Failure of Lateral Acetabular Growth 12 Years After Labral Splitting during Anteromedial Open Reduction of the Hip

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Abstract: A number of techniques are described to aid in open reduction for developmental dysplasia of the hip. Radial incision of an obstructive or inverted labrum has been considered as an effective means to "open" the acetabulum to facilitate anteromedial reduction. We present follow-up of a patient who underwent radial splitting of the labrum via an anteromedial approach at 14 months of age, which resulted in successful reduction of the hip. Twelve-year clinical follow-up reveals significant acetabular dysplasia, likely due to injury to the labrum and underlying secondary centers of ossification of the acetabulum. We recommend that surgeons use great caution when considering a labral incision or excision during anteromedial open reduction of the hip and consider other means of obtaining a stable reduction.

Key Concepts:

- An obstructive or inverted labrum can be a significant block to reduction in some dislocated hips, especially teratologic dislocations.
- Radial splitting of the acetabular labrum during open reduction can put the underlying acetabular epiphyseal cartilage at risk.
- When faced with unstable anteromedial open reduction, one should make sure all blocks to reduction have been effectively removed. In cases where the hip is still unstable, we would suggest conversion to a standard anterior approach with capsulorrhaphy before incising or otherwise opening the inverted labrum.

Introduction

Developmental dysplasia of the hip (DDH) can present as a spectrum of pathology from isolated radiographic abnormalities to frank hip dislocation. An estimated 1.0-1.5 cases of hip dislocation per 1,000 live births has been reported, making it one of the most common presenting diagnoses for newborns in an orthopaedic clinic.[1] Infants with a persistently dislocated hip after attempted conservative measures are typically indicated for closed versus open hip reduction in the operating room. There are several approaches described for open reduction of the hip, including the anterior, anteromedial, and medial approaches. The anteromedial approach allows for excellent access to multiple potential blockades to reduction, including the psoas and adductor tendons, transverse acetabular ligament, pulvinar, and ligamentum teres. Capsulorrhaphy, which can be helpful in enhancing stabilization of a newly reduced hip, is challenging from the anteromedial approach. Surgeons may also find that additional structures, including a raised ridge of the cartilaginous acetabulum and labrum, appear to block the femoral head from deeply seating within the acetabulum. This bulge of thickened cartilage at the periphery of the acetabulum, the neolimbus, is essential for later development of the acetabulum. Our

Figure 1. *Left hip arthrogram after psoas and adductor releases demonstrating wide medial dye pool and obstructive labrum. Note the hourglass-shaped constriction of the capsule, further preventing reduction.*

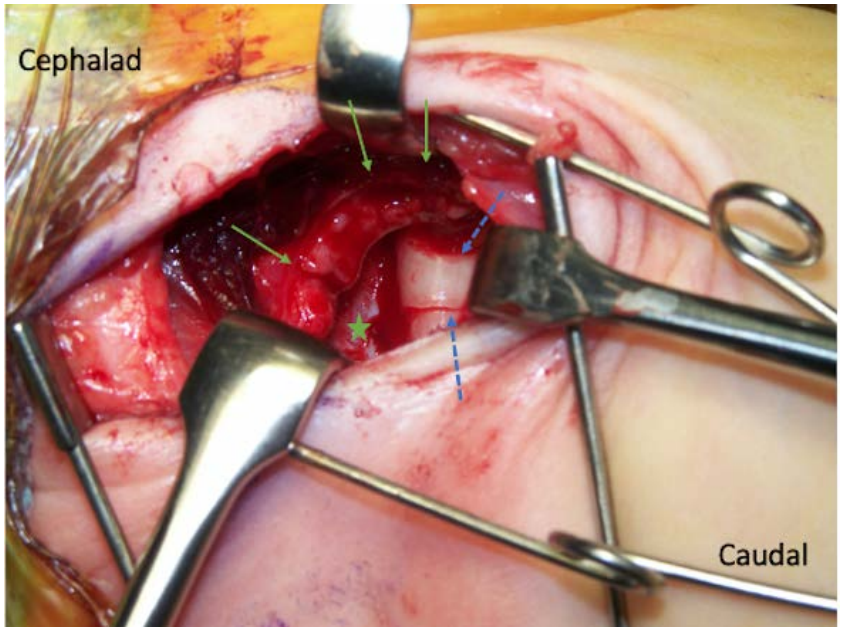

Figure 2. *Clinical photos of the anteromedial approach to left hip open reduction. The hip capsule has been incised. The femoral head is dislocated and not visible in this photo. Green arrows indicate the acetabular brim while the green star indicates the deeper medial acetabulum, cleared of pulvinar. Radial splits in the posterosuperior labrum are indicated by the blue dashed arrows.*

report describes 12-year clinical follow-up of a hip that was treated with open reduction and radial splitting of a structure identified intraoperatively as the labrum, with resultant acetabular dysplasia.

