Technical Note

Tractionless Hip Arthroscopy for Septic Arthritis in Children

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Abstract: Surgical management of septic arthritis in young children is traditionally performed with open techniques, although arthroscopic approaches are commonly used in the knee and shoulder. Hip arthroscopy is technically demanding in small children and requires modification from traditional hip arthroscopy. The purpose of this study is to describe a safe technique to perform hip arthroscopy without traction in the pediatric hip and, secondarily, to report short-term results of a case series. Pediatric hip arthroscopy can be safely performed without traction on a radiolucent table and allows joint irrigation and debridement including drain placement through the use of 1 or 2 portals. Hip arthroscopy is a safe, valuable, minimally invasive technique in the treatment of children with septic arthritis of the hip.

Septic arthritis of the hip is an urgent condition that requires prompt diagnosis and treatment in both adults and children. Delay in treatment can result in progression of the infection with potential for harm to the joint and surrounding tissues.[1,2] The gold standard of treatment for septic arthritis of the hip in children is irrigation and debridement through an open arthrotomy.[3-8] However, arthroscopic techniques are commonly used for other joints including the knee and shoulder. The recent increase in the number of orthopaedic surgeons who are experienced with hip arthroscopy[9,10] will potentially increase the frequency with which this technique is used to address septic arthritis. However, given the small size of the hip joint space in children and the familiarity and comfort that most pediatric orthopaedic surgeons have using the standard open arthrotomy approach, the use of arthroscopy for septic arthritis of the hip in children may be limited without technical modifications and clear guidance.

Arthroscopic treatment for children with septic arthritis of the hip has been previously reported, but it has not become widespread.[11-18] Other than a number of small case series there has been one prospective comparison of open versus arthroscopic treatment of children with septic arthritis of the hip.13 Of the 20 children studied, there was no difference in final outcome.[13] However, the length of hospitalization was decreased in the arthroscopy cohort.[13]

Hip arthroscopy is a minimally invasive method to visualize the joint space and perform effective irrigation and debridement of infection. Less soft tissue dissection and disruption has an obvious advantage of promoting rapid rehabilitation. However, the smaller anatomy poses challenges to safe portal placement with the use of modern hip arthroscopic equipment and standard 5.0-mm cannulas. Additionally, traditional hip arthroscopy commonly uses traction to enter the central compartment, whereas peripheral compartment entrance without traction has been well described. Hip

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Table 1. Specific Potential Risks Associated with Pediatric Hip Arthroscopy

Transient pudendal nerve palsy
Injury to medial femoral circumflux or profundus femoris artery
Injury to obturator nerve
Instrument breakage
Injury to chondral surface or labrum
Osteonecrosis/avascular necrosis
Hip instability
Recurrent infection

arthroscopy in children is technically more challenging and potentially poses a risk of labral or chondral damage during instrumentation of the joint space (Table 1; Fig 1A). Iatrogenic chondrolabral injury may be avoided by accessing the hip in the peripheral compartment first (Fig 1B). The purpose of this study is to describe a safe technique to perform hip arthroscopy without traction in small children who are presumed to have septic arthritis of the hip.

Surgical Technique

Indications and Setup

Pediatric tractionless hip arthroscopy can be performed on any child with a suspected septic hip after appropriate history and physical examination, laboratory evaluation (complete blood count with differential, erythrocyte sedimentation rate, C-reactive protein, and blood culture), and radiographic evaluation (plain radiograph, ultrasound, or magnetic resonance imaging) to confirm the presence of a hip effusion and assess for the possibility of contiguous infection.[19]

This technique can be performed in children with an age range from 6 months to 12 years. For those who are older than 12 years, arthroscopy can be performed in the traditional manner either using traction or tractionless approach with initial peripheral compartment entry. Children with prior hip procedures must be approached with caution, as key structures may be in abnormal anatomic positions or the capsular space may be constricted. Exclusion criteria include any concerns for aberrant anatomy or an inability to rotate the hip passively externally.

Setup and equipment are listed in Table 2. The procedure is performed on a radiolucent table under general anesthesia without the need for a traction device, regional anesthesia, or muscle relaxation. Fluoroscopy is used, and either a 30° or 70° 4.0-mm arthroscope can be used based on surgeon preference. A hip arthroscopy set including a 14-gauge needle and a nitinol wire is commonly provided by most hip arthroscopy vendors and comes in a single set for traditional hip arthroscopy. A cannulated arthroscopy sheath system is required with options including a metal cannula (4.5 or 5.0 mm) from a traditional hip arthroscopy set or a blunt polymer-tipped cannula (Flowport Cannula, Stryker, Kalamazoo, MI). Fluid management may be accomplished with either gravity or an arthroscopic pump under low pressure settings (<35 mm Hg).

