



The Outside-In Technique for Slipped Capital Femoral Epiphysis: A Safe and Reproducible Approach in Hip Arthroscopy

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Abstract: Femoroacetabular impingement syndrome caused by slipped capital femoral epiphysis (SCFE) can be successfully treated arthroscopically and with the minimally invasive, outside-in surgical technique. The advantages of the technique are that the residual cam-type deformity caused by the slippage can be corrected and reconstructed reliably and reproducibly before distracting the hip joint; and radiation with fluoroscopy is used for only definitive reduction and reconstruction, which is obtained with cannulated screws. In addition, this safe technique allows distraction of the hip after screw placement, without affecting the reconstruction, to address labral tears and chondrolabral delaminations caused by the impingement.

Slipped capital femoral epiphysis (SCFE) is the most common form of hip pathology in young patients (Figure 1), with consequential changes in the anatomy predisposing the hip to further cartilage damage and arthrosis. The chronicity and abutment of the residual deformity of the proximal femur can result in so-called femoroacetabular impingement syndrome (FAIS), causing anterior pain and disability.¹

The use of hip arthroscopy (HA) in children was introduced in 1977, with procedures in pediatric and adolescent patients who had a variety of orthopedic conditions, including developmental dysplasia of the hip (DDH), Legg-Calve-Perthes disease (LCPD), and slipped capital femoral epiphysis (SCFE). The procedure started with difficulties because of the lack of instruments and material for HA. Manual traction was

used without fluoroscopy, and visualization was very limited on the extraarticular and capsular portion of the hip, resulting in difficulties in orientation and visualization.² These days, HA in the pediatric and young population is very common, and more arthroscopic hip preservation and pediatric surgeons are offering this treatment with good to excellent results for the pathologies mentioned above.³⁻⁵ Our surgical arthroscopic technique is very similar to the one performed 40 years ago, since we do not use fluoroscopy to access the hip—on the contrary, we have achieved orientation and visualization of the capsule and hip around the peripheral compartment through the outside-in approach. To our knowledge, no surgical techniques have been published describing an outside-in technique as an option to treat residual deformities, impingement, and labral tears caused by SCFE in the hip.⁶

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The authors report that they have no conflicts of interest in the authorship and publication of this article. Full ICMJE author disclosure forms are available for this article online, as [supplementary material](#).

Received September 2, 2019; accepted December 3, 2019.

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2212-6287/191066

<https://doi.org/10.1016/j.eats.2019.12.001>

Surgical Technique

HA is performed with the patient in the modified supine position, supported on a standard operating room (OR) table. The hip is distracted with a hip distractor (ArthroMX, San Pedro Garza Garcia, Mexico) under general anesthesia, and no muscle relaxants are used, although they may be added. The upper body of the patient is prepared in the Tutankhamun fashion (Figure 2). Both arms are placed over the chest in a figure-8 or X position. Bony prominences are protected with an egg crate foam at the level of the elbows and

