Review Article

Surgical Hip Dislocation in Pediatric and Adolescent Patients

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ABSTRACT

Treatment of common orthopaedic pathologies about the hip necessitates a thorough understanding of complex anatomy, pathology, surgical technique, and appropriate indications. Furthermore, treatment of orthopaedic pathology about the pediatric and adolescent hip joint requires an additional level of understanding of intricate acetabular and femoral deformity, physeal growth, skeletal maturity, and blood supply. Surgical hip dislocation (SHD) provides excellent exposure to the hip joint and allows for the treatment of a wide array of pathology, including trauma, oncologic conditions, complex hip deformity, chondrolabral pathology, and femoral acetabular impingement. To effectively treat these pathologies, one must be familiar with a standardized SHD technique and have an excellent understanding of the particular nuances of a variety of pathologies. We review the SHD technique and the various procedures it may be combined with to treat pediatric and adolescent hip conditions.

Level of Evidence: V, Expert opinion.

The contemporary surgical hip dislocation (SHD) technique was developed and popularized in the early 21st century by Ganz et al after a better understanding of proximal femoral head vascular anatomy was developed.[1,2] Before this, the risk of osteonecrosis to the femoral head with other approaches to the hip joint was a significant concern when a hip dislocation was performed for indications other than arthroplasty. The SHD approach developed by Ganz et al uses a greater trochanteric osteotomy that leaves the short external rotators intact and at the same time protects the medial femoral circumflex artery (MFCA)—the main blood supply to the femoral head[3]—thus decreasing the risk for iatrogenic osteonecrosis. Furthermore, this technique largely preserves the abductor function of the gluteal musculature after osteotomy healing. These modifications have been critical to the now broader application of this approach for the treatment of a variety of pathologies.

The SHD approach may be used for a vast array of pathologies about the adult hip. The original description of this technique presented results of 213 procedures (mean age 33.5 years) for the following pathologies: femoroacetabular impingement (FAI), residual deformity from Perthes disease, synovial chondromatosis, and other tumor conditions such as pigmented

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villonodular synovitis.[1] The pediatric and adolescent patient population often present with differing and unique pathologies that benefit from safe SHD for exposure and appropriate treatment. Such pathologies include slipped capital femoral epiphysis (SCFE), developmental dysplasia of the hip (DDH), osteochondritis dissecans, Perthes disease, and other various congenital deformities. Conditions related to trauma, tumor, osteonecrosis, and FAI also have different treatment principles compared with the adult hip. This article will present a brief review of the SHD technique with a focus on the indications, outcomes, complications, and unique surgical pearls for the treatment of various pediatric and adolescent hip pathologies (Table 1).

Surgical Technique Considerations

The SHD approach was introduced as a safe and effective way to evaluate and treat intra-articular pathology of the hip. The approach, as it is commonly used today, uses predictable anatomic relationships to safely preserve the blood supply to the femoral head, while gaining full access to the femoral head and acetabulum. The deep branch of the MFCA is the dominant blood supply to the femoral head/epiphysis.[1] Damage or injury to this vessel during trauma or a surgical approach can result in osteonecrosis to the head, and therefore, thorough knowledge of the anatomy is crucial to prevent iatrogenic injury (Figures 1, A and B). The MFCA is a branch of the profunda femoris artery. The deep branch runs toward the intertrochanteric crest between the pectineus medially and the iliopsoas tendon laterally, along the inferior border of the obturator externus. The main division of the deep branch crosses posterior to the tendon of the obturator externus, anterior to the other short external rotators, and then perforates the capsule obliquely just cranial to the insertion of the superior gemellus, and distal to the piriformis tendon. The terminal branches perforate the posterosuperior aspect of the femoral head/neck junction and function as the dominant blood supply to the femoral head/epiphysis.[2]

