Technical Note

Treatment of Coxa Profunda With Open Surgical Hip Dislocation, Rim Resection, Cam Resection, and Labral Reconstruction

Emma L. Klosterman, M.D., Anthony J. Zacharias, M.D., Matthew S. Dooley, B.S., Nathaniel M. Wilson, M.D., Elizabeth H. G. Turner, M.D., David C. Goodspeed, M.D., and Andrea M. Spiker, M.D.

Abstract: Coxa profunda presents a unique challenge in surgical treatment approach given global acetabular over-coverage. Arthroscopic treatment can be fraught with difficulty obtaining hip distraction for safe arthroscopic instrumentation, and limited arthroscopic access may prevent sufficient osseous resection of the excess acetabular rim. Although hip arthroscopy use has increased markedly over the past decades for all types of hip pathology, coxa profunda may represent one unique indication for surgical hip dislocation. This technique describes open surgical hip dislocation, rim resection, femoral osteoplasty, and labral reconstruction using anterior tibialis allograft for coxa profunda with combined-type femoroacetabular impingement syndrome and labral ossification.

Coxa profunda is defined as the floor of the fossa acetabuli touching or overlapping the ilioischial line medially. Coxa profunda, not to be confused with acetabular protrusio in which the femoral head overlaps the ilioischial line medially, can present very similarly to more common types of femoroacetabular impingement syndrome (FAIS) such as cam or pincer type. Previous studies have shown coxa profunda, often also defined as a radiographic lateral center edge angle of $>40^\circ$, to be present in 55% to 61.6% of patients with FAIS.2,3

The global nature of acetabular overcoverage in the setting of coxa profunda can present unique challenges in accessing the hip joint through arthroscopic surgery. Several factors relating to coxa profunda can make arthroscopic management more difficult. Global over-coverage often requires acetabuloplasty of the anterior, lateral, and posterolateral acetabulum. Sufficient hip distraction may be difficult, requiring additional traction force and increasing the risk of traction injury.4,5 An outside-in technique and potentially acetabuloplasty-first approach may additionally be required to enter the central compartment.6,7 Because of these challenges, an open technique via a surgical hip dislocation approach has been suggested.5 Although the use of arthroscopic hip surgery has continued to rise over the past decades, with ever-expanding indications, surgical hip dislocation was initially used as the gold standard treatment for FAIS.8-14 Surgical hip dislocation was described by Ganz et al.15 and represents a landmark change in the open approach to hip surgery in that the approach does not compromise the femoral head blood supply from the medial femoral circumflex artery. The trochanteric flip approach also allows full exposure to the acetabulum and does not violate the external rotator muscles of the hip.15 The following technique describes open surgical hip dislocation, rim resection, femoral osteoplasty, and labral reconstruction using anterior tibialis allograft in the setting of combined type FAIS with cam lesion, coxa profunda,
and labral ossification. This approach offers the advantage of 360° surgical exposure of the acetabular rim and labrum and addresses both the pathologies associated with coxa profunda, as well as concomitant FAIS and intraarticular derangement.

**Surgical Technique**

**Preoperative Planning**

For diagnostic and preoperative planning purposes, the routine work-up for hip preservation patients includes standing anterior-posterior (AP) pelvis, modified 45° Dunn lateral and false profile radiographs (Video 1; Fig 1).16,17 Non-contrast magnetic resonance images are obtained to evaluate for labral and cartilage pathology, as well as computed tomography scans with 3-dimensional reconstruction for bone morphology and assessment of radiographic measures, as well as evaluation of extra-articular areas of impingement.18-21

Key surgical equipment can be found in Table 1. In addition to this, an anterior tibialis allograft (anterior tibialis allograft 6 to 12 mm/20-38 cm; musculoskeletal transplantation foundation) was available for expected labral reconstruction.

**Patient Positioning**

Before administration of general anesthetic, our preference is to use epidural anesthesia for pain control. A Foley catheter is placed before positioning. Patient is placed in the lateral decubitus position on a Jackson table with a bean bag. Padding is placed under the axilla, nonoperative leg, as well as between the operative and nonoperative leg. Care is taken to verify that the operative leg is able to adduct anteriorly over the operative table (Video 1, Fig 2). The operative extremity is prepared with sterile technique and draped using an Ioban “sandwich” technique and impervious stockinette.22

**Incision and Superficial Dissection**

A modified Gibson approach is used to access the hip. The incision is about 14 centimeters in length, centered over the greater trochanter and curved slightly posterior. The dissection is carried down through the subcutaneous tissue, in line with the skin incision. A Cobb elevator and lap sponge are used to clear the iliotibial band and gluteal fascia. The interval between the gluteus medius (gMed) and minimus (gMin) is developed bluntly. At this point, the piriformis is left intact (Video 1; Fig 3).

