traction is released and the patient is prepared and dressed. Subsequently, the definitive traction is established. The anterolateral portal is established first under fluoroscopic guidance. A spinal needle—guide wire technique is used. Under fluoroscopic guidance, the spinal needle (Hip Preservation System; Conmed, Largo, FL) is introduced at the anterolateral portal site (located at the superior anterior corner of the greater trochanter). The stylus is removed from the needle and air is introduced into the joint with a 40-mL syringe to increase the positive pressure within the joint, producing further separation of the femoral head from the acetabulum. The flexible (nitinol) guide wire (Hip Preservation System; Conmed) is introduced trough the needle and the needle removed. A dedicated hip arthroscopy set of cannulated instruments is used to establish the arthroscopic portal over the prepositioned nitinol guide wire. A 4.0-mm 70° arthroscope is used

Table 1. Etiologies of Dysmorphic Anterior Inferior Iliac Spine and Subspine Impingement

Developmental	Associated with acetabular retroversion or in athletic individuals due to frequent powerful contractions of the rectus femoris
Pelvic osteotomies	When overcorrected
Apophyseal/rectus avulsion	Usually athletic individuals aged 14-23 years
Valgus and anteverted proximal femur	Predicted experimentally only

(Hip Preservation System, Conmed). The anterior portal (located at the intersection of a horizontal line directed anteriorly from the tip of the greater trochanter and a vertical line descending from the anterior superior iliac spine) is then established under direct arthroscopic vision. The spinal needle is introduced at the anterior portal site triangulated toward the tip of the 70° arthroscope inside the joint; the tip of the needle is observed as it pierces through the anterior hip capsule between the free margin of the anterior labrum and the superior anterior femoral head. The stylus is removed from the needle and the guide wire is introduced into the joint through the needle. A small skin incision (5 mm long) is performed around the guide wire and a cannulated switching stick (Hip Preservation System; Conmed) is brought into the joint over the previously positioned guide wire. (As shown in Video 1 at the beginning of the surgical video section, these steps are performed without fluid in the joint to facilitate arthroscopic visualization because examination under air prevents bleeding from obstructing the field of view.) A slotted cannula (Hip Preservation System; Conmed) is then slid into the joint over the guide wire and fluid is pumped at 50 mm Hg using the inflow valves from the arthroscopy cannula (Hip Preservation System; Conmed) previously positioned at the anterolateral portal. With the portal established, a radiofrequency hook probe (ligament chisel probe hook; Smith & Nephew Endoscopy) is introduced via the slotted cannula, which is then removed and an interportal capsulotomy (the entry sites of the anterolateral and direct anterior portal are connected with a capsular cut) is performed with it in retrograde fashion. The radiofrequency hook is also used to elevate 1 cm of hip capsule proximal to the acetabular rim and labrum at the anterior aspect of the hip joint, which is accessible with the radiofrequency hook probe working from the direct anterior portal. The viewing portal is exchanged from the anterolateral position to the direct anterior portal; to do this, a slotted cannula is slid into the joint using the radiofrequency hook probe positioned at the direct anterior portal as a guide, the radiofrequency hook probe is exchanged for a switching stick within the slotted cannula. The slotted cannula is then removed, with the switching stick remaining inside the joint through the anterolateral portal. A second hip arthroscopy cannula is introduced into the joint over the switching stick, leaving it in position at the direct anterior portal; thereafter, the arthroscope is removed from the arthroscopy cannula inside the anterolateral portal and repositioned in the hip arthroscopy cannula located at the direct anterior portal. After this portal exchange, the procedure is performed and the viewing portal becomes the direct anterior portal. The original hip arthroscopy cannula that is in the anterolateral portal is identified from the direct anterior portal. A switching stick is introduced through the hip arthroscopy

Table 2. Anterior Inferior Iliac Spine Morphologic Classification

Type	Description	Example
I	Smooth ilium wall without bony prominences between the caudad level of the AIIS and the acetabular rim	
II	Bony prominence on the ilium wall extending from the caudad area of the AIIS sits just at the level of the acetabular rim	
III	The AIIS extends distally to the anterosuperior acetabular rim	

NOTE. The schematic representation of the bony prominent AIIS (in blue) shows the space between the joint and the AIIS (in red), Note that in the case of types 1 and II there is reduced and minimal space. There is no existent space for type III.

AIIS, anterior inferior iliac spine.