Antibiotics should be held until after the joint aspiration has taken place. Standard prepping and draping should include the entire lower extremity and allow access to the adductor longus tendon and the iliac crest. Prior to aspiration and portal placement, anatomic landmarks should be marked. These include the anterior superior iliac spine (ASIS), greater trochanter, and the adductor longus tendon.

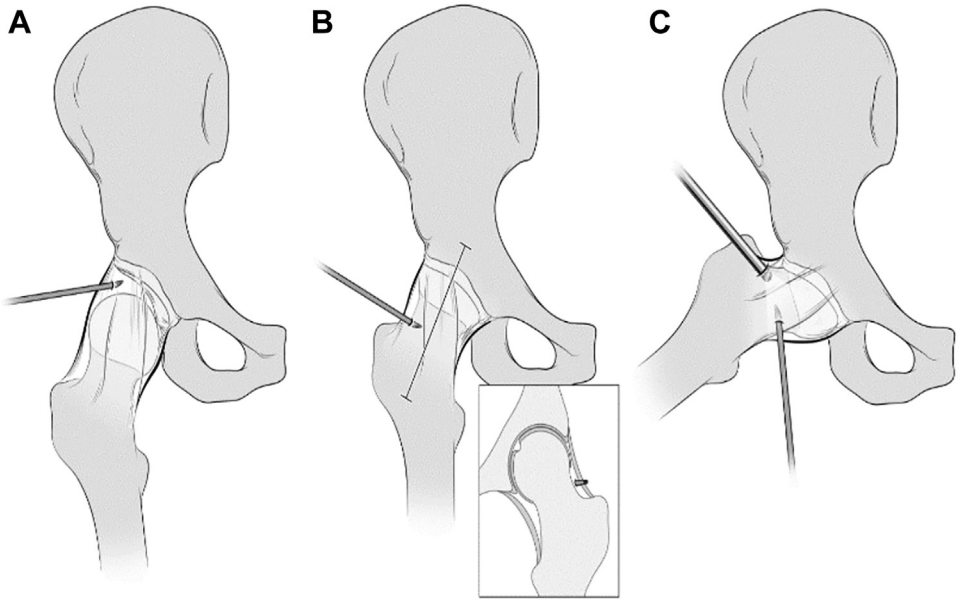

Fig 1. Initial portal entry points. (A) Represents the traditional anterolateral portal that is used in adults, which places the arthroscope in the central compartment with the hip in traction. (B) Represents the modified anterolateral portal used in young patients in which the arthroscope is placed in the peripheral compartment without traction. (C) Dual portal option in hip arthroscopy for children using the subadductor portal. Credit: Boston Children's Hospital, © 2021

Table 2. Equipment for a Hip Arthroscopy in a Very Young Patient

Recommendations are based on known available equipment that might minimize iatrogenic injury in a very young hip. Note that listed equipment is not necessarily the same for a traditional hip arthroscopy for these authors.
Radiolucent table—traction table not required
Fluoroscopy
Needle aspiration:
18-gauge spinal needle
5-cc syringe
20-cc of normal saline solution
Arthroscopy equipment:
Standard arthroscopy setup with a dual flow cannula or adapter
4.0-mm arthroscope: 30° and 70° available
14-gauge needle
Nitinol wire
Cannula system (Flowport Cannula, Stryker Incorporation, Kalamazoo, MI)
Suction tubing
Shaver—4-mm curved full radius
10-French Hemovac

Aspiration Technique (if not previously performed) (With Video Illustration)

The aspiration of the hip joint can occur through the same starting point as the initial portal. The location of this needle should be at the intersection of a vertical line extending distally from the ASIS and a horizontal line extending medially from the tip of the greater trochanter (Fig 2, Video 1). If conversion to an open arthrotomy may be necessary, consider minor adjustments to this starting point to include (1) be directly over the inguinal fold, and (2) at the interval of the sartorius and tensor fascia lata. This will be the site of the portal and is typically more anterior and proximal than a standard anterolateral portal used for traditional traction hip arthroscopy.

With the assistance of fluoroscopy and leg in extension, a 14- or 18-gauge needle is directed toward the midpoint of the femoral neck approximately 10° to 20° toward the bottom of the ipsilateral tear drop (Fig 3, Video 1). Compared with the trajectory of a standard anterolateral portal, this avoids aiming the needle at the articular margin of the femoral head. An 18-gauge needle is preferred if limited available fluid is suspected owing to its shorter length and smaller bore to limit wasted aspirate in the needle. Use of the stylet will avoid fat and capsule plugging the needle. Placement of the needle is anterior and oblique to the femoral neck. If concern exists regarding the location of the needle, an arthrogram can be performed but may obscure future fluoroscopic visualization.