A lateral decubitus position with the surgical leg draped into the field is typically used for this approach.[1,3] A straight posterolateral incision based over the greater trochanter is used. After the initial dissection, a Gibson interval (tensor fascia lata and gluteus maximus) or a gluteus maximus split interval is made proximally, whereas the IT band is split distally. Alternatively, the gluteus may be sharply dissected from the IT band fascia and reflected posteriorly. The trochanteric bursa is then excised to better identify the landmarks for the trochanteric osteotomy. Proximally, the osteotomy begins about 1 cm anterior to the posterior border of the gluteus medius insertion and distally extends to the posterior edge of the vastus lateralis origin. It can be helpful to identify the interval between the gluteus minimus and piriformis before performing the trochanteric osteotomy to better visualize the correct trajectory of the saw cut. The gluteus medius and vastus lateralis should mobilize anteriorly with a 1- to 1.5-cm-wide trochanteric wafer of bone, whereas the piriformis should remain intact to ensure the safety of the deep branch of the MFCA. If proximal femoral osteotomy is planned, maintaining a 1.5 cm width of bone, or slightly more, is essential. Some authors advocate for a step-cut at this stage to aid in later osteotomy reduction and stability if no trochanteric advancement or proximal femoral osteotomy is planned. Progressive external rotation of the leg can help aid in exposure of the interval between the hip capsule and the gluteus minimus. A large spiked Hohmann retractor is placed on the ilium to maintain a wide capsular exposure. A Z-shaped, or reversed Z-shaped (based on laterality), capsulotomy is then performed with the transverse limb proceeding along the axis of the femoral neck toward the acetabulum and the inferior limb extending toward the lesser trochanter at the base of the femoral neck (Figure 2). The superior limb is created along the capsulolabral junction with care to protect both the labrum and the articular cartilage. The hip is then subluxated anteriorly with progressive external rotation, flexion, and adduction, whereas the ligamentum teres is cut with curved scissors. The hip can now be freely dislocated anteriorly with a now 360-degree visualization of the femoral head and acetabulum. On conclusion of the surgery, the trochanteric osteotomy site is typically repaired with 3.5-mm cortical screws.

Depending on the indication for SHD, an extended retinacular flap can also be used to aid in osteotomies of the femoral head/neck junction, realignment of SCFE deformity, or relative neck lengthening procedures. The retinacular flap starts with an osteotomy of the proximal stable trochanter into the piriformis fossa with careful subperiosteal dissection of the insertion of the short external rotators to protect the MFCA. The retinacular flap is elevated in a subperiosteal fashion off the base of the femoral neck working from anterior to the vessels and moving posteriorly to protect the posterosuperior aspect of the flap, as the terminal branches of the MFCA insert into the femoral head/neck.

Unique to the skeletally immature patient is the presence of the proximal femoral physis and greater

Table 1. Indications

Trauma
Osteochondral avulsion secondary to posterior hip dislocation (fleck sign) acetabular fractures
Labral tears
Foreign/loose body removal
Femoral head fractures
Femoral neck fractures
Oncology
Osteochondroma
Osteoblastoma
PVNS
Ewing sarcoma
Osteosarcoma
Chondrocalcinosis
Giant cell tumor
Bone cysts (unicameral and aneurysmal)
Osteoid osteoma
Fibrous dysplasia
Femoroacetabular impingement (FAI)
Slipped capital femoral epiphysis
Acute reduction: modified Dunn procedure
Chronic deformity: osteochondroplasty with proximal femoral osteotomy
Legg-Calve-Perthes disease surgical containment
Residual coxa magna/coxa breva deformity
Management of hinged abduction
Developmental dysplasia of the hip
Cartilage defect treatment
Osteochondral allograft/allograft
Osteonecrosis decompression and bone grafting
Hip distraction arthroplasty
Complete synovectomy
Hip fusion

PVNS = pigmented villonodular synovitis

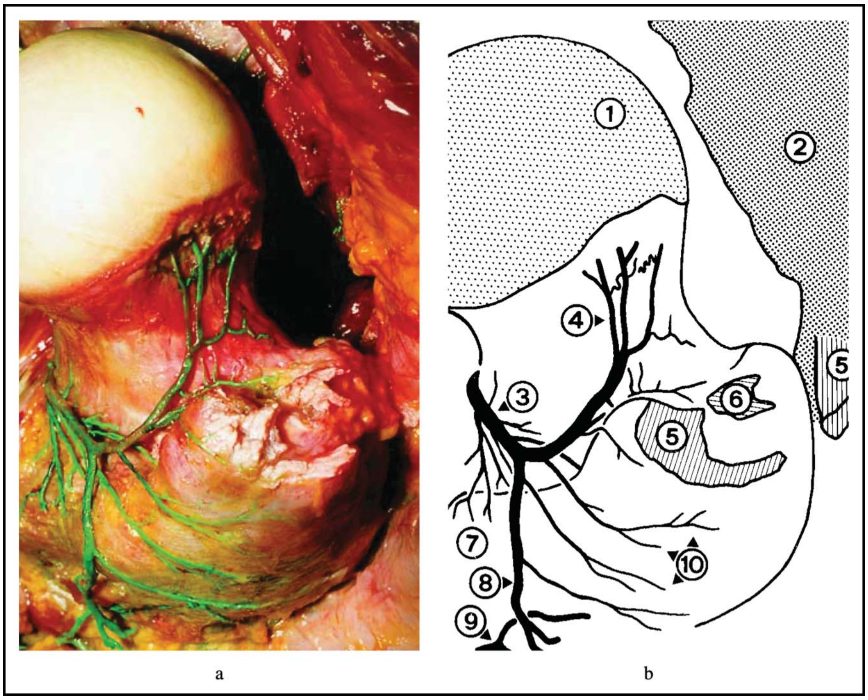
trochanteric apophysis. There is some debate over the exact timing of closure/separation and therefore the clinical significance of premature damage/closure of the trochanteric apophysis. It has been our experience that damage/closure after age 8 is rarely of clinical significance. This surgical approach can be beneficial in patients less than 8 years of age, and in this scenario, we have performed a modified dislocation approach without trochanteric osteotomy. The overall approach is similar, but instead of an osteotomy, a small cartilaginous sleeve with the abductors and vastus lateralis remaining attached is developed off the trochanteric apophysis, elevated anteriorly, and then repaired with suture instead of screws. This provides a safe and extensive view of the proximal femoral epiphysis.

