Application of the Surgical Dislocation Approach to Perthes Deformity

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In Legg-Calvé-Perthes disease (LCPD), resultant femoral head deformity may lead to abnormal mechanical function of the hip. The morphology of the proximal femur and acetabulum after healed LCPD is the single most important factor predicting the long-term outcome.\textsuperscript{1,2,3}

Instability and impingement are usually two distinct opposite pathologic disorders of hip mechanics. Instability results from femoral head uncoverage and may lead to the acetabular rim syndrome - labral tear and articular cartilage damage.\textsuperscript{4} Femoroacetabular impingement (FAI) involves abnormal, repetitive contact between the anterior femoral head and/or head-neck junction against the anterior aspect of the acetabular rim and has been linked to the onset of early osteoarthritis of the hip.\textsuperscript{5}

However, in healed LCPD, the hip may be unstable in upright activities and yet still impinge in hip flexion due to an aspherical shaped femoral head. In addition to FAI and acetabular dysplasia leading to instability, the patient with healed LCPD may develop symptoms due to abductor fatigue and to osteochondritic lesions in the femoral head.
Previous strategies for the treatment of Femoroacetabular Impingement in the healed Perthes hip includes:

- **Valgus intertrochanteric osteotomy** $^{6-8}$—typically applied for the treatment of lateral impingement—the so-called hinge abduction phenomenon. An isolated valgus osteotomy does not allow for correction of the anterior deformity of the femoral head and impingement. Abnormal hinge movement varies according to whether the impingement is lateral or anterior. Yoo et al. $^9$ identified some patients in whom major aspherical portion on the femoral head (the so called “bump”) was located anteriorly. In this case the classic valgus-extension osteotomy may not be indicated because the extension component will further add
to the anterior impingement. An isolated valgus osteotomy would not address the anterior deformity and impingent.

- **Isolated cheilectomy** (resection of the extruded antero-lateral femoral head). Garceau\(^\text{10}\) postulated that “in late Legg-Perthes-Calvé’s disease osteoarthritic changes resulted from incongruity of the femoral head which, because of bulging on the outer side, impinged on the acetabular lip. The degenerative changes could be reduced or delayed if the head of the femur was remolded. Klisic\(^\text{11}\) reported on cheilectomy in children aged ten years or over. In children with severe subluxated epiphyses, cheilectomy resulted in 75% of ovoid femoral heads with no poor results. According to Rowe et al.\(^\text{12}\) cheilectomy is effective at reducing pain and improving range of hip motion during the early postoperative years, however the clinical and radiographic results obtained at 25-year follow up were not satisfactory.

- **Trochanteric Advancement.** Joo et al\(^\text{13}\) reviewed 15 patients (mean age 16.9 years; 13-26) followed for average of 42 months after trochanteric advancement. Using kinematic and kinetic analysis the authors reported hip adduction angle and abductor moment were not changed. Only 3 patients were pain free postoperatively. They concluded trochanteric advancement does little to relieve pain and improve limp in the healed LCPD hip.

**The Surgical Dislocation Approach to the Hip**
The surgical hip dislocation (SHD) approach was initially described by Ganz et al. after studies of the blood supply to the femoral head. This approach allows complete access to the femoral head and acetabulum without risk of avascular necrosis of the femoral head.

**Indications**

- Symptomatic patients (pain, limp) with healed LCPD (at or past reossification stage) with positive anterior impingement test (Flexion + adduction + internal rotation). The typical presenting symptom is hip (groin, lateral) pain aggravated by hip flexion (seating). Lateral pain and abductor fatigue is also common.
- Preserved joint space without advanced signs of osteoarthritis.
- Goal: to improve hip mechanics (eliminate FAI and improve abductor lever arm); relieve pain and improve hip motion. Improve function of daily leaving and maintain or enhance quality of live and physical activity level.

**Contraindications**

- Advanced osteoarthritis of the hip
- Early Perthes (fragmentation stage)

**Advantages:**

- **CORRECTION OF ALL FEMORAL DEFORMITIES THROUGH A SINGLE SURGICAL APPROACH**
- Low risk of avascular necrosis of the femoral head
• Allows complete dynamic evaluation of hip motion to determine the areas of impingement (anterior, lateral, antero-lateral or global) and the best position of joint congruency

• Allows correction of the CAM deformity and/or PINCER deformity by means of a head-neck/acetabular rim osteochondroplasty

• Relative femoral neck lengthening or trochanteric advancement to correct extraarticular impingement due to a high-riding greater trochanter and a short wide neck can be performed.