At least 1 cc of aspirated fluid is necessary to send to the laboratory for all appropriate studies. The aspirate is routinely sent for cell count (250 μL), aerobic culture (1-2 drops), and a 16S Ribosomal PCR (750 μL; to detect a wide variety of bacterial organisms that are relevant in pediatric septic arthritis, including *Kingella kingae*, which commonly infects children between the ages of 6 months and 4 years).[20] If the gross appearance of the aspirate is consistent with normal synovial fluid, the surgeon may decide to await the cell count prior to proceeding with arthroscopic irrigation and debridement. Immediately after aspiration, the hip joint should be insufflated with 10 to 20 cc normal saline solution to fully distend the capsule to increase the working space for portal entry and avoid iatrogenic chondral injury. At this point, appropriate empiric antibiotics may be administered by the anesthesia staff.

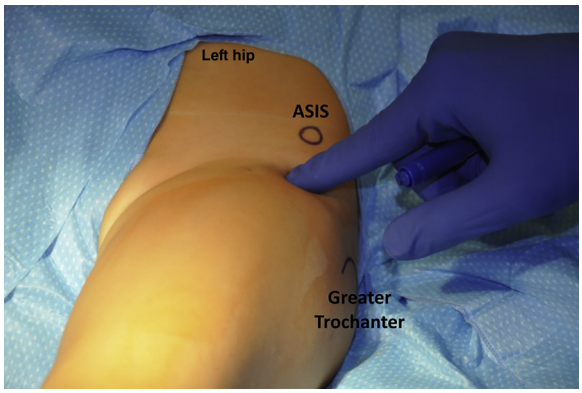

Fig 2. Anatomic landmarks to note prior to performing a needle aspiration of the left hip or prior to a left hip arthroscopy. The photograph is the left hip of a 7-year-old. Note the head of the patient is on the top of the image, whereas the left thigh is directed to the bottom of the image. (ASIS, anterior superior iliac spine.)

Tractionless Pediatric Hip Arthroscopy Technique Portal Placement

Two portals are typically used for the visualization and irrigation of the hip joint. However, if limited synovitis or fibrinous exudate is present, a single portal may be effectively used for the procedure, including drain placement. The advantage of the second portal is to allow for synovial debridement or biopsy specimen, potentially better fluid flow through the joint, and visualization of the drain placement. For the modified anterolateral portal, 5-mm transverse or vertical incision can be performed at the entry location of the needle at the inguinal fold, as previously described, to allow for cosmesis and an opportunity to convert to an open arthrotomy if needed. After the stylet is removed from the 17-gauge needle and free pressurized flow of fluid is returned through the needle hub, a nitinol wire is inserted through the needle and visualized to be within the capsule by fluoroscopy. The nitinol wire should extend past the bony head-neck junction but be contained within the capsule (Fig 4). Using the Seldinger technique,[21] the path of the nitinol wire can be dilated and then replaced with a standard hip arthroscopy cannula. This can be performed with the leg in extension to provide tension on the capsule during