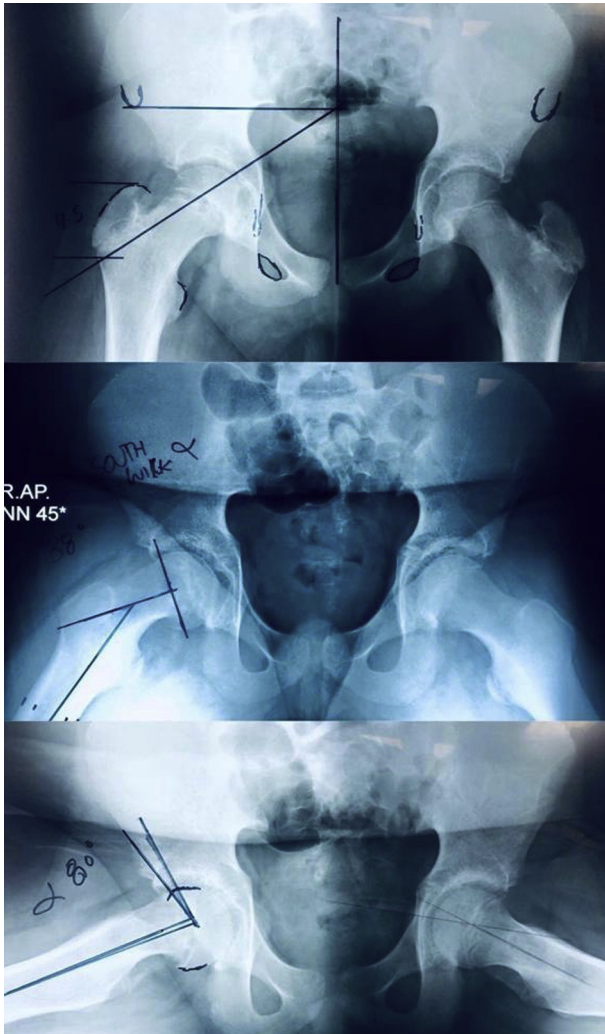


Fig 1. Radiographic landmarks for preoperative planning. Observe the anteroposterior (AP) pelvis, 45 Dunn view, and frog view of a 12-year-old patient with slipped capital femoral epiphysis (SCFE).

wrists. Hands are left free for intravenous line and medication passage, which are double-checked by the anesthesiologist. A long blanket is placed around the patient's upper body. Heavy-duty duct tape (3M, Austin, TX) is placed in an X or figure-8 fashion posteriorly, securing the patient's upper body on the OR table. The duct tape is wrapped around the patient several times (4 to 6 times), and the tape is stuck to the metallic edges of the OR table. Observation of the patient's thoracic motion, chest respiration, and intravenous line passage is done by the anesthesiologist.

The nonoperative hip is positioned in flexion, abduction, and external rotation to permit the passage of the image intensifier. The patient is prepped and draped in a standard fashion. Anatomic landmarks are marked on the patient's operative hip, and portals are established to access the peripheral compartment and central compartment. An anterolateral portal is used for vision, immediately anterior to the trochanteric tip; a paratrochanteric space portal used as a working portal, 3 cm distal from the anterolateral portal and over the anterior trochanteric border; and a new modified midanterior portal is located 1.5 cm above and between the anterolateral and paratrochanteric space portals, which we call the trochanteric triangle portal.

The anterior hip bursa is resected with a shaver and cauterized if bleeding with a radiofrequency wand. A longitudinal capsulotomy is performed posteriorly to access the head-neck junction and perform a femoroplasty for the residual cam deformity (Figure 3). If there is a pincer deformity, an acetabuloplasty is performed without distraction. With the image intensifier placed properly to obtain a truth AP of the pelvis and a lateral view, reduction of the hip is performed with maximal internal rotation and abduction. Posterior femoral head pinning is performed and observed in both x-ray planes, after pin reduction and passage of

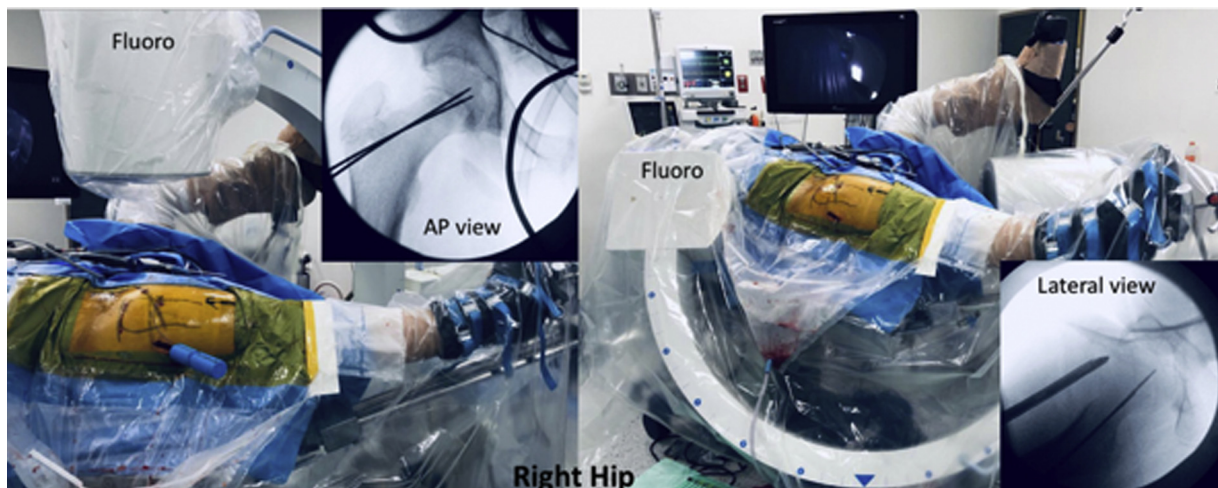


Fig 2. Hip arthroscopy in the modified supine position, with maximal internal rotation of the foot for hip reduction. Observe the image intensifier placed in the anteroposterior (AP) and lateral plane.