**Deep Dissection**

With the hip internally rotated and extended, the interval between the gluteus medius (gMed) and minimus (gMin) is developed bluntly. At this point, the piriformis is left intact (Video 1; Fig 3).

**Step-Cut Greater Trochanter Osteotomy**

An oscillating saw is used for the step-cut greater trochanteric osteotomy with the leg held internally

---

**Table 1. Equipment Required for Surgical Hip Dislocation**

| Equipment Required for Surgical Hip Dislocation |
|------------------------------------------------|
| Jackson surgical table: bean bag, axillary roll, blanket platform |
| Open hip pan: Charnley retractor, Hibbs retractors, wide and narrow Deaver retractors, Homann retractors |
| Large C-arm for intraoperative fluoroscopy |
| Burr: 5 mm round (Stryker) with femoral head sizes |
| Anterior tibialis allograft (6-12 mm × 20-38 cm; Musculoskeletal Transplant Foundation) |
| Labral Anchors: 1.4 mm NanoTack Flex (Stryker) |
| Labral Anchor Drill Bit: NanoTack Flex (Stryker) |
| Osteotomy fixation: K-wires (smooth, 0.062; Synthes), three 3.5 mm cortical screws (Synthes) |
| Closing: 0 PDS (polydioxanone; Ethicon), no. 1 Vicryl (Ethicon), 2-0 Vicryl (Ethicon), 3-0 Monocryl (Ethicon), sterile Mepilex Ag with border (Molnlycke) |

---

**Fig 1.** Preoperative (A) standing AP pelvis, (B) modified 45° Dunn lateral, and (C) standing false profile radiographs show coxa profunda, defined as the acetabular fossa (asterisk) medial to the ilioischial line (dotted) with labral ossification (arrow). (A) Lateral center-edge angle (LCEA) measures 56° (dysplasia <20°, normal 20°-40°, overcoverage >40°). (B) Modified 45° Dunn lateral view shows alpha angle of 59° (normal <42°, cam deformity >50°-55°). (C) False profile radiograph shows anterior center edge (ACE) angle of 45° (normal >25°).
rotated and in extension. The saw blade should normally be about 20° to 25° posteriorly off-axis to the tibia in order to be orthogonal to the axis of the greater trochanter. The planned osteotomy is outlined with electrocautery along the posterior aspect of the greater trochanter starting just anterior to the most posterior fibers of the gMed. The osteotomy is carried below the vastus lateralis ridge while staying above the posterior overhang of the trochanter. The osteotomy is made in 2 cuts with a small step in between to provide a stable reduction for later fixation. The bone should be protected from thermal injury with irrigation. The trochanteric segment is mobilized with a wide osteotome. The proximal attachments of the vastus intermedius are released as well to more easily retract the flip osteotomy (Video 1; Fig 4).

**Hip Capsule Exposure and Z-Type Capsulotomy**

The remaining fibers of the gMed are sharply dissected off of the stable trochanter (Video 1; Fig 5A). Next, the plane beneath the gMin is sharply dissected from posterior to anterior with care taken to stay superficial to the hip capsule (Video 1; Fig 5B). The hip is brought to a position of flexion and external rotation to expose the anterior capsule. The vastus intermedius is sharply dissected free along the anterior capsule. The piriformis remains intact and serves to protect the constant anastomotic vessel between the inferior gluteal artery and the medial femoral circumflex artery that lies at the distal border.

A modified Z-type capsulotomy is used to expose the hip joint. Instead of incising distal to the labral as is done in a typical Z-capsulotomy, the flap is raised subperiosteally anteriorly and posteriorly off of the acetabular bone to allow for later rim excision and capsule repair (Video 1; Fig 6). A tag stitch is placed in each limb, as well as in the capsule to allow for later repair (Video 1; Fig 7).