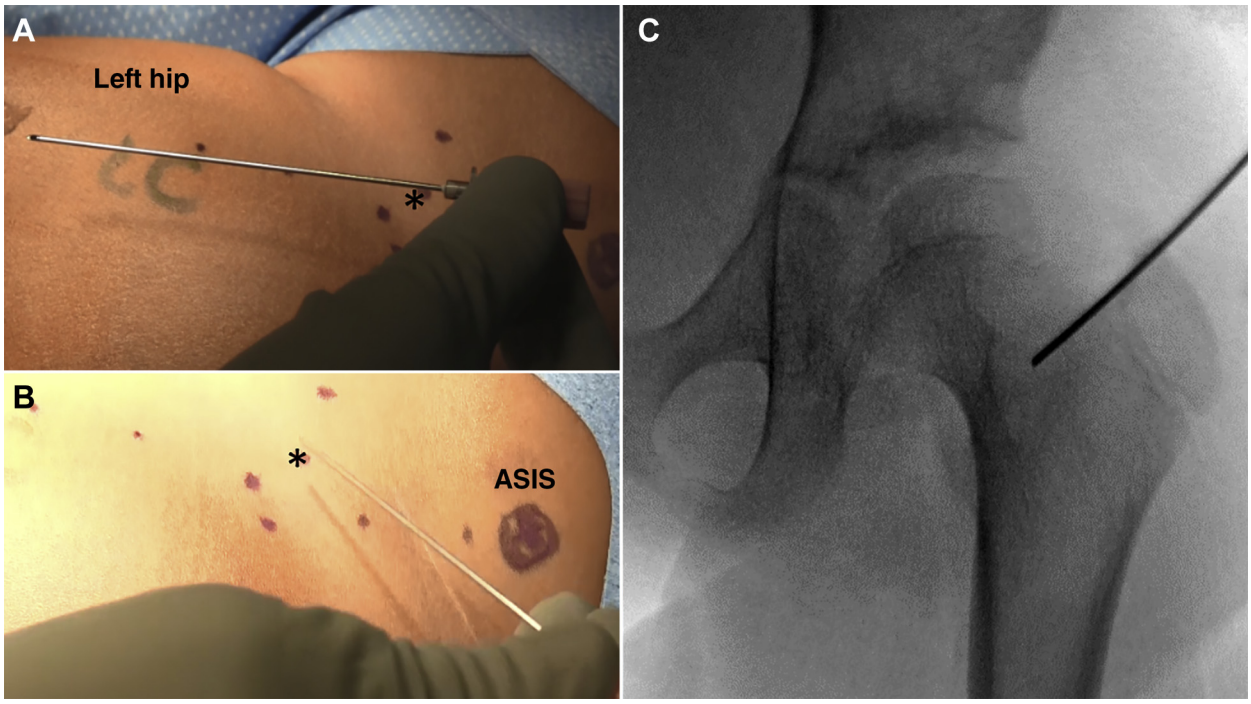

Fig 3. Image description of a needle aspiration in a pediatric patient with a suspected septic hip. Note image is a left hip with the head of the patient to the right of the image (A) is showing an 18-gauge needle pointing down the leg of the patient. Alternatively a larger bore needle (17-gauge) can be used that will allow a nitinol wire to be passed prior to the cannulation of the joint. The inguinal fold is at the junction of the 2 dotted lines marked with an *. (B) Needle prior to skin penetration at junction of ASIS (noted with an x and a circle) and the greater trochanter (not seen on this image). (C) Anteroposterior fluoroscopic image of the needle trajectory toward the base of the left femoral neck. (ASIS, anterior superior iliac spine.)

cannula entry or at 45° of hip flexion to relax the capsule. We prefer the 5.0-mm plastic blunt tip cannula to avoid iatrogenic scuffing of the joint cartilage (Fig 5, Video 1). A standard 4.5-mm arthroscope is then inserted. A diagnostic arthroscopy can now be performed visualizing the labrum, synovium, and peripheral compartment of the femoral head (Fig 6). Slight manual traction can be performed to access and lavage the central compartment if needed. Using a dual flow cannula, alternating the inflow and suction can adequately irrigate the hip with a single portal (Video 1).

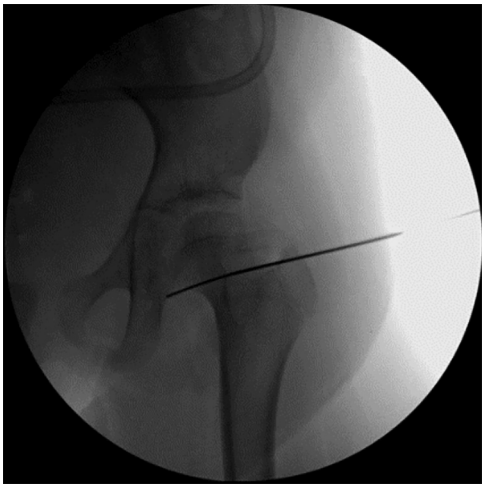

Fig 4. Anteroposterior fluoroscopic image of a left hip after advancement of the nitinol wire from the initial portal position. Tactile feedback is needed to ensure the wire is within the capsule with an endpoint over the anteroinferior acetabular wall.

Fig 5. Placement of a blunt cannula over the nitinol wire into the left hip under fluoroscopic guidance. Image shows an anteroposterior left hip.