Case Report

Twelve years ago, a 13-month-old female presented for initial orthopaedic evaluation of a gait abnormality. Clinical examination revealed a positive Galeazzi sign on the left and limited left hip abduction. Pelvis radiographs demonstrated a dislocated left hip, and after discussion of these findings and options for future treatment, the family elected to proceed with closed versus open reduction of the left hip. Once in the operating room, an open adductor longus and psoas tenotomy were performed followed by an arthrogram and attempted closed reduction. The arthrogram demonstrated a wide medial dye pool and an obstructive capsule and limbus that prevented closed reduction (Figure 1). The decision was made to proceed with open reduction of the left hip through the existing medial incision. The hip capsule was incised, the ligamentum teres and pulvinar were excised, and the transverse acetabular ligament was identified and divided. The primary surgeon experienced continued difficulty in getting the femoral head to seat fully within the acetabulum. He elected to radially incise the obstructive labrum as a means to enlarge the introitus to the acetabulum (Figure 2). Improved stability of the hip was noted on exam, and the incision was closed in a standard fashion and a spica cast was applied. Immediate postoperative CT demonstrated concentric reduction of the left hip.

She returned to the operating room 6 weeks later for a scheduled cast change and repeat hip arthrogram, which

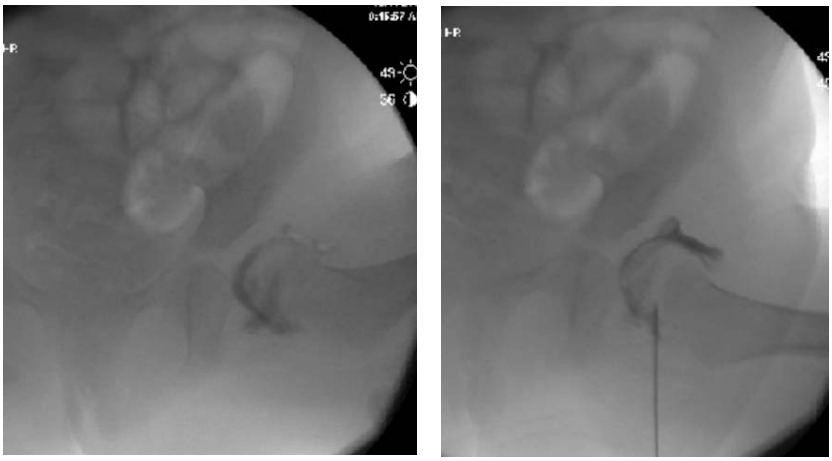

Figure 3*. Left hip arthrogram demonstrating maintained reduction 6 weeks after index procedure. Note that a sharp labral edge is not yet present.*

demonstrated continued reduction of the hip (Figure 3). She was maintained in a spica cast for a total of 3 months, after which it was removed, and she was transitioned to an abduction brace.

She was followed clinically and was noted to have persistent left acetabular dysplasia 1 year after her index surgery. She underwent a varus osteotomy of the left proximal femur at the age of 27 months, from which she had an uneventful early recovery (Figure 4). She was thereafter lost to follow-up until the age of 12 years old when she returned to clinic due to complaints of mild and intermittent left thigh and hip pain. Radiographs revealed retained femoral implant and severe left acetabular dysplasia (Figure 5). After discussion with the patient and her family about corrective surgical options at this stage, the family declined surgical reconstruction. Seven months later, she sustained a left subtrochanteric femur fracture above her retained femoral hardware and underwent removal of hardware with cephalomedullary nailing of the femur. The fracture healed uneventfully, and she returned at age 13 years + 9 months for nail removal. An arthrogram of the left hip was performed at the time of nail removal (Figure 6).