• When the osteochondroplasty and relative femoral neck lengthening are not enough to correct the FAI then a femoral osteotomy can be performed.

• Resection of the central portion of the femoral head (FHRO) can be done when indicated.

Disadvantages:

• Extensive surgical dissection

• The approach is not widely familiar – Learning curve required

• Minimum 6 weeks on crutches

Surgical Technique

• Patient in the lateral decubitus position.

• The entire lower extremity is prepped and draped allowing visualization of the ASIS and the posterior superior iliac spine (PSIS). A sterile bag drape is placed on the opposite side of the table.
• A straight lateral incision (approximately 20 cm in length) is performed and subcutaneous tissue dissected to expose the fascia lata and the gluteal fascia
• The fascia lata is opened longitudinally in line with the incision up to the greater trochanter
• Careful incision of the fascia defines the upper border of the gluteus maximus and the gluteal fascia is divided along this border (Gibson approach)
• The gluteal maximus and the fascia on top of the gluteus medius are retracted posteriorly (safely keeping the blood supply and innervation to the gluteus maximus).
• The trochanteric bursa is opened from posterior to anterior exposing the greater trochanter and the insertion of the gluteus medius and origin of the vastus lateralis.
• The gluteus medius insertion on the postero-superior trochanter is identified and retracted anteriorly to facilitate exposure of the gluteus minimus and the piriformis tendon
• The piriformis tendon is easily palpated and the fascia on top of it incised to expose the tendon. Internal rotation of the hip facilitates exposure of the piriformis.
• Careful dissection is recommended to avoid damage to the anastomosis between the inferior gluteal artery system and the deep branch of the medial circumflex artery that usually is on the lower aspect of the piriformis
• The fascia on top of the gluteus minimus tendon is incised on top of the piriformis and the muscle is retracted anterior-superiorly exposing the hip capsule
Although the original technique does not include dissection of the interval between the piriformis and gluteus minimus, we believe this step to be very important in patients with LCPD hips because of the high position of the greater trochanter. This allows for the trochanteric osteotomy to be safely performed and facilitates keeping the entire piriformis tendon attached to the stable trochanter. Performing this initial dissection will also facilitate the exposure of the hip capsule further in the procedure.

- Distally the posterior fascia of the vastus lateralis is identified and incised longitudinally leaving about 3 mm cuff of fascia for later repair. The vastus is lifted in an anterior direction from the femur to facilitate further exposure – the periosteum should not be violated.

- Trochanteric osteotomy: using C-arm guidance a 2.0 mm Kirschner wire is inserted on the lateral greater trochanter in line with the desired femoral neck-shaft angle (about 130o). The osteotomy is performed parallel to the wire. Proximally it is usually done 2-3 mm anterior to the insertion of the gluteus medius and distally at the posterior aspect of the origin of the vastus lateralis. The oscillating saw is used up to the medial cortex that should be completely cut with an osteotome.

- The original technique describes a trochanteric fragment of about 1.5 cm. In LCPD however we recommend a thicker piece at least 2 cm to avoid insufficient fixation after the trochanter is advanced distally. This is specially important when an osteotomy is performed and the trochanter piece is fixed using the blade plate. Having exposed the piriformis tendon previous to the
cut allows for safely performance of a thicker cut without the risk of leaving the piriformis in the mobile trochanter fragment.

- The trochanteric piece is reflected and flipped anteriorly with the attached vastus lateralis and gluteus medius and minimus.

- The previously exposed gluteus minimus is further completely elevated anteriorly off the hip capsule. The gluteus minimus should be released posteriorly as far as to the level of the sciatic notch – this will avoid difficulty acetabular exposure by a tight gluteus minimus.

- The anterolateral portion of the vastus lateralis is released from the femur along with the insertion of the vastus intermedius. Placing the hip in abduction and external rotation facilitates exposure of the hip capsule.

- With complete exposure of the capsule a capsulotomy is performed in a Z shape fashion (right hip) or reverse Z shape (left hip) with the longitudinal arm of the Z in line with the anterior femoral neck. The distal capsulotomy extends anterior proximally to the lesser trochanter while the proximal cut is performed along the acetabular rim until the level of the piriformis tendon.

  - In LCPD the enlarged femoral head is easily exposed with the initial longitudinal capsulotomy. Using an inside-out technique to expose the usually very thick capsule helps to avoid injury to the head and labrum.

- With the capsule opened, the hip is carried through a range of motion with special attention to flexion and internal rotation. Intra and extra articular causes of FAI can be dynamically determined.
• Flexion, adduction and external rotation subluxates the hip and the ligamentum teres is divided to allow complete dislocation of the femoral head.