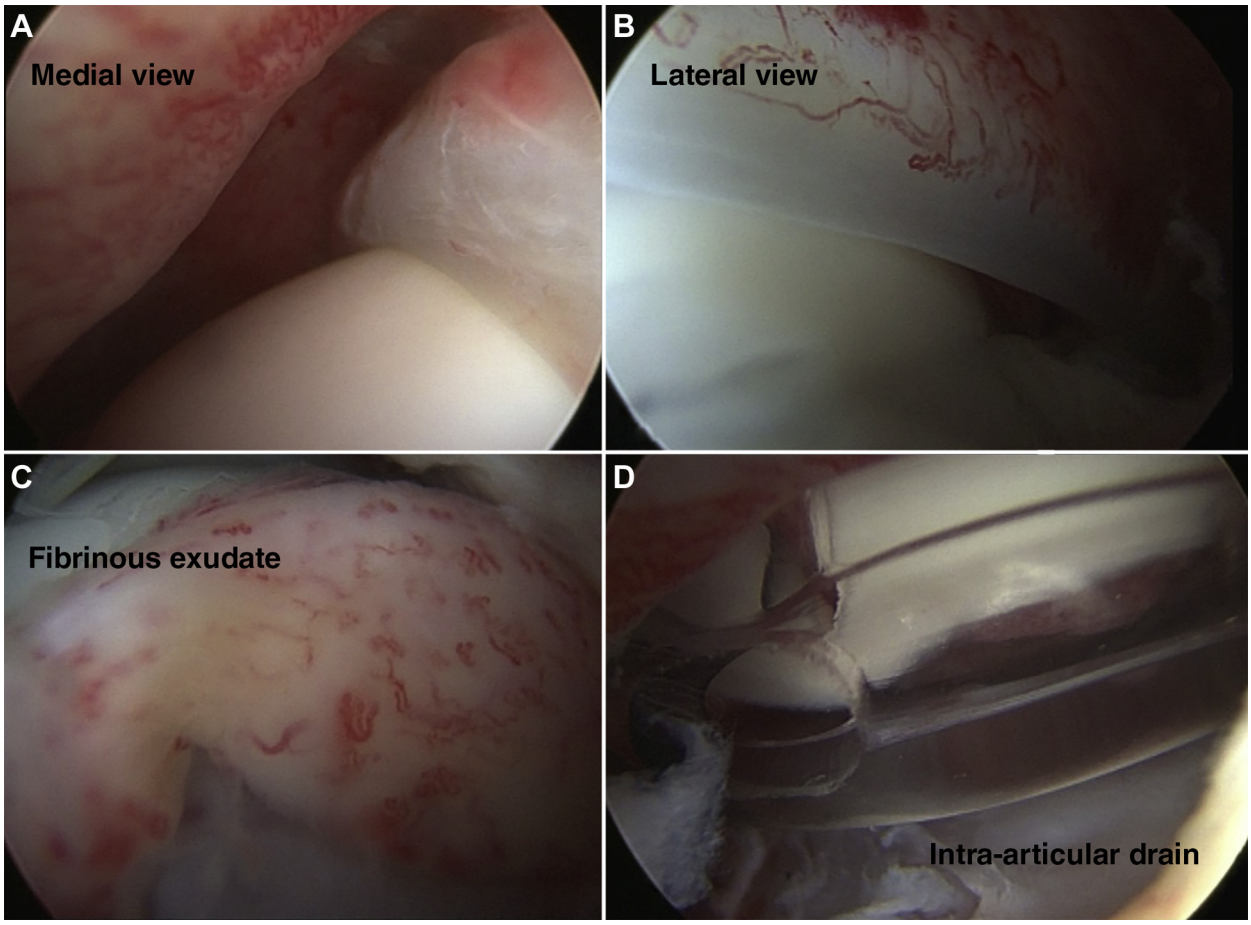

Fig 6. Arthroscopic images from a left hip arthroscopy performed for a septic hip in a 3-year-old boy. Hyperemia is noted on the labrum and synovium indicative of synovitis. Images from the primary modified anterolateral portal looking medially (A) and laterally (B). (C) Image shows fibrinous exudate that may necessitate a second portal for debridement. (D) Visualization of placement of intra-articular drain.

A second subadductor portal can be considered for a synovial biopsy specimen, debridement or synovectomy, or to visualize the placement of the drain (Fig 7, Video 1). A subadductor portal can be used as a secondary portal or as a primary portal. The technique for needle placement is identical to previously described techniques to perform a hip arthrogram.[22] The leg is then placed in the figure-4 position for the subadductor portal (Fig 8A). Prior to placement of the needle, the neurovascular bundle should be palpated and marked (Fig 8B). The adductor longus tendon is readily palpated in this position. A 15 blade is used to make a 5-mm incision through the skin only posterior to the adductor longus tendon.

The hip length spinal needle is inserted just posterior to the adductor longus tendon, which will minimize injury to the obturator nerve. The needle should then aim toward the ipsilateral nipple of the patient (Fig 8C). Use of fluoroscopy is important during this step as the needle should not be aimed toward the base of the femoral neck as this will put the medial femoral circumflex and profundus femoris artery at risk. The trajectory of the needle should be the femoral head neck junction (Fig 8D) and can also be visualized directly with the arthroscope. A nitinol guidewire is placed, and another 5.0-mm cannula is inserted over the guidewire into the joint through this subadductor portal (Fig 8E). The establishment of these portals can be reversed.