Discussion

Operative treatment of unilateral hip dislocations identified in the older infant and toddler is considered by most to be the standard of care to optimize function and reduce the risk of future pain and degeneration. There are relative merits and downsides to each of the described approaches to open reduction, a full discussion of which is beyond the scope of this report. The anteromedial approach, favored under appropriate conditions by the surgeon in this case, affords direct access to many of the obstacles to reduction but makes capsulorrhaphy very difficult.[1] Because of difficulty encountered in reducing this hip via an anteromedial approach, a radial incision of the labrum was performed. Twelve-year follow-up demonstrates that the patient has marked acetabular dysplasia, which we strongly suspect is the sequela of this intraoperative technique.

Residual dysplasia requiring reoperation after an open reduction via the anteromedial approach is not uncommon, occurring in 22% of patients in one study.[2] Our patient did demonstrate residual dysplasia following her open reduction and therefore went on to have a proximal femoral osteotomy. Despite this, she did not show any evidence of acetabular remodeling as would be expected. It is possible that a pelvic-sided osteotomy performed at the same time as the VDRO would have lessened the severity of her dysplasia. However, the fact that she demonstrated virtually no acetabular remodeling in response to the improved femoral head position suggests a deficit in the growth capacity of the developing acetabulum.

We hypothesize that that the structure radially incised in our described case was not just the labrum but also the

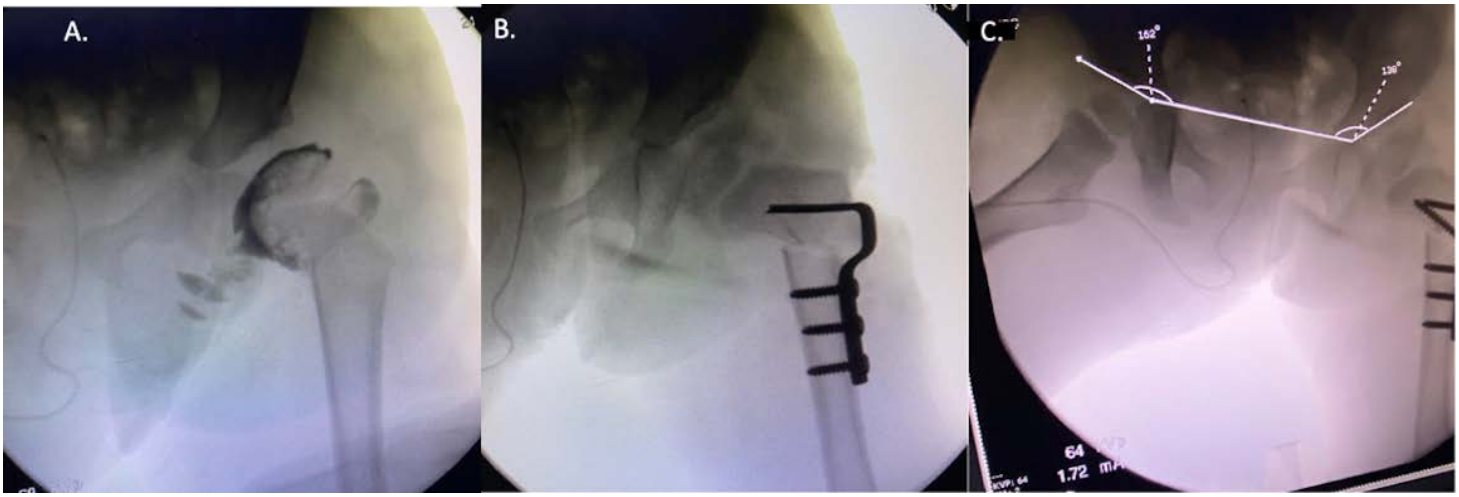

Figure 4. *Fluoroscopic images taken at the time of left proximal femur varus derotational osteotomy (VDRO) performed 1 year after her index surgery. A. Arthrogram prior to osteotomy; B. Varus osteotomy is completed; C. Measurement of the acetabular indices reveal 18 degrees on the right and 42 degrees on the left consistent with marked left acetabular dysplasia.*

underlying acetabular cartilage including the epiphyseal cartilage responsible for the later development of the lateral acetabulum. Review of the literature regarding open hip reduction and the role of the labrum over the last 70 years is complicated by the evolving and often overlapping use of the terms neolimbus, limbus, and labrum—some ambiguity remains when distinguishing between these entities. The neolimbus is consistently defined as a ridge or bulge of acetabular cartilage over which the unstable hip glides to produce the "clunk" of dislocation associated with the Ortolani sign.[1,3–5] It is important to note that the neonatal acetabular cartilage is not only articular but also epiphyseal, creating a hemispherical growth plate that is important for future acetabular growth.[1] The contemporary description of a limbus is a true inverted labrum or a hypertrophied labrum noted to be an uncommon finding outside of true teratologic dislocations. Graf suggests that using the term limbus to describe the acetabular labrum is "misleading" and discourages its use.[6] A tendency to incorrectly identify the bulge of the neolimbus as an inverted labrum, or limbus, on hip arthrogram, is also described.[1,5] The labrum is a thin rim of fibrocartilage at the periphery of the cartilaginous acetabulum.