Applications for Pediatric and Adolescent Patients

Trauma

A variety of traumatic pathologies about the hip may require wide exposure of the femoral head, neck, and/or

Figure 1



A, Photograph showing the perforation of the terminal branches into bone (right hip, posterosuperior view). The terminal subsynovial branches are located on the posterosuperior aspect of the neck of the femur and penetrate bone 2 to 4 mm lateral to the bone-cartilage junction. **B,** Diagram showing (1) the head of the femur, (2) the gluteus medius, (3) the deep branch of the MFCA, (4) the terminal subsynovial branches of the MFCA, (5) the insertion and tendon of the gluteus medius, (6) the insertion of the tendon of the piriformis, (7) the lesser trochanter with nutrient vessels, (8) the trochanteric branch, (9) the branch of the first perforating artery, and (10) the trochanteric branches. Reproduced with permission of the British Editorial Society of Bone and Joint Surgery. MFCA = medial femoral circumflex artery

acetabular regions for optimal treatment. In the pediatric patient in particular, proximal femur fractures of the head and neck result from high-energy trauma and account for only 0.3% to 0.5% of all fractures among children.[4] Although rare, these injuries necessitate anatomic reduction to achieve their highest healing potential and to avoid catastrophic complications such as premature physeal closure, osteonecrosis, and early onset osteoarthritis.[4] Treatment goals in these patients include anatomic reduction, stable fixation, and preservation of blood supply about the proximal femur, all of which may be achieved using an SHD approach. Commonly used surgical approaches include the anterolateral, anterior, and posterolateral exposure. These approaches may result in a relatively limited exposure of the acetabulum and femoral head and neck region. In contrast, the advantage of the SHD approach is a wide exposure and visualization of the fracture fragments, thereby aiding in anatomic reduction and hopeful preservation of the femoral head retinacular vessels.

Although acetabular fractures and labral pathology after traumatic hip dislocations are less common among children than adults, management of these injuries after hip dislocation is critical to preventing future complications. A fleck sign, a nonconcentric reduction, or an inability to achieve a stable reduction should raise suspicion for a major labral injury or incarcerated fracture fragment, and a CT or MRI scan may assist in the evaluation of the injury pattern.[5-7] In a 2016 study, Blanchard et al[5] reported on 10 patients with osteochondral acetabular injuries treated with SHDs for acetabular exposure and definitive treatment as the standard of care. Labral avulsion injuries were treated with suture anchors, and posterior wall fractures were treated with 3.5-mm screws. At a mean of 9.8 months of follow-up, there were no cases of osteonecrosis and no evidence of implant complication, fracture nonunion, or trochanteric osteotomy nonunion.[5] There were two cases of heterotopic ossification that did not require surgical intervention due to clinical nonsignificance.

Utilization for the management of pediatric, displaced femoral neck fractures has not been optimally studied or reported. Our experience suggests that the SHD approach aids in anatomic reduction, improved fixation,