- It is not uncommon to find a torn ligamentum teres in LCPD hips.

• Three Hohmann retractors are placed around the acetabulum allowing complete exposure. The acetabulum articular cartilage and the labrum are inspected for presence of labral and chondral lesions.

• A labral tear or chondrolabral dissociation can be treated by complete exposure of the labrum, debriding the osseous surface under the labrum to expose bleeding bone and reattachment of the labrum using suture anchors.

• If the acetabulum is not severely dysplastic but retroverted with signs of PINCER impingement on the femoral head/neck junction then an osteoplasty of the anterolateral acetabular rim is undertaken.

• Most often severe deformities require a relative lengthening of the femoral neck (RLFN) to improve abductor muscle function and correct extraarticular FAI. In these situations an extended retinacular soft-tissue flap should be developed to protect the blood supply to the femoral head. 16

• To develop the retinacular flap, the femoral head is reduced back in the acetabulum. 16, 17

• The first step is to trim the posterosuperior portion of the stable greater trochanter down to the level of the femoral neck. The greater trochanter physis is identified. The portion of the greater trochanter proximal to the growth plate is mobilized
with an osteotome and the cancellous bone carefully removed from the periosteum.

- The periosteum is incised along the anterior neck beginning at the anterosuperior corner of the greater trochanter growth plate. The periosteum of the neck, including the retinaculum with the blood vessels and the external rotators, is gradually released.

- The retinacular flap is extended posteriorly along the femoral neck while leaving it secured to the epiphysis.

- After the retinacular flap is developed the superior contour of the stable trochanteric segment is further trimmed in line with the femoral neck.

- The hip is one more time dislocated. The deformity of the femoral head is accessed using spherical templates. Any nonspherical portion of the femoral head is removed with an osteotome and a high speed burr. Careful identification of the nutrient vessels is important to avoid damage.

- Reduction of the femoral head after osteochondroplasty should reveal improved flexion and internal rotation, as well as abduction without impingement.

- If an osteochondroplasty and relative femoral neck lengthening is all that is required then the periosteum is approximated and the capsule is closed loosely.

- The trochanteric fragment is fixed distally with two or three 4.5 mm cortical screws. The trochanteric fragment should be fixed with its superior border in line with the center of the femoral head with to correct the articulo-trochanteric distance.
• When the osteoplasty and neck lengthening is not enough to correct the FAI then a femoral intertrochanteric osteotomy is performed. The decision on the type of osteotomy to be performed is based on preoperative evaluation of hip range of motion, functional radiographs and perioperative assessment of the dynamic of the femoroacetabular contact during hip motion.

• A flexion osteotomy is indicated when the anterolateral impingement area is too large to be completely removed. When the articulating portion of the femoral head is retroverted and functional retroversion of the proximal femur is present, a flexion-internal rotation osteotomy may be necessary to realign the lower extremity and reestablish a more functional arc of motion. Valgus ITO may be indicated for a major varus deformity and associated leg length discrepancy in addition to cases of better joint congruency with the hip in adduction.

• After correction of the femoral deformity it is crucial to evaluate the hip for instability specifically in cases where FAI is associated with acetabulum dysplasia.

• The hip is moved through a complete range of motion examination under C-arm guidance to determine the need for additional stabilization of the joint. Anterior stability is checked with extension/external rotation while lateral and posterosuperior stability are assessed during a functional flexion/extension range of motion testing.

• If the hip is found to have mechanical instability symptoms may persist after surgery. For this cases a periacetabular osteotomy (PAO) maybe required.
Although the PAO can be done in the same surgical setting we prefer to stage this two procedures.

**Treatment of FAI secondary to LCPD disease by open joint surgery using the SHD Approach – What is the evidence?**

Since the first description of the surgical dislocation approach by Ganz et al.\(^\text{14}\) its application has gained popularity. Recently there has been an increasing number of publications about the treatment of FAI in healed LCPD using this approach. All studies are Level-IV retrospective case series and evaluate patients with short-term follow-up. In general, the SHD approach to the hip has allowed functional improvement as well as pain relief with a low rate of complications and failures (Table 1). Further studies will elucidate the question of whether or not reshaping the proximal femur and eliminating FAI affects the long-term outcome and prevents the development/progression of hip osteoarthritis.

**References**


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<th>Study</th>
<th>Year</th>
<th>Level of evidence</th>
<th>Number of patients</th>
<th>Average age (range)</th>
<th>Average Follow-up (months)</th>
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<td>2006</td>
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<td>11 (12 hips)</td>
<td>21 (14-32)</td>
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<td>Shore et al.</td>
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