In his 1957 publication, Somerville, an early proponent of removal of the limbus for congenital hip dislocations, provides a photo of "a typical limbus" following removal that demonstrates a stout, five by one centimeter structure.[7] The robust appearance of this structure, in contrast to the modern description of a labrum as thin and primarily fibrocartilaginous, raises concern that underlying cartilage was excised as well.

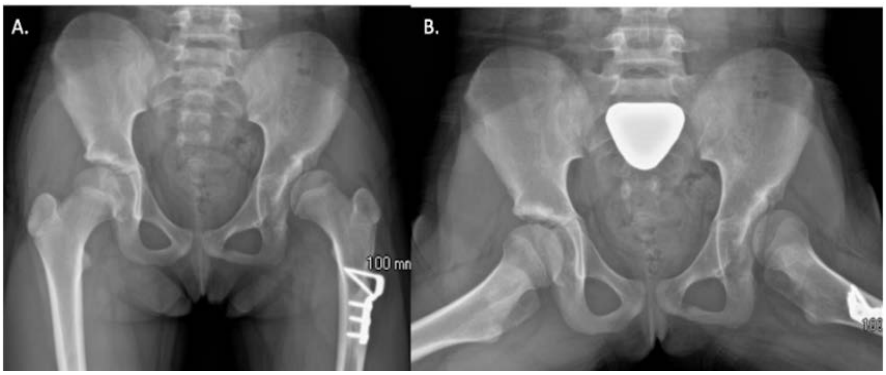

Figure 5. *AP and frog-leg views of the pelvis are shown in images 4A and 4B. Retained hardware from prior VDRO is noted. The acetabular teardrop is abnormal on the left and the sourcil is abnormally upward-sloping. There is a break in Shenton's line with superolateral subluxation of the femoral head and approximately 40% of the femoral head is uncovered. Lateral center edge angle is 5 degrees (normal 25-39).*