Figure 2

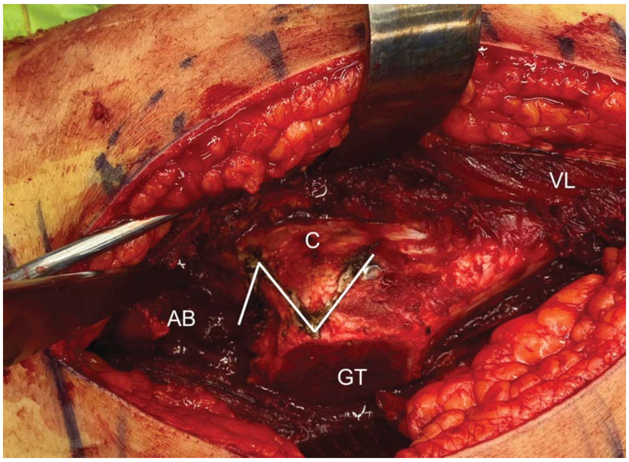


Diagram showing that for the Z-shaped capsulotomy, the femur is flexed and externally rotated further. GT = greater trochanter; AB = abductors; VL = vastus lateralis; C = capsule

and allows for acute bone grafting in often comminuted fracture patterns related to high-energy trauma or pathologic fracture.

Oncology

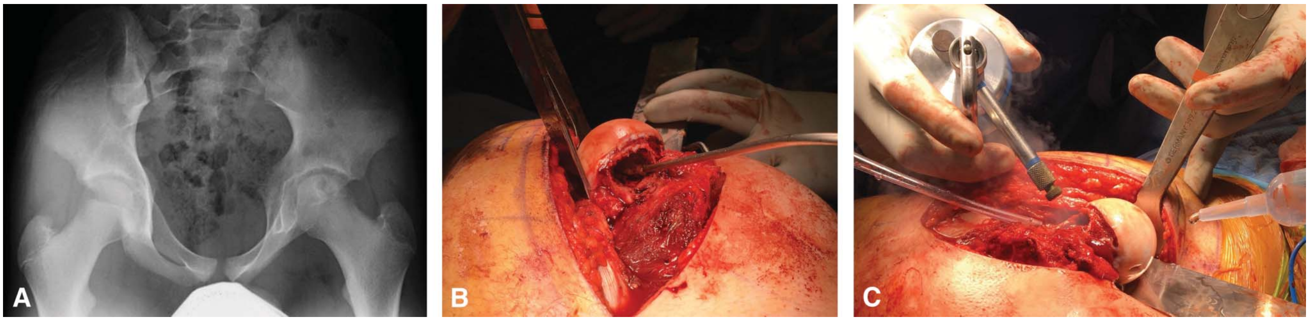
Oncologic pathology about the hip joint is common in children and adolescents. Both benign, benign but aggressive, and malignant conditions may manifest about the hip joint, both on the acetabular and femoral sides. These include isolated osteochondromas, multiple hereditary exostosis, chondroblastoma, osteoid osteomas, aneurysmal bone cysts, unicameral bone cysts, pigmented villonodular synovitis, giant cell tumor, Ewing sarcoma, osteosarcoma, and chondrocalcinosis.[8-10] These lesions may occur about the trochanteric region, femoral neck, femoral head, and, less frequently, the acetabulum and pelvis. Although intra-articular lesions are less common, they present unique treatment and surgical exposure challenges. The anterolateral and lateral hip approaches may limit exposure to the femoral neck and acetabulum, whereas the posterior approach requires release of the short external rotators and may damage femoral head blood supply. In addition, benign lesions of the femoral head and neck region may drive other pathology such as FAI that may be addressed at the time of surgery. SHD provides excellent exposure for the treatment of such scenarios, without the limits of the aforementioned approaches (Figures 3, A and B and Supplemental Figures, http://links.lww.com/JAAOS/A870, http://links.lww.com/JAAOS/A871, and http://links.lww.com/JAAOS/A872). In many of these cases, bone void or poor bone quality necessitates bone cement, grafting, and/or prophylactic implant in addition to the routine use of trochanteric osteotomy fixation screws. Combined fixation of the trochanteric osteotomy with fixation into the femoral neck may be used for prophylactic purposes if indicated in the oncologic setting.

Multiple reports have described the use of the SHD approach for exposure of bone lesions. Furthermore, Sorel et al[11] reported on a cohort of 20 hips with difficult to access symptomatic femoral neck osteochondromas treated with resection after an SHD approach. At a mean follow-up of 46 months, they reported improved range of motion and clinical outcomes scores among all patients. Three patients required revision surgery secondary to a traumatic trochanteric osteotomy separation, a traumatic peritrochanteric fracture, and a trochanteric osteotomy pseudarthrosis. One patient went on to develop femoral head osteonecrosis requiring decompression. The authors point to improved hip joint stability, improved exposure, and a low osteonecrosis rate as advantages of this approach for osteochondromas. Nisar et al[8] used this approach to address PVNS, synovial chondromatosis, fibrous dysplasia, osteochondromas, and osteoblastomas among nine patients. In particular, the 360-degree view provided by an SHD allows for the complete resection of synovial tissue, as is often required in cases of PVNS. The authors reported no cases of osteonecrosis at a minimum follow-up of 18 months.