**Acetabulum Rim Recession and Cam Resection**

The labrum may be ossified in the setting of coxa profunda as it was in our patient (Video 1; Fig 8 A). If there is viable labrum, a bucket-handle release of the damaged labrum is performed, leaving very anterior and very posterior attachments in place (Video 1; Fig 8 B). With the hip in flexion and external rotation with adduction, the femoral head can be gently dislocated. In the setting of coxa profunda, dislocation may be
impeded by the amount of acetabular overcoverage. The acetabular overcoverage may be resected with the hip reduced if the hip is not able to dislocate, which is what was required in the current case. The rim is resected using osteotomes while the femoral head is protected with a freer elevator. Amount of acetabular rim resection is based on preoperative center edge angle templating (Video 1; Fig 8 C). The amount of bone resection is confirmed with fluoroscopy. The ligamentum teres may need to be cut with a curved scissors. The hip is then dislocated and flexed, adducted and externally rotated and placed in the pouch of the hip drape on the anterior side of the patient. With the hip still dislocated, the remaining acetabular wall can be contoured with a 5 mm round burr (Video 1; Fig 8D). If indicated based on preoperative templating, an open subspine decompression is completed with a 5 mm round burr.

There is now excellent visualization of the cam lesion (Video 1; Fig 9 A). A 5 mm round burr (Stryker, Kalamazoo, MI) is used to resect the cam lesion. Femoral head sizers can be used to measure the amount of bone resection to establish femoral head sphericity (Video 1; Fig 9 B).

**Labral Reconstruction With Anterior Tibialis Allograft**

With the hip dislocated, anchors (1.4 mm NanoTack with flex inserter; Stryker) are placed along the rim of the resected wall. Placing anchors with the hip dislocated allows for verification that suture anchors do not penetrate the chondral surface of the acetabulum. Meanwhile, an anterior tibialis allograft (6-12 cm × 20-38 cm; Musculoskeletal Transplant Foundation) is tabularized with interrupted, circumferential 0 Vicryl suture (Ethicon, Bridgewater, NJ) on the back table.24,25 The knots are buried within the tendon. The hip is reduced before securing the graft to avoid unnecessary trauma to the reconstruction. The graft is then secured with mattress sutures at the most anterior and posterior aspect to the native labrum and

---

**Fig 4.** A trochanteric step-cut osteotomy is performed with the gMed tendon, long tendon of the gMin tendon, and vastus lateralis tendon attached to the mobile trochanter by making a cut along the posterior aspect of the greater trochanter starting just anterior to the most posterior fibers of the gMed. TO, trochanteric osteotomy; ST, stable trochanter; gMed, gluteus medius; VR, vastus ridge.

**Fig 5.** (A) The trochanteric osteotomy is retracted to put the remaining fibers of the gMed on tension and then allowing their sharp release. (B) The remaining gMed fibers are sharply elevated off the stable trochanter. (C) The gMin is sharply elevated from the hip capsule. TO, trochanteric osteotomy; ST, stable trochanter; gMed, gluteus medius; gMin, gluteus minimus; P, piriformis; Ca, Capsule.
acetabular rim (Video 1; Fig 10 A). Simple suture technique is used for the intervening anchors that incorporates the native labrum if present. The excess allograft is trimmed. On completion of the reconstruction, the suction seal of the hip socket is restored (Video 1, Fig 10B).

Capsular Closure and Osteotomy Repair

The wound is copiously irrigated. The capsule is closed using a 0 PDS (polydioxanone; Ethicon) suture. The piriformis tendon can also be repaired with 0 PDS (Video 1; Fig 11). Using fluoroscopy, the greater trochanter osteotomy is reduced using a ball spike pusher (Synthes; Johnson & Johnson, New Brunswick, NJ) and held in place with smooth Kirschner wires (K wire 0.062; Synthes) (Video 1; Fig 12 A). Definitive fixation is complete with three 3.5 mm inserted using standard lag by technique (Synthes) (Video 1; Fig 12 B).

Closure

The gluteal and iliobibial band fascia are closed with no. 1 Vicryl (Ethicon). Subcutaneous closure is complete with 2-0 Vicryl, and the skin is closed with a 3-0 Monocryl (Ethicon) in a running subcuticular stitch. SteriStrips are applied. A sterile Mepilex Ag with border (Molnlycke) dressing is placed. A final intraoperative radiograph (AP pelvis) is obtained (Video 1; Fig 13).