Fig 1. Preoperative anteroposterior pelvis radiograph showing the lower position of the anterior inferior iliac spine (AIIS) predominantly at the right hip (red arrow). A less prominent AIIS is observed on the left side.

cannula at the anterolateral portal, the cannula removed, and a slurred cannula (Hip Preservation System, Conmed) slid into position at the anterolateral portal over the switching stick. A radiofrequency hook probe is introduced through the slotted cannula, which is removed. The radiofrequency hook probe is used to elevate the capsule from the iliac bone about 1.5 cm proximal to the insertion of the labrum on the lateral rim in continuity with the capsular elevation previously performed from the direct anterior portal (Fig 5, Video 1). At this point, complete examination and management of pathology in the central compartment is performed. The viewing and working portals may be alternated as necessary depending on the findings in the central compartment. Once treatment of the central compartment pathology is completed, the viewing portal is positioned at the anterolateral portal and the working portal at the direct anterior portal.

Exposure of the AIIS is performed next. With the hip still under traction, a shaver (Ergo Shaver Handpiece; Conmed) is introduced at the anterior portal through a slotted cannula and used to expose the tip of the protruding AIIS. At this point, fluoroscopy is used to assist in localizing the tip of the protruding AIIS with the shaver, because it is behind the anterior hip capsule. Minimal resection of the area where the tip of the protruding AIIS was located is performed with the shaver. Once the tip of the AIIS is confirmed under direct arthroscopic vision and fluoroscopy, the shaver is exchanged for a radiofrequency hook probe using a slotted cannula. The radiofrequency hook probe is then used to create a capsulotomy around the distal aspect of

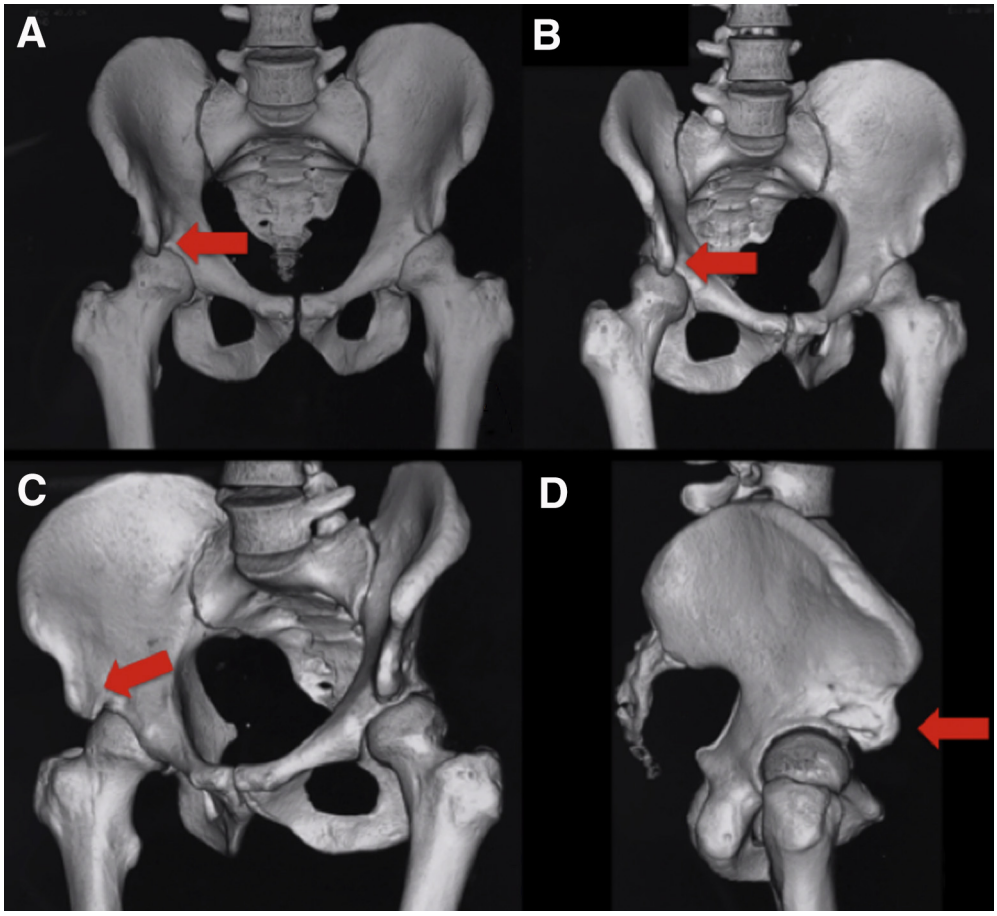


Fig 2. (A-D) Series of preoperative 3-dimensional computed tomographic scans revealing a grade III subspine impingement (red arrow).