Femoroacetabular Impingement

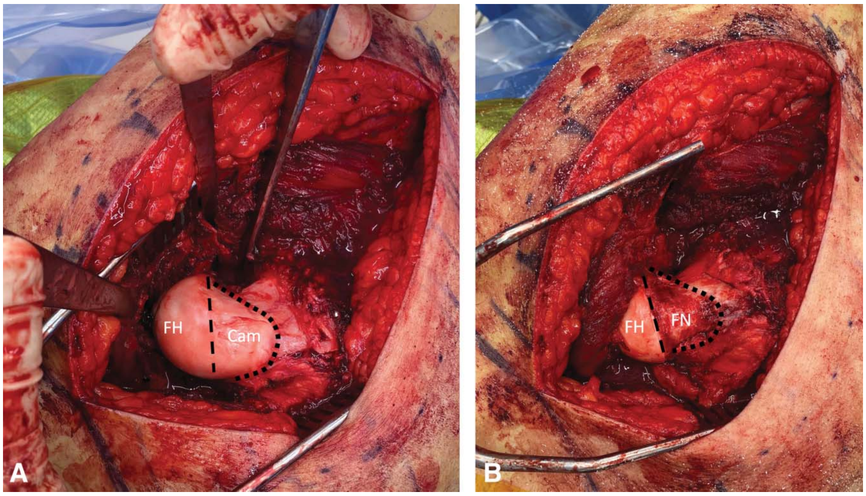
FAI is defined as abnormal contact between the acetabular rim and the femoral neck.[12] In cam impingement, an abnormal femoral head-neck junction contacts the acetabular labrum and bony rim, causing damage to the cartilaginous surfaces and premature arthritic changes. Pincer impingement results from abnormal acetabular morphologic coverage, which causes chondral damage and premature arthrosis. Combinations of these two subtypes are also common. Even with the relatively recent popularization of hip arthroscopy, SHD is still an important tool for deformity correction in FAI. Restoration of the head-neck offset is critical to allow impingement free range of motion. Compared with the SHD approach, hip arthroscopy has a more limited field of visualization and access and therefore has been shown to under correct or potentially miss certain deformities. The versatility of the SHD approach allows management of both labral pathology and articular cartilage lesions possible. With near-circumferential access, the labrum can be repaired, débrided, or reconstructed and articular cartilage lesions can be débrided, and various cartilage

Figure 3



A, AP pelvis radiograph in a 13-year-old boy with a left proximal femur osteoblastoma. **B,** The SHD approach was performed, and a cortical window was made to access the tumor for curettage and bone grafting. **C,** With excellent visualization, adjuvant liquid nitrogen was used to ensure complete removal. SHD = surgical hip dislocation

Figure 4



A, Visualization during a surgical hip dislocation for femoroacetabular impingement showing a very large anterolateral cam deformity that would be challenging arthroscopically. Dotted lines represent the planned osteoplasty. **B,** Postosteoplasty images showing much improved femoral head/neck offset. FH = femoral head; FN = femoral neck

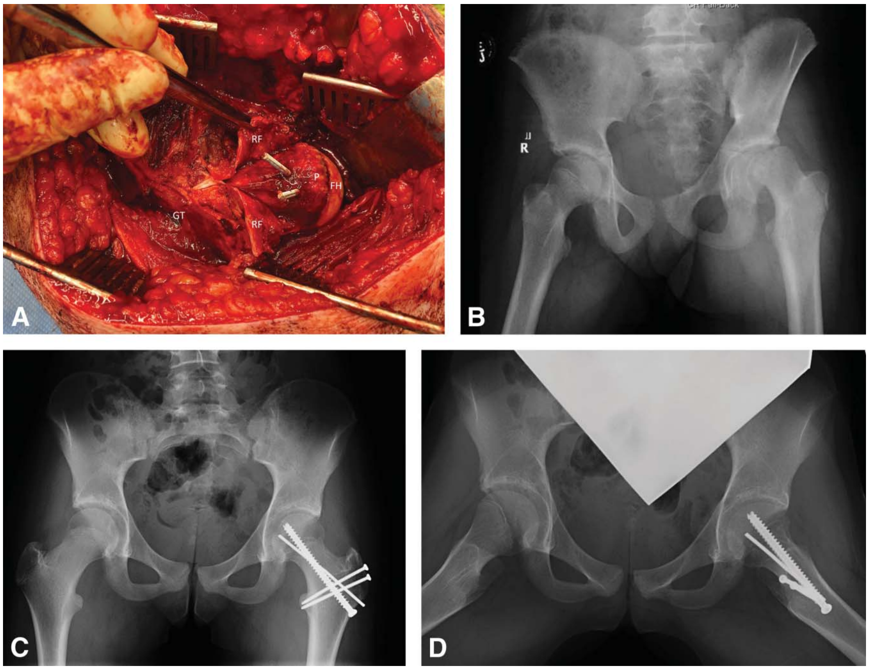
restoration procedures simultaneously performed (Figures 4, A and B).