Inpatient Postoperative Care

After surgery, the patient is admitted for pain control and mobilization with discharge typically planned on postoperative day 2. We use a continuous passive motion machine to prevent capsular adhesions, initially set from 0° to 30°, on for 2 hours, 3 times per day. Weightbearing is limited to 20% body weight for the first 6 weeks. Deep vein thrombosis prophylaxis consists of chemoprophylaxis for the first month. The patient is discharged home on aspirin 81 mg twice daily with compression stockings for 4 weeks. Heterotopic ossification prophylaxis consists of a 4-day course of indomethacin 75 mg per day. Routine posterior hip precautions are followed, with additional restrictions consisting of no active abduction and no passive adduction past midline for 6 weeks.

Rehabilitation Protocol

During the first 6 weeks after surgery, the goal is to return to a normal gait with assistive device. The continuous passive motion machine is recommend for 6 hours use per day, gradually increasing from 30° to 90° of flexion as tolerated. This is usually discontinued

![Fig 6. The Z-capsulotomy performed in coxa profunda patients differs from a standard Z-capsulotomy in that it is raised subperiosteally off of the acetabular rim versus distal to the labrum in a standard Z-capsulotomy.](image)

![Fig 7. (A) The modified Z-capsulotomy is used to access the hip joint. (B) The piriformis is transected and tagged to complete the capsulotomy and allow greater access to the posterior wall. GT, greater trochanter.](image)
Fig 8. (A) The native labrum is elevated sharply in a bucket-handle fashion. In this case, a majority of the labrum was ossified, so the native labrum was diminutive. (B) The amount of resection required is determined by using the osteotome under fluoroscopy to establish a normal center edge angle. (C) The acetabular rim is resected carefully using osteotome. Here is shown halfway through completion. If it is done with the hip reduced, a freer is used to protect the cartilage. It can also be done with the hip dislocated. (D) The rim resection is complete. The native labrum is left intact at the far anterior and posterior aspect. Ac, acetabulum; FH, femoral head; La, labrum.

Fig 9. (A) The femoral head can be gently dislocated with hip flexion and external rotation to visualize the cam lesion. (B) A 5 mm round burr is used to perform femoral osteoplasty until sphericity is achieved as confirmed by a femoral head sizer. FH, femoral head.
about 2 weeks after surgery. As comfort allows, weightbearing is progressed from 20% of body weight to 75% of body weight. From 6 to 12 weeks, the goal is to progress to normal gait without an assist device, as well as to ascend an 8-inch step with good pelvic control. Strength can be gained with closed chain, balance, and proprioceptive work. Hip range of motion and full motor strength should return with single limb activities possible by week 16. Finally, by 20 weeks after surgery, progressive return to sport can begin.

Discussion

Surgical goals of hip preservation are to relieve pain, improve function, and preserve the native hip joint. Both arthroscopic and open techniques have been described. This Technical Note describes open surgical hip dislocation, rim resection, femoral osteoplasty, and labral reconstruction using anterior tibialis allograft in the setting of coxa profunda and combined-type FAIS with labral ossification (Table 2).

When compared to hip arthroscopy for the treatment of combined-type FAIS and marked coxa profunda, surgical hip dislocation offers the advantage of circumferential exposure and visualization (Table 3). Ahmad et al. showed that surgical hip dislocation had an odds ratio of 10 ($P = .002$) in achieving a lateral center edge angle correction $>12^\circ$ or acetabular index correction $>8^\circ$ compared to hip arthroscopy. For femoral neck osteoplasty, however, there was no significant difference in correction achieved. In the setting of coxa profunda, surgical hip dislocation is also
advantageous given that hip distraction is difficult to achieve, resulting in potential iatrogenic damage to the labrum or cartilage with arthroscopic instrumentation particularly if a lateral or posterolateral acetabuloplasty is indicated. The disadvantage to surgical dislocation of the hip for treatment of FAIS compared to hip arthroscopy is its invasive nature and longer rehabilitation time. This is largely thought to be related to the greater trochanteric osteotomy. Given that outcomes between arthroscopic and open surgical treatment of FAIS are similar, hip arthroscopy has largely become the preferred surgical method, bolstered by improvements in instrumentation, implants, increasing experience, and training in the technique. Still, the surgical hip dislocation, originally the gold standard treatment for FAIS, does have a role in hip preservation surgery. Marked coxa profunda is one of those indications. The trochanteric osteotomy is usually healed by 8 weeks after surgery, and full abductor force returns 4 to 6 weeks after surgery. Rarely, at a rate reported to be 0.3%, surgical hip dislocation patients develop Brooker grade I or II heterotopic ossification, although this has not translated to any clinical relevance.