Washout of the Hip

Three liters of fluid are washed through the joint either by gravity or with the use of a pump. Debridement and biopsy specimen of synovitis can be performed with a shaver or grasping instrument. The hip can be gently manipulated in rotation to ensure thorough irrigation and debridement. If necessary, slight gentle traction with internal and external rotation can be used to access the central compartment.

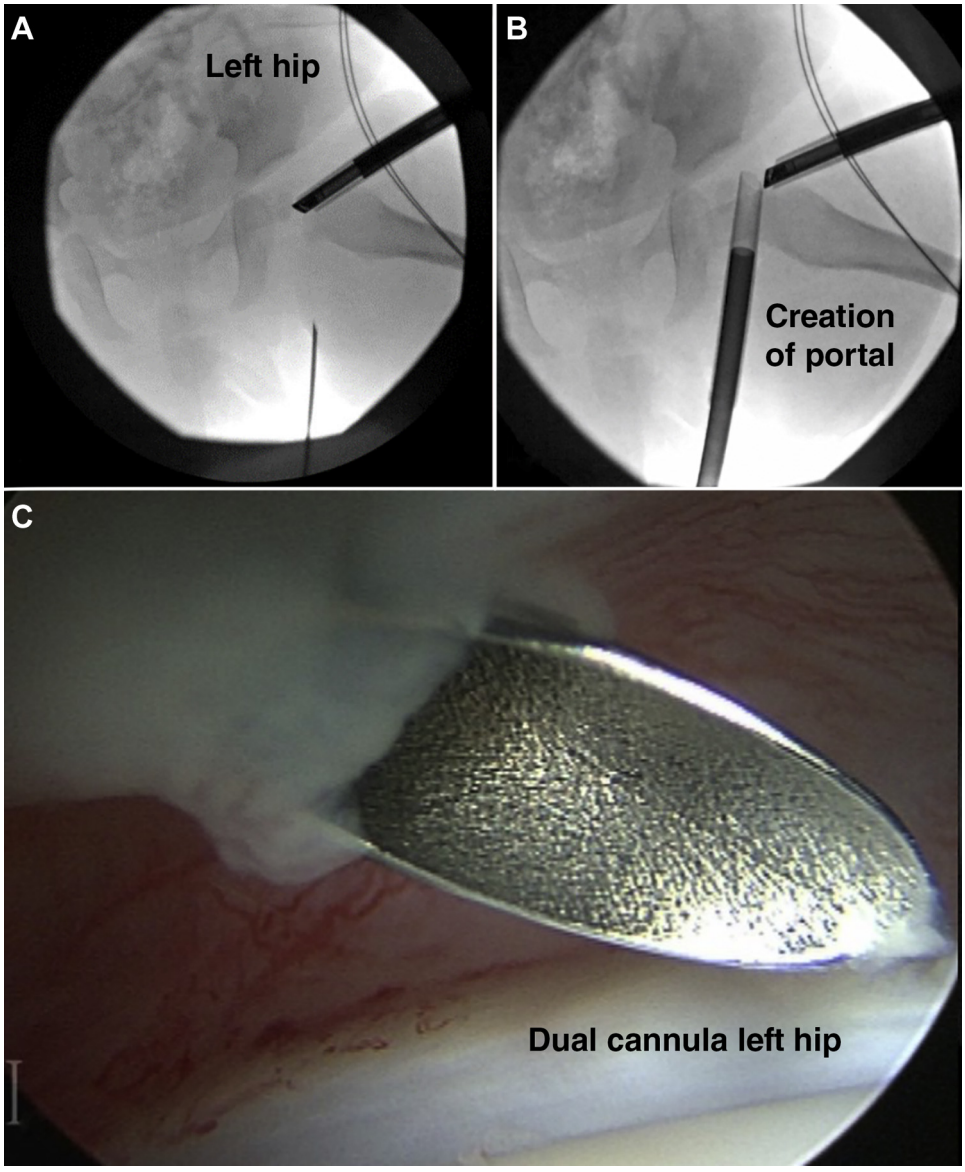

Fig 7. Demonstration of the establishment of a subadductor portal under direct visualization. (A) Anteroposterior fluoroscopic images of a left hip in a figure-4 position. Trajectory of the needle must start from posterior to the palpable adductor longus and aim toward the base of the femoral head neck junction. Although direct visualization of creation of this portal is not required (B), it is useful to avoid iatrogenic injury. (C) Anteroposterior arthroscopic image of a dual cannula left hip arthroscopy in a 3-year-old patient in a figure-4 position.