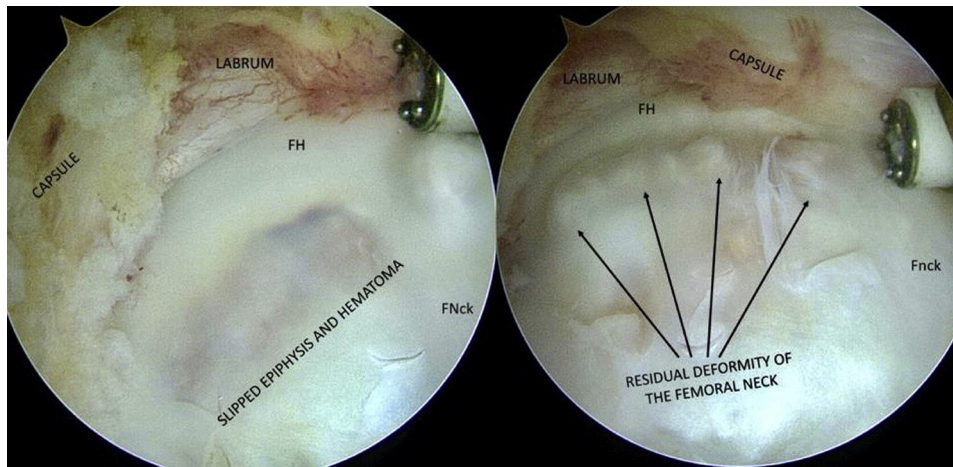


Fig 3. Arthroscopic view of the right hip showing the slipped epiphysis, hematoma, and residual femoral deformity.

cannulated 3.5-in. screws (Depuy-Synthes, New Brunswick, NJ). Final reconstruction is performed under fluoroscopic and arthroscopic control (**Figure 4**). Hip distraction can be made under arthroscopic vision to enter to the central compartment and observe the femoral head cartilage, labrum, chondrolabral junction, ligamentum teres, and acetabular fossa. If a labral tear

exists, it is tackled in a standard fashion with 2.8-mm carbon fiber Parcus knotless anchors (Parcus Medical, Sarasota, FL). Next, distraction is released, and an arthroscopic dynamic impingement test is performed with the help of the surgical assistant (**Table 1**), fellow, or nurse. This is useful to evaluate the site of impingement and the termination of the femoroplasty.