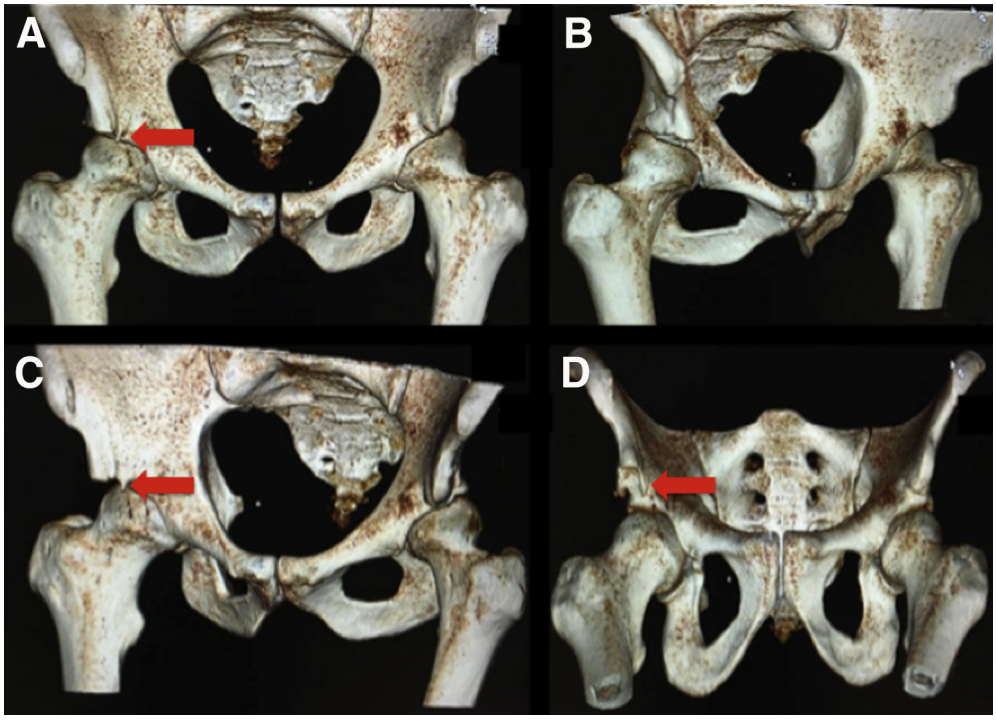


Fig 3. (A-D) Series of postoperative 3-dimensional computed tomographic scans revealing subspine decompression. Note a small spike-shaped remnant after decompression (red arrow).

the AIIS. Elevating the anterior hip capsule from around the protruding AIIS provides full exposure of this structure (Fig 6, Video 1). A 4.5-mm straight burr and a 4.5-mm round burr (Hip Preservation System, Conmed) are used to resect the protruding portion of the AIIS (the straight shaft and the pre-bent burrs have different trajectories to the AIIS, which may facilitate complete resection of the structure as they are alternated). In the case example presented in this report, a more medial portal was established to reach the most medial aspect of the dysmorphed AIIS because it was out of reach from the direct anterior portal for both the straight and pre-bent burrs (Fig 7, Video 1). The medial accessory portal site was located 2 cm distal and 2 cm medial to the site previously described for the direct anterior portal. This accessory portal is established under direct arthroscopic vision with a spinal needle, which is entered into the joint piercing the anterior hip capsule medial to the exposed AIIS. Once the guide wire is positioned through the spinal needle, a 5-mm skin incision is made around the needle, and then the needle is removed and the guide wire used to position the switching stick. A slotted cannula is slid over the switching stick at the accessory portal, the switching stick removed, and the straight 4.5-mm burr introduced to complete resection of the medial aspect of the AIIS. After the decompression is complete, the traction is released and a range of motion evaluation is performed to confirm that the abutment has been adequately treated. The capsular cuts were not repaired.