Drain Placement

Once irrigation and debridement of the joint has been performed; a 10-French drain is placed through the anterior portal cannula with viewing from the subadductor portal. The camera can be used to help secure the drain by holding the camera against the drain on the femoral neck to ensure that the drain does not dislodge when pulling out the anterior cannula. It is also possible to place the drain using a single portal technique. This is accomplished by removing the arthroscope from the sheath, cutting the blind end of the drain approximately 2 to 3 fenestrations from the end, and inserting the drain through the arthroscope sheath until resistance is felt (within the joint capsule). The arthroscope sheath is then pulled out of the hip while gentle forward pressure is maintained on the drain to keep it from being removed as the sheath is being withdrawn.

Closure

The skin is closed with small absorbable sutures; a drain stitch is used at the discretion of the surgeon. The drain is typically left in place for 48 hours or until resolution of drainage.

Discussion

Septic arthritis of the hip is an uncommon but potentially devastating diagnosis in children. Most cases occur in patients under 2 years of age, with open incision and drainage as the most frequently used form of surgical intervention. Traditional hip arthroscopy techniques can be difficult in this patient population.

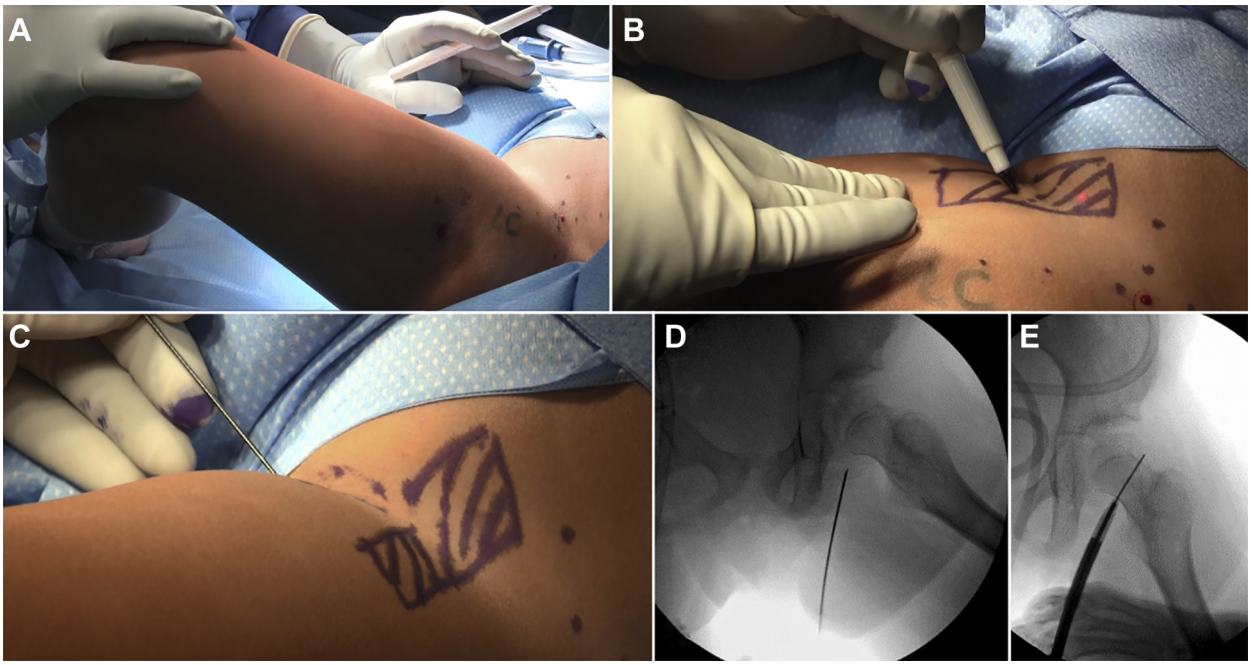

Fig 8. A primary subadductor approach to placement of a needle in the left hip of a 7-year-old patient. Images show the head of the patient to the right of the photograph. Figure-4 position (A) is ideal for placement of a subadductor needle. Prior to needle placement, acknowledging the femora neurovasular bundle is valuable (B). The needle is placed posterior or below the adductor longus tendon (C) and aimed toward the nipple of the patient. The needle should enter the femoral head neck junction to avoid iatrogenic injury (D). After needle placement and confirmation, a nitinol wire and blunt cannula can be inserted (E).

However, technical modifications using safe anatomic intervals provides access to the hip, even in small children, and permits effective treatment. This technique has been performed in children as young as 6 months of age. Hip arthroscopy offers a minimally invasive approach with arguably less morbidity than open arthrotomy procedures, which frequently jeopardize the lateral femoral cutaneous nerve or occasionally lead to hip subluxation or osteonecrosis after aggressive anterior capsulectomy (Tables 3 and 4).