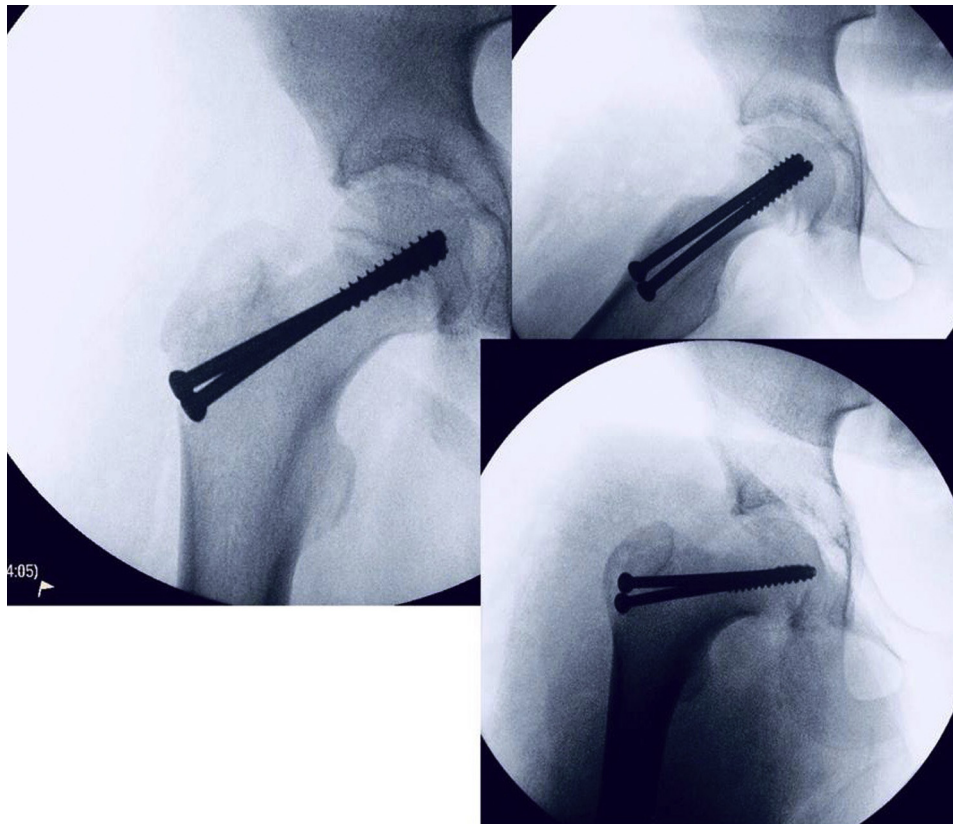


Fig 4. Final reconstruction of the slipped capital femoral epiphysis (SCFE) with cannulated screws. Observe the intraoperative images taken with the image intensifier in anteroposterior (AP) view, frog view, and 45 Dunn view.

Table 1. Tips and Pitfalls

1. Position of the nonoperative hip in flexion-abduction-external rotation is mandatory to permit the passage of the image intensifier.
2. Placement of the image intensifier is mandatory to obtain a perfect anteroposterior view of the pelvis and a lateral view for femoral head pinning.
3. Hip arthroscopy is performed first with a capsulotomy using the outside-in technique, to observe the slipped head-neck junction and hematoma.
4. Identify the fibers of the anterior capsule to address the capsulotomy.
5. The reflected head of the rectus femoris is also an anatomic landmark if you get lost in the peripheral compartment of the hip.
6. The femoroplasty is performed at the level of or below the epiphysis where the slipped and cam-type deformity is present.
7. Position the hip in abduction and maximal internal rotation of the foot for reduction under fluoroscopic vision.
8. Pinning is done under fluoroscopic guidance and also under arthroscopic vision.
9. Hip distraction can be made safely to observe the femoral head, acetabular cartilage, and acetabular fossa.
10. A labral repair can be made safely after pinning the slippage with hip distraction.

It is doubled-checked with the image intensifier in all x-ray planes (Figure 5, Table 2, Video 1).⁷⁻⁹

Discussion

As hip arthroscopy has gained in popularity over the past few decades, the indications for arthroscopic and preservation treatments for hip pathologies have grown exponentially, including treatment for SCFE. Reconstruction with screw placement is currently the treatment of choice to prevent slippage and the residual

deformities causing FAIS and, later in life, hip arthritis. Stabilization and reconstruction alone with screws may not relieve symptoms completely and will not preserve the hip joint in the long term, because an SCFE joint will impinge and consequently cause labral and cartilage delamination.^{7,8} HA as a treatment for SCFE has been reviewed by several authors who investigated articular cartilage damage and also labral injuries from fracture of the perichondral ring of the epiphysis. They concluded that this investigation would be of great