Peters et al[13] reviewed a cohort of 96 patients who underwent SHD and treatment of symptomatic FAI. They found significant improvement in Harris hip scores at a mean of 18 months follow-up. They described six failures of the procedure, in which patients reported worsening Harris hip scores and underwent total hip arthroplasty. They noted that four of the six hips that failed had severe acetabular articular cartilage damage (Outerbridge Grade IV). Two complications of greater trochanteric osteotomy fixation failure requiring revision surgery were reported. There were no incidences of osteonecrosis, nerve injury, infection, or fractures. Graves and Mast[14] also retrospectively reviewed 48 hips with symptomatic FAI that underwent SHD and restoration of the femoral head-neck offset. Ninety-six percent of patients in this series showed improvement in Merle d'Aubigne-Postel scores with no incidences of failure of the trochanteric implant. Several other authors have successfully used the SHD technique to address FAI with excellent results.[15-17]

Slipped Capital Femoral Epiphysis and Deformity

SCFE is one of the most common pediatric hip disorders with an incidence of approximately 10 per 100,000 per year, with a 2:1 male to female preponderance.[18,19] In SCFE, the metaphyseal region of the femoral neck displaces relative to the epiphysis causing deformity of the proximal femur. Metaphyseal displacement is typically anterior and externally rotated resulting in a deformity that is multiplanar and can cause impingement of the

Figure 5



A, Limited retinacular flap used for modified Dunn realignment for SCFE by the authors. The pins show provisional fixation used during the dislocation. GT= greater trochanter, FH = femoral head, RF= retinacular flap, P = physis. **B,** Twelve-year-old girl with an acute-on-chronic, unstable left SCFE. **C,** Three-year postoperative AP radiograph following SHD with a modified Dunn procedure. No evidence of osteonecrosis. **D,** Three-year postoperative frog lateral radiograph following SHD with a modified Dunn procedure. SCFE = slipped capital femoral epiphysis; SHD = surgical hip dislocation

femoral neck on the acetabular rim.[20,21] Percutaneous in situ screw fixation has become the standard of care and is used to stabilize the proximal femur and prevent further slippage in the acute setting.[16] Once stabilized, the resultant deformity varies but may lead to FAI and thus symptoms including hip pain, labral tear, and cartilage damage. The severity of deformity has been shown to correlate with osteoarthritis.[22]

The SHD approach has been used to manage SCFE in both the acute and chronic/residual settings. Acute correction of the deformity can be accomplished through a subcapital osteotomy using a surgical dislocation approach. This approach often is performed with the development of a retinacular flap to help wide exposure, ease reduction, and preserve the femoral head blood flow. This is referred to as a modified Dunn procedure and is used for management of moderate to severe SCFE, most commonly if unstable (Figures 5, A and B and Supplemental Figures, http://links.lww.com/JAAOS/A870, http://links.lww.com/JAAOS/A871, and http://links.lww.com/JAAOS/A872). In the chronic or residual healed SCFE, the SHD approach is frequently used to address intra-articular deformity and labral pathology and perform an osteochondroplasty of the femoral head-neck junction, in addition to an extracapsular proximal femoral osteotomy.

Ziebarth et al described the modified Dunn procedure to address deformity in moderate to severe SCFE.[16] This procedure allows for acute correction of the SCFE at the level of physis, which is the site of deformity. This series reported no cases of osteonecrosis, infection, DVT, or nerve injuries among 40 patients. Three patients had screw or wire breakage and needed revision procedures. Patients in this series had near-normal range of motion postoperatively. In a multicenter effort, Sankar et al evaluated 27 hips that underwent the modified Dunn procedure for unstable SCFE.[18,23] At a mean follow-up of 22.3 months, they reported a relatively high rate of osteonecrosis when compared with previous studies (7/27 hips; 26%). Finally, Persinger et al used the modified Dun technique to treat unstable SCFE among 31 consecutive patients and found a low rate of osteonecrosis. In their study, 2 (6%) patients went on to develop osteonecrosis at an average of 19 weeks postoperatively.[24] Other complications in their study included heterotopic ossification in three patients (9%) and implant removal in four patients (12%).