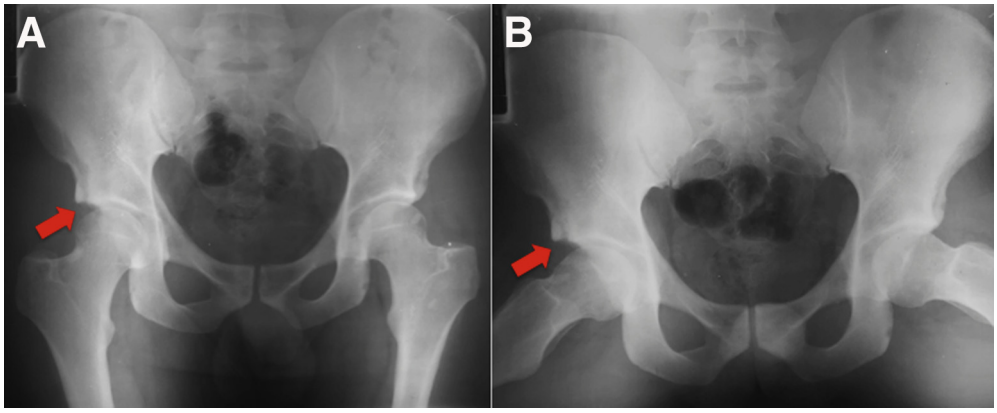


Fig 4. Postoperative (6 months) anteroposterior pelvis (A) and frog leg lateral radiograph (B). The arrow indicates the space obtained below the anterior inferior iliac spine after decompression.

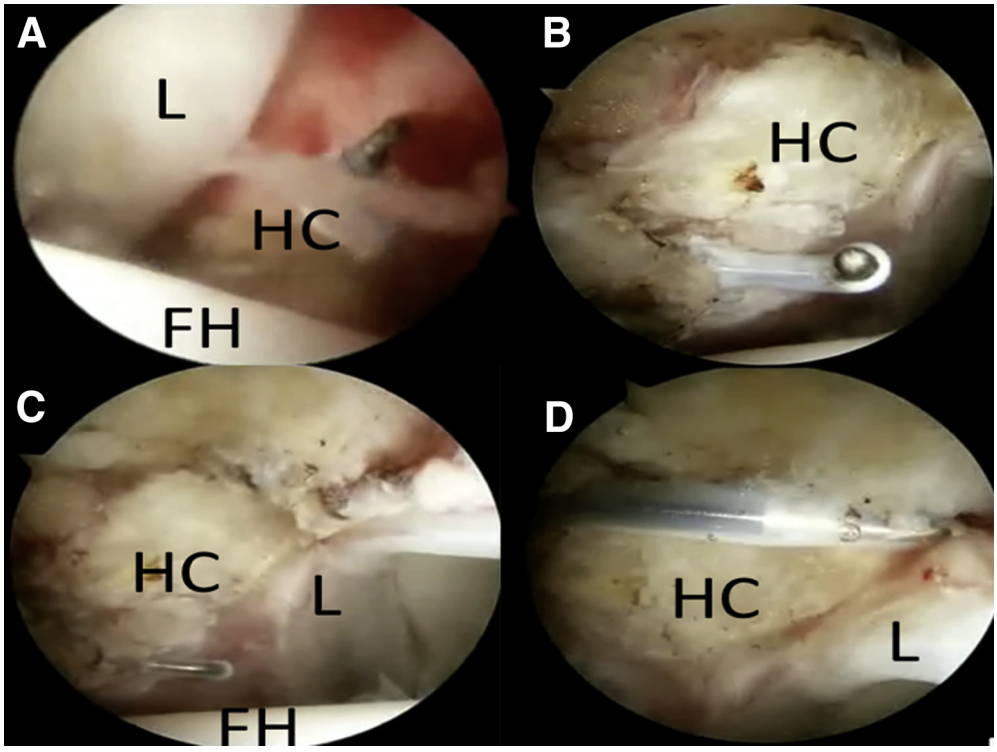


Fig 5. A series of arthroscopic photographs taken from a right hip. (A) An anterior hip capsulotomy is performed using a radiofrequency hook probe (the arthroscope is at the anterolateral portal). The labrum is at the top and the femoral head is at the bottom. The hip capsule is at the center of the image. (B, C) A radiofrequency hook probe is in position at the anterolateral portal to complete the lateral cut at the hip capsule. The labrum is at the top and the femoral head at the bottom. (D) A radiofrequency hook probe is used to elevate the hip capsule from the iliac bone proximal to the labrum. (FH, femoral head; HC, hip capsule; L, labrum.)