Access to the peripheral compartment is performed obliquely to the femoral neck, minimizing the probability of iatrogenic damage to the articular surface of the femoral head.[23] The safety of the medial portals has been established by cadaveric and radiographic simulation and has been used clinically.[24,25] The use of a lateral and medial portal allows excellent visualization of the joint, the ability to introduce an arthroscopic shaver and perform synovial debridement, and thorough irrigation of the joint.

Indication for very young hip arthroscopy continues to expand with very few cases of iatrogenic injury or residual osteonecrosis. Eberhardt et al.[26] reported on 25 hips that underwent arthroscopy for dislocated hip caused by developmental dysplasia of the hip with no reported cases of technical complications. In another series comparing open versus arthroscopic treatment of developmental dysplasia of the hip in children younger than 18 months old, Duman et al.[27] reported 2 of 26 (7.6%) arthroscopic cases developed avascular necrosis (AVN) of the hip. Arthroscopic treatment was compared with a match cohort that under a medial approach to the young hip with an AVN rate of 14.2%. Based on this limited data, hip arthroscopy in the very young patient does not add additional risk of AVN compared with a medial open approach for developmental dislocation of the hip.

Septic arthritis of the adult hip is an even rarer entity, which is treated with aspiration, open or arthroscopic irrigation, and debridement.[11,15,28-33] Much like the pediatric literature, the limited case series of arthroscopic treatment of septic arthritis of the hip in adult populations have provided favorable results.[11,30,33]

Although children with septic arthritis have been successfully treated with hip arthroscopy,[11-17] open surgery remains the first choice for many surgeons for the treatment of septic arthritis. El-Sayed[13] compared open arthrotomy to arthroscopic drainage for septic arthritis of the hip and reported a shorter hospitalization time with equivalent clinical outcome and infection control using arthroscopy. Most previous reports have used traction, multiple portals, or have not performed drain placement.[11-17] Recently, Duman et al.[18] and Garg et al.[34] reported case series of pediatric hip arthroscopy for septic hip with a combined 29 patients.

Table 3. Pearls and Pitfalls of Pediatric Septic Hip Arthroscopy

Pearls
Use of blunt soft cannulas will prevent iatrogenic injuries.
Needle and portal entry should be performed with hip in flexion to relax anterior capsule.
Use 18-gauge needle for the aspiration and insufflation.
Marking out anatomic landmarks is valuable for needle trajectory.
Anterior portal should be along the same incisional line used for an open arthrotomy to prepare for conversion to open arthrotomy if necessary.
Appropriate use of fluoroscopy will aid in needle trajectory and avoid iatrogenic injury.
For simple irrigation, a single portal arthroscopy is acceptable.
Either 30° or 70° arthroscope is acceptable.
Figure-4 position is best for the subadductor approach.
Subadductor approach should be performed with fluoroscopy and under direct visualization.
Drain placement performed under direct visualization to ensure drain is deep to capsule.
Pitfalls
Avoid in a child with a prior hip procedure.
Avoid in a child that does not have passive external rotation.
The larger size of the 14-gauge needle for aspiration will limit the opportunity to obtain adequate fluid for cell count and culture.
Ensure nitinol wire is within the hip capsule prior to insertion of the cannula.
Avoid nitinol wire breakage with in-line trajectory during portal placement.
Cannula entry should be performed with control and not under force to avoid chondral or labral damage during entry.

Two children (6.8%) required a secondary irrigation and debridement, whereas another (3.4%) sustained a transient femoral nerve palsy. In these series, no cases of AVN were noted with greater than 1 year follow-up in both series. In our small series of 14 children, we have had no complications and full infection control.

The current manuscript is a technical description of a simple reproducible technique that can be performed expeditiously and may allow a faster recovery (Table 4). It avoids a potentially unsightly scar, and may provide a shorter hospitalization compared with open arthrotomy. The technique can be performed with knowledge of the anatomy, limited arthroscopic experience, and with little morbidity.

Table 4. Advantages and Disadvantages to Pediatric Hip Arthroscopy for a Septic Hip

Advantages
Arthroscopy for septic arthritis in other joints is now well accepted.
Technical ease with experienced arthroscopist.
Decreased length of hospitalization.
Improved visualization of intra-articular structures including synovium.
Smaller incision.
Decreased operative time.
Decreased risk of traction injury to lateral femoral cutaneous nerve.
Ease performing synovial debridement or biopsy specimen.
Disadvantages
Gold standard remains open arthrotomy.
Technically challenging especially for those not facile with arthroscope.
Requires specialized instrumentation.
Visualization may be challenging without adequate insufflation.
Requires fluoroscopy.
Potential risk to surrounding structures during portal entry.
Cannot be performed if aberrant anatomy is suspected or prior surgery.
Expensive—increase use of disposable equipment.

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