To decrease rates of osteonecrosis while still addressing the deformity in chronic stable slips, an intertrochanteric osteotomy may be used. In some cases, the SHD can be used to address the intra-articular deformity simultaneously. Erikson et al retrospectively reviewed 19 patients who underwent SHD with simultaneous osteochondroplasty and Imhauser intertrochanteric osteotomy for chronic stable slips.[25] There were no instances of osteonecrosis in this series. There was one case of implant failure requiring revision and one case of nonunion requiring revision and bone grafting.

Addressing the deformity in SCFE in both acute and chronic stages is important for hip preservation. Access to the hip joint via the surgical dislocation is helpful in both acute, unstable and chronic, stable scenarios. Clear improvement in pain and function is noted with restoration of anatomic head-neck offset. SHD allows for multilevel osteotomies in efforts to preserve long-term hip function after SCFE and a deformed proximal femur.

Hip Dysplasia and Sequela of Osteonecrosis

Developmental DDH is a disorder that is defined as any abnormal development of the proximal femur or acetabulum and represents a spectrum of disorders from hip instability or dislocation to mild acetabular uncovering. Basic goals of nonsurgical and surgical management of DDH include obtaining a stable, concentric hip, avoiding iatrogenic complications, and thus promoting normal hip development. Unfortunately, one of the more common complications of management of childhood DDH is development of osteonecrosis, which leads to varying amounts of proximal femoral and acetabular deformity. When more severe, patients develop complex deformities similar to Perthes disease, including an aspheric femoral head, coxa magna and breva deformity, and trochanteric overgrowth.[26] The goal of management is to avoid both intra-articular impingement (due to coxa magna) and extra-articular impingement (due to coxa breva and relative varus). To reduce the femoral head volume, varying degrees of femoral osteoplasty can be performed. After osteoplasty, an extended retinacular approach is often necessary to reshape the femoral neck, called relative neck lengthening. This improves head-neck offset and distalizes the greater trochanter to a mechanically more normal position. With a smaller head and improved motion in the hip, care must be taken to evaluate for hip stability, and often, the addition of a pelvic osteotomy to address residual dysplasia is necessary (Figures 6A and B).

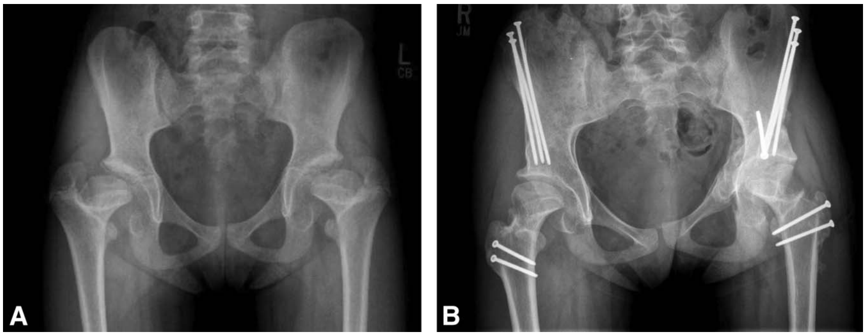
Clohisy et al[27] used the SHD approach in conjunction with a periacetabular osteotomy (PAO) to address Perthes-like deformities in acetabular dysplasia in 16 patients. Patients were treated with a combination acetabuloplasty/femoroplasty to address residual FAI-like deformities and a PAO to address structural instability. At a minimum of 2 years of follow-up, modified Harris Hip scores (mHHSs) significantly improved. One patient failed based on an mHHS of less than 70 and another secondary to conversion to total hip arthroplasty. There were no reported cases of osteonecrosis and one reported case of a deep infection. These results suggest that an SHD to address the deformities is safe and may result in a successful clinical outcome with low complication rates.

Residual Legg-Clave-Perthes Disease

Legg-Calve-Perthes disease (LCPD) most commonly occurs in children aged 4 to 8 years. Males are more likely to be affected (4:1), and it can occur in both hips in up to 10% of cases, though often at differing stages in each hip.[28] Disruption of the vasculature, in some manner, is a common proposed etiology, and the disease process has been described as idiopathic necrosis of the proximal femoral epiphysis.[29] Through the course of the disease, growth and morphology of the proximal femur is altered, resulting in deformation of the hip joint. Subchondral collapse secondary to insufficient bony architecture after vascular compromise can lead to deformity of the epiphysis, whereas premature physeal arrest can lead to coxa magna, coxa breva, and relative greater trochanteric overgrowth.[30] These deformities cause intra-articular impingement, abductor dysfunction, altered gait, and limited range of motion. Treatment modalities are targeted either early to prevent deformity or late to correct the resultant deformity. Late treatment is focused on addressing the aspherical head and correcting head/neck offset to address intra-articular impingement, which is allowed by the SHD and direct dynamic evaluation of impingement. The ability to perform a relative neck lengthening also allows for correction of extra-articular impingement and improved hip biomechanics.