Discussion

The AIIS plays an important role as a cause of extra-articular hip impingement. Numerous studies have described excellent results following arthroscopic subspine decompression.[3,5-9] A failure to recognize or treat this condition has been associated with the requirement for revision hip arthroscopy.[10]

Although the exact etiology of the dysmorphism of the AIIS that leads to impingement is not clear at this time, in theory, the avulsion of the rectus tendon can

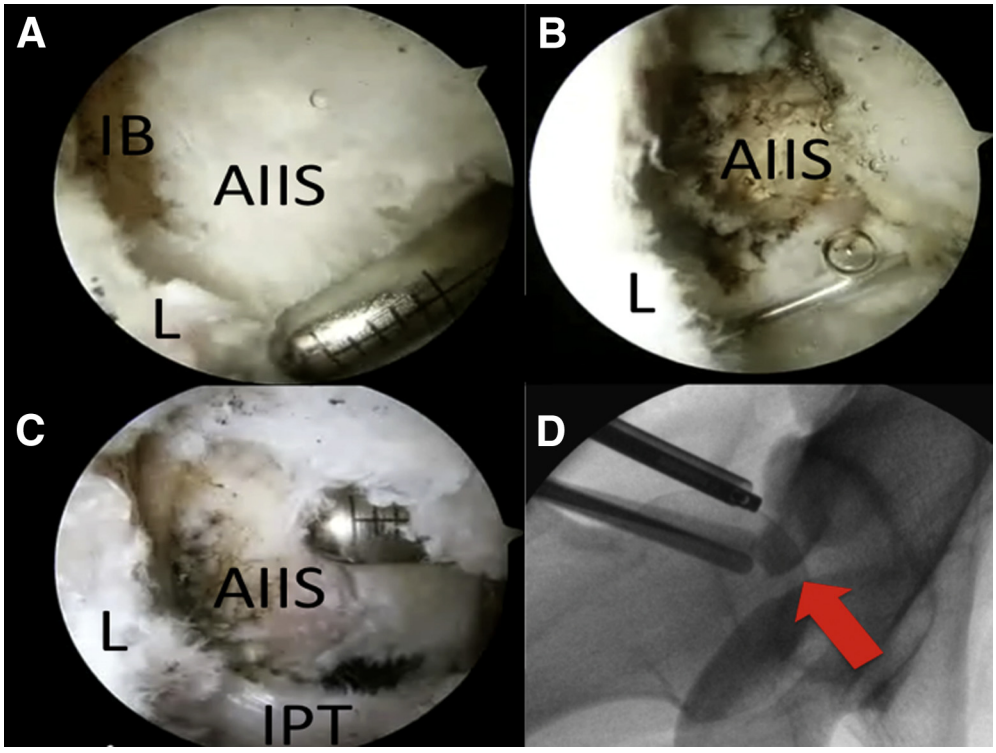


Fig 6. Arthroscopic photographs of right hip. (The arthroscope is positioned at the anterolateral portal.) (A) The anterior inferior iliac spine (AIIS) is exposed using a shaver; the iliac bone is on the left and labrum at the bottom. (B) The radiofrequency hook probe is used to further expose the AIIS. (C) The AIIS is fully exposed; the labrum is to the left and the iliopsoas tendon at the bottom. (D) Fluoroscopic view during exposure of the AIIS (red arrow). The position of the arthroscope and shaver is revealed. (IB, iliac bone; IPT, iliopsoas tendon; L, labrum.)