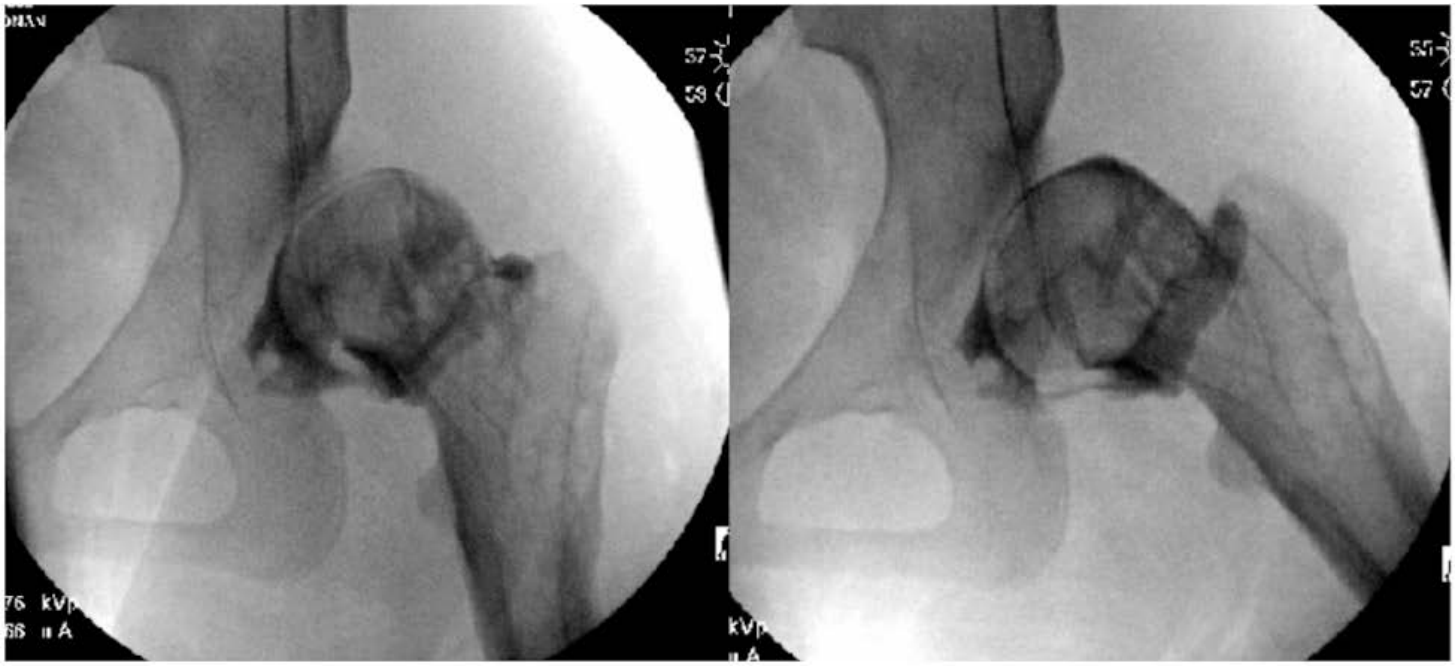

Figure 6. *Left hip arthrogram performed at the time of intramedullary nail removal 12.5 years after index open reduction procedure. Deficient lateral coverage of the femoral head and significant upsloping of the lateral acetabulum is again noted.*

Tachdjian's *Pediatric Orthopedics* appropriately counsels caution in this portion of the procedure, reminding us that the constricted and elongated hip capsule, not the acetabulum, can often prevent the femoral head from moving under the acetabular rim. The authors note, "Clinicians often use the term *labrum* for this blocking structure, and sometimes they excise it. However, the actual labrum is a thin fibrocartilaginous rim around the periphery of the acetabular cartilage. The blocking structure encountered in patients with DDH is not only the labrum but also a significant portion of the cartilaginous acetabulum itself. This vital cartilaginous acetabular anlage is essential for the normal growth and development of the acetabulum, and it should not be excised."[1]

In 1989, O'Hara described the long-term radiographic outcomes of 31 patients who underwent limbectomy at the time of open reduction. All patients who underwent a limbectomy were found to have failure of development of the lateral acetabular epiphysis by age 13.[8] This supports the observation in the Tachdjian's text that excision of what is often identified as the limbus or labrum intraoperatively actually includes epiphyseal cartilage.

The labrum contributes to the development of acetabular depth in the immature hip.[1] De Pelligrin and colleagues noted that the labrum increased in size and echogenicity following stabilizing treatment in infants with DDH, suggesting that the labrum plays a role in stabilizing the newly centered femoral head.[9] In the more mature hip, it acts to deepen the acetabular socket and provides a seal around the joint that helps maintain overall stability of the femoral head within the acetabulum.[10] There is some evidence in animal studies that labral eversion can have a negative effect on femoral head stability.[11] In this case, it cannot be determined whether the radial incisions, which increased the size of the acetabular introitus only several millimeters, contributed to destabilization of the hip by way of an incompetent labrum. Perhaps this may have contributed to the pathology that developed; however, it is unlikely that it is the primary cause of the marked dysplasia that developed.

This case demonstrates that significant acetabular dysplasia can result after radial incision of a structure identified as the labrum during open reduction of the hip. This occurred despite appropriate clinical monitoring following open reduction and spica casting and a femoral osteotomy at a later date. Distinguishing the true labrum from underlying cartilage at the time of surgery can be challenging. It seems most likely that our patient's degree of acetabular dysplasia is primarily a result of injury to the underlying acetabular epiphyseal cartilage. We recommend against using incision or excision of the labrum in the aid of hip open reduction. Meticulous care should be taken to avoid damaging the adjacent acetabular cartilage, as the effect of such an injury on future acetabular development can be devastating. We advise that if satisfactory reduction of the hip cannot be achieved through an anteromedial approach once the standard obstacles to reduction have been addressed, the labrum should be left alone and the surgery should be converted to an anterior approach where the hip capsule and femoral head can be more readily accessed.

Additional Links

1. POSNAcademy Authors Preferred Techniques: Medial Open Reduction for DDH by Dr. Dennis Wenger http://www.posnacademy.org/media/Medial+Open+Reduction+for+DDH/0_8uj9t8cr/19140162

2. AAOS Orthopedic Video Theater: The Weinstein-Ponsenti Approach for Open Reduction in Teratologic Hip Dislocation https://www.aaos.org/videos/video-detail-page/19937__Videos

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