In some cases, LCPD deformity can result in hinged abduction where the large and deformed femoral head extrudes outside the acetabulum and blocks hip motion. A femoral head reduction osteotomy is a unique way to correct the femoral head deformity.[31,32] This osteotomy is technically demanding and removes the often necrotic central portion of the femoral head while preserving the blood supply to the lateral and medial femoral head. This allows for a significant decrease in size and improves sphericity of the head. Another option is for cheilectomy, which simply removes the extruded/aspherical aspect of

Figure 6



A, Preoperative radiograph of a 10-year-old girl with VATER syndrome and bilateral hip dysplasia/proximal femoral deformity secondary to ECMO as a neonate. **B,** One-year postoperative AP image following SHD with osteochondroplasty/relative neck lengthening, combined with a modified Dega pelvic osteotomy on the right. A staged procedure was performed on the left side with periacetabular osteotomy instead of Dega osteotomy. SHD = surgical hip dislocation

the femoral head that causes the hinged abduction. The long-term outcomes of this technique have been unsatisfactory, with frequent early arthrosis.[33]

Leunig and Ganz[34] described the use of SHD to treat both intra- and extra-articular pathology associated with LCPD. Following an extended retinacular flap SHD, the abnormally shaped femoral head may undergo a reduction osteotomy to reduce the volume of the articular surface, allowing for more complete coverage within the acetabulum. Siebenrock et al[32] retrospectively reported on 11 patients with severe deformity as a result of LCPD. They used an SHD with relative femoral neck lengthening similar to Leunig and Ganz. Their patients underwent femoral head reduction osteotomies to address the asphericity of the femoral head. At a mean follow-up of 5 years, they noted statistically significant improvement in femoral head sphericity, extrusion index, and lateral center edge angles. They reported no cases of osteonecrosis postoperatively.

The treatment of LCPD continues to evolve. Efforts to prevent late deformity and shorten the length of the disease process show promise, but many patients continue to experience late deformity with poor long-term outcomes. In young patients, efforts to preserve the native hip joint are important to consider. Surgical dislocation offers a safe way to address nearly all aspects of late deformity with rates of iatrogenic osteonecrosis being low.

Miscellaneous Indications

As evidenced by the aforementioned breath of pathology, there are a wide variety of indications for this surgical exposure. Additional indications include restoration procedures for chondral defects or osteochondral defects, foreign body removal, hip fusion, or treatment of congenital deformities such as a duplicated femur or proximal femoral focal deficiency.

Maqungo et al[35] demonstrate safe use of an SHD for the removal of retained bullet fragments among 10 patients and point to the concomitant evaluation and treatment of osseocartilaginous lesions as an advantage of the approach. They reported one superficial infection and no cases of osteonecrosis. Arthroscopic assisted foreign body removal is also frequently reported however certain instances, such as embedded foreign material in bone or associated fractures, may preclude the arthroscopic approach.[36]

Chondral defects of the femoral head may be addressed with relative ease given excellent visualization of the femoral head. Khanna et al[37] prospectively followed 17 hips after the use of fresh osteochondral allografts to treat large cartilage defects secondary to osteochondritis dissecans and osteonecrosis at a mean age of 25.9 years. This approach allows full view of chondral defects and restoration of a true type II hyaline cartilage surface. Lesions must be contained and less than 50% of the femoral head with no concomitant osteoarthritis. At a mean follow-up of 41.6 months, HHS significantly improved. Complications included revision allograft treatment and hip arthroplasty in one patient each, although no cases of osteonecrosis were reported. Others have addressed chondral defects using this approach in combination with osteochondral autograft transplantation with similar success.[38-40]

Summary

An important consideration in the surgical management of complex pediatric and adolescent hip pathology is the best surgical approach to allow safe, preservation surgery. The SHD approach is a well-described anatomic-based exposure that allows full access to femoral head and hip joint pathology. Studies suggest low risk of iatrogenic osteonecrosis and further complications, allowing this approach to aid the surgeon in the correction of a multitude of traumatic, oncologic, developmental, and congenital hip deformities in the pediatric and adolescent hip.

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