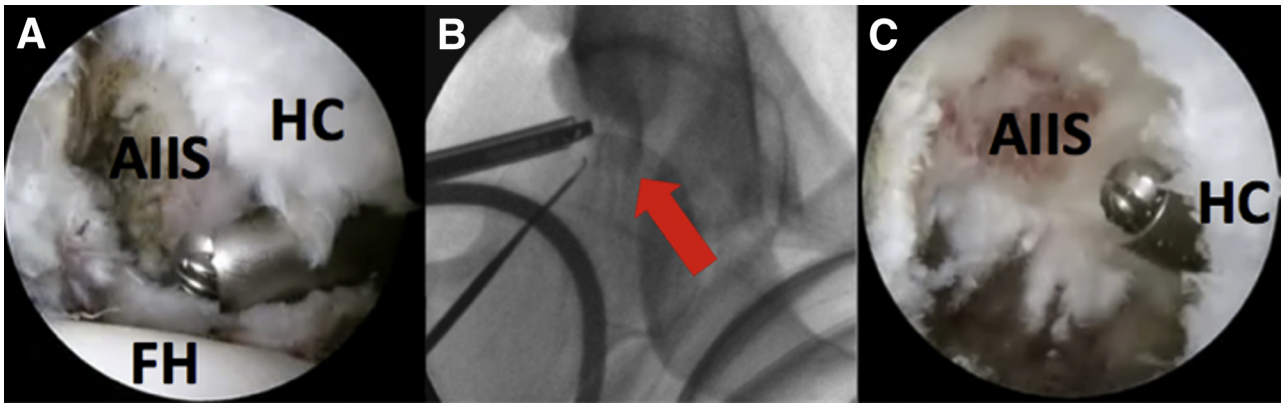


Fig 7. Series of photographs reveals decompression of the anterior inferior iliac spine (AIIS) in the right hip. (A) A 4.5-mm spherical burr is in position in the anterior portal as the decompression of the AIIS is performed. The hip capsule is to the right and the femoral head at the bottom. (B) Fluoroscopic view of the AIIS (red arrow). The arthroscope and radiofrequency hook probe are in position. (C) A more medial portal was established to reach the most medial aspect of the AIIS (the decompression is almost complete). The hip capsule is to the right. (FH, femoral head; HC, hip capsule.)

result in a prominent AIIS and thereby an increase in the distal volume of this structure that may generate impingement.[11] The avulsion usually occurs in skeletally immature athletic patients.[12] Other causes have been described as well (Table 1).

Hetsroni et al.[3] proposed a morphologic classification of the SSI. This classification establishes 3 types (I, II, and III) of possible AIIS morphologies (Table 2).

Patients with SSI typically complain of groin pain with flexion-based activity, and a sensation of discomfort anteriorly with flexion and lateral movements.[1] Impingement cysts can be located further distal on the femoral neck than typically observed with acetabular rim impingement, and increased sclerosis of the anterior acetabular rim on radiographs may also be consistent with SSI.[13] This sclerotic appearance of the anterior rim appears to be related to overlap of the anterior rim with distal extension of the AIIS.[3,14] When developmental SSI is suspected, it is often seen in the setting of acetabular retroversion. Inferior or distal extension of the AIIS on anteroposterior radiographs can also be mistaken for acetabular retroversion if not carefully scrutinized.[15]

When the AIIS extends to or below the acetabular rim and/or has excessive anterior extension, we consider an arthroscopic decompression as part of a femoroacetabular impingement corrective procedure.[16] Specific intraoperative findings can help to confirm the diagnosis. The AIIS can be decompressed at the level of the anterior rim and is easily identified by stripping the capsule off the AIIS with a combination of a shaver and radiofrequency probes.[15] However, there may be some inherent risks of performing this procedure arthroscopically that will require further investigation.[13,16] If an overly aggressive resection is performed, the rectus femoris could be detached from its origin, leading to a potential hip flexion deficit.[6,17] It is unclear whether this represents strictly bony impingement, strictly impingement of the rectus femoris, or a combination of both.[13]

Access to the area of the AIIS requires a medial extension of the anterior portal capsulotomy and exposure of the bony anatomy proximal to the anterior acetabular rim. This technique is complicated and requires experience from the surgeon. This is similar to exposure of the acetabular rim from the capsular side when addressing a pincer deformity.[18] Adequate exposure of the AIIS for arthroscopic visualization and navigation with fluoroscopy may be of great assistance to the surgeon (Table 3).

Table 3. Pearls and Pitfalls of Endoscopic Subspine Decompression of AIIS

Pearls
Perform a capsulotomy at the site of prominence of the AIIS for adequate endoscopic visualization.
Use fluoroscopic imaging throughout the resection of the AIIS to assist in adequate decompression.
Perform a dynamic evaluation of range-of-motion clearance to confirm adequate decompression.
Pitfalls
Monitor the abdomen throughout the procedure and, more importantly after the capsulotomy for access to the AIIS has been performed to detect the possibility of intra-abdominal fluid extravasation.
Make sure multiple straight-shaft and angled arthroscopic burrs are available to facilitate complete decompression of the AIIS. Because of the hardness of the bone in the area, the burrs may lose sharpness or fail.
Complete detachment of the rectus femoris tendon may occur with decompression of the AIIS.
Prophylaxis against heterotopic bone formation is advisable. Our preferred protocol is to use celecoxib 400 mg daily for 3 weeks after surgery.

AIIS, anterior inferior iliac spine.

Conclusions

Arthroscopic SSI decompression is a reproducible procedure that can provide improvement in range of motion and relief from the clinical symptoms. Arthroscopic treatment is a valuable tool in treating patients with intra- and extra-articular pathologies. To avoid any complication related to the arthroscopy, the surgeon should take all the necessary measures to prevent them in addition to performing adequate subspine decompression.

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