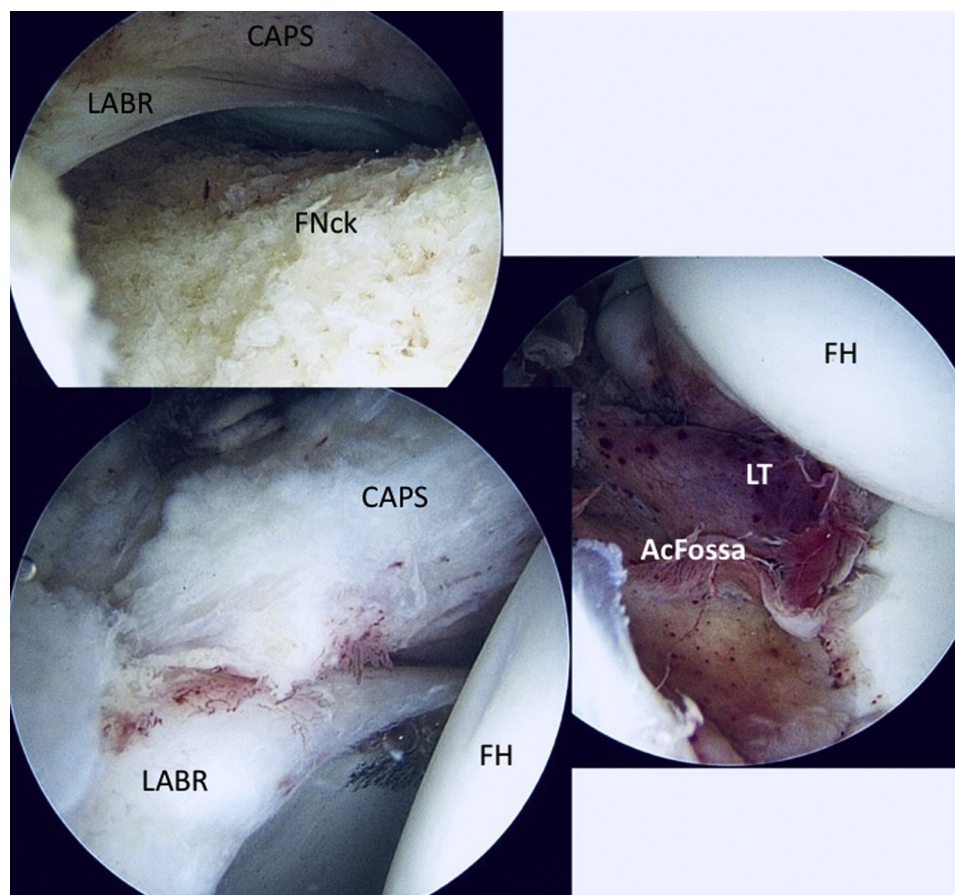


Fig 5. A dynamic impingement test is performed. Observe the space between the femoral neck and the labrum in maximal hip flexion (upper left quadrant), the distracted hip with an intact labrum and a pristine femoral head (lower left quadrant), and the hematoma and inflamed ligamentum of teres (right).

Table 2. Advantages and Disadvantages

Advantages

1. The ability to address concomitant hip deformities, labral tears, and ligamentum teres tears;
2. Direct visualization of acetabular and femoral head cartilage;
3. Hip distraction under arthroscopic vision;
4. Dynamic impingement test after hip reduction and reconstruction; and
5. Less radiation because there is no distraction as a starting point to enter the central compartment.

Disadvantages

1. Not knowing the hip anatomy to properly perform the outside-in technique to visualize the anterior hip capsule;
2. The learning curve of the outside-in technique in hip arthroscopy;
3. Instability of the hip if a capsulectomy is done instead of a capsulotomy; and
4. Laceration or foot palsies resulting from the maximal internal rotation of the hip while reducing and reconstructing to place the pins and screws.

benefit in the treatment and interpretation of pathology in SCFE. They also mentioned that evacuation of the resultant hematoma by arthroscopic lavage effectively reduces pain and may permit earlier postoperative motion and weightbearing.

Leunig et al.⁵ mentioned that the ultimate goal of SCFE treatment should be to intervene before irreversible joint injury occurs. What is most important for mild SCFE is in situ pinning with immediate arthroscopic osteoplasty to reduce or even eliminate hip impingement, which is reportedly the cause of osteoarthritis of the hip.

Siebenrock and Schwab¹⁰ mentioned that the cam-type deformity in young patients is not an osteophytic reaction. Although it can be a sequela of SCFE, it mostly arises in hips without previous childhood disease. More disturbingly, this deformity seems to be triggered by certain sports and pivoting activities during growth.¹¹ Recent research also suggests that alteration of the proximal growth plate in children who engage in elite-level vigorous sporting activity may contribute to its development.¹²

Castañeda et al.¹ highlighted that the occurrence of FAIS or the pistol grip deformity in even a low-grade slip is not uncommon. Almost 80% of their patients presented clinical and radiographic signs of FAIS; what is more, they also found that the degree of deformity was directly related to the presence of hip arthritis in early adulthood.

We strongly believe that the current standard of care for a stable SCFE is still in situ pinning, but evolving knowledge on FAIS should lead to excellent long-term

results in young patients. We believe that we should intervene fast and acutely before irreversible cartilage injuries and damage. In our patients with SCFE treated by the outside-in technique, we have found it's very important that in-situ pinning with arthroscopic femoro-plasty eliminates hip impingement and also treats labral tears and addresses cartilage injuries in the same arthroscopic stage.

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