Although the most serious complication of surgical hip dislocation remains avascular necrosis, in his original technique article, Ganz et al. highlights that with proper technique there were no cases of avascular necrosis in 213 cases over 9 years. In a study conducted by the Academic Network for Conservational Hip Outcomes Research group, similar results were presented with no cases of osteonecrosis or femoral neck fractures in 334 hips studied over 6 years. The overall complication rate was 9% at a median follow-up of 36 months. The most common complication (60%) was heterotopic ossification. With grade I and II heterotopic ossification excluded, the complication rate decreased to 4.8%. A trochanteric nonunion rate of 1.8% represents the greatest risk that would not have occurred during a less invasive procedure.

The success in addressing FAIS by surgical hip dislocation has been shown to be equivalent to hip arthroscopy in both survivorship and hip-specific patient reported outcomes at mid-term follow-up in a systematic review. Steppacher et al. has shown an 80% 10-year survivorship after surgical hip dislocation for the treatment of FAIS. More recently in a propensity-matched analysis of hip arthroscopy versus surgical hip dislocation, Neppe et al. reported no significant difference in postoperative patient reported outcomes after surgery, revision to total hip arthroplasty (surgical hip dislocation 3.1% compared to arthroscopy 0%, P = .12),

Fig 12. (A) The greater trochanteric osteotomy is reduced and held with k-wires. (B) Definitive fixation of the osteotomy with three 3.5 mm lag screws is confirmed with fluoroscopy.

Fig 13. Final intraoperative AP pelvis radiograph shows normal center edge angle, removal of ossified labrum, and trochanteric osteotomy fixation.
or persistent symptoms (surgical hip dislocation 24.4% compared to arthroscopy 21.9%, \( P = .55 \)).

In conclusion, surgical hip dislocation remains an effective surgical technique to address certain hip pathology, including coxa profunda. Concomitant pathology such as FAIS or labral tears/degeneration/ossification can be simultaneously addressed.

### References

1. Beck M, Kalhor M, Leunig M, Ganz R. Hip morphology influences the pattern of damage to the acetabular cartilage femoroacetabular impingement as a cause of early osteoarthritis of the hip. *J Bone Jt Surg* 2005;87:1012-1018.

2. Zhou J, Melugin HP, Hale RF, et al. The prevalence of radiographic findings of structural hip deformities for femoroacetabular impingement in patients with hip pain. *Am J Sports Med* 2020;48:647-653.

3. Boone G, Pagnotto MR, Walker JA, Trousdale RT, Sierra RJ. Radiographic features associated with differing impinging hip morphologies with special attention to coxa profunda. *Clin Orthop Relat Res* 2012;470:3368-3374.

4. Meek WM, Abraham PF, Kucharik MP, Martin SD. Limitations of post–hip arthroscopy for a patient with coxa...
1. Naal FD, Miozzari HH, Wyss TF, Nötzli HP. Surgical hip dislocation for femoroacetabular impingement in high-level athletes. *Am J Acad Orthop Surg* 2013;5:267-273.

2. Ahmad SS, Heilgemeir M, Anwander H, Beck M. Surgical hip dislocation is more powerful than arthroscopy for achieving high degrees of acetabular correction in pincer type impingement. *Orthop Traumatol Surg Res* 2015;105:1519-1527.

3. Tibor LM, Sink EL. Pros and cons of surgical hip dislocation for the treatment of femoroacetabular impingement. *J Pediatr Orthop* 2013;33:S131-S136.

4. Nwachukwu BU, Rebolledo BJ, McCormick F, Rosas S, Harris JD, Kelly BT. Arthroscopic versus open treatment of femoroacetabular impingement. *Am J Sports Med* 2015;44:1062-1068.

5. Addai D, Zarkos J, Petitt M, Sunil Kumar KH, Khanduja V. Outcomes following surgical management of femoroacetabular impingement: A systematic review and meta-analysis of different surgical techniques. *Bone Jt Res* 2021;10:574-590.

6. Steppacher SD, Anwander H, Zurmühle CA, Tannast M, Siebenrock KA. Eighty percent of patients with surgical hip dislocation for femoroacetabular impingement have a good clinical result without osteoarthritis progression at 10 years. *Clin Orthop Relat Res* 2015;473:1333-1341. https://doi.org/10.1007/s11999-014-4025-8.

7. Nepple JJ, Zaltz I, Larson CM, et al. Surgical treatment of femoroacetabular impingement. *J Bone Jt Surg* 2020;102:51-58 (Suppl 2).