

Arthroscopy Of the Pediatric and Adolescent Patient

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Arthroscopy of the pediatric and adolescent hip has seldom been performed in the past because of the complexity of surgery and concern for iatrogenic damage in the growing hip. Presently it is increasingly indicated for a number of problems in the immature hip because it offers less morbidity to patients than traditional open techniques and is becoming as effective as open surgery in many cases. Hip arthroscopy is currently performed for a number of diagnoses including slipped capital femoral epiphysis, Legg-Calve-Perthes disease, and femoroacetabular impingement. As our technical understanding and long-term outcomes are refined, the ability to alter disease outcome through arthroscopy may perhaps increase.

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Arthroscopy of the immature and adolescent hip is a demanding but potentially very useful treatment modality for certain mechanical disorders. Even in the larger adult hip, the constrained nature of the joint makes hip arthroscopy technically challenging. Pediatric and adolescent orthopedic patients are not simply smaller versions of the adult. Hip pain in the immature patient may have infectious, traumatic, and developmental etiologies, just as in the adult. The common problematic conditions of the immature hip, however, usually are diagnosed at characteristic ages and have distinctive clinical presentations. The earliest possible accurate diagnosis and effective treatment of abnormalities of the immature hip is important because most cases of osteoarthritis of the adult hip in North America, Europe, Japan, and much of the world have a developmental etiology. Developmental dysplasia of the hip (DDH), Legg-Calve-Perthes (LCP) disease, and slipped capital femoral epiphysis (SCFE), although not always diagnosed before maturity, may be associated with as much as 75% of the hips requiring total hip replacement for osteoarthritis.¹ Although inflammatory and frankly traumatic conditions of the pediatric hip are important causes of morbidity, they are not usually treated with arthroscopy and will not be considered further in this report.

The abnormal mechanical environment in the nontraumatized uninflamed symptomatic hip in the young patient often

has elements of instability (as in DDH) or femoroacetabular impingement (FAI). The degree of instability may be great and obvious as in the positive Ortolani test in a newborn with DDH or in the Perthes patient with a flat femoral head that is not congruous with the acetabulum. Much more common, though, are subtle degrees of instability or FAI, often presenting clinically as an acetabular rim syndrome.²

Any mechanically based treatment of pediatric and adolescent hip disorders, whether open, arthroscopic, or combined, must address the mechanical abnormality present. Arthroscopy provides a direct approach to the anterior hip joint, rim, and femoral head and neck, with minimally invasive techniques, offering advantages over traditional open methods for a range of intra-articular problems. Its use is still limited, and should still be, to centers with both technical expertise in arthroscopy and deep knowledge of normal and abnormal hip function in the immature and mature native hip. The low initial morbidity and fast postoperative recovery of function of hip arthroscopy compared with more open methods will lead to its increasing use for certain hip disorders as the necessary conceptual and technical expertise in treating mechanical hip disease becomes more widespread.

Role Of Hip Arthroscopy

Arthroscopic surgery of the hip may offer potential advantages compared with traditional open methods in terms of decreased morbidity and less surgical invasiveness. Most of the described experience in hip arthroscopy has been in adults, and the indications and results in the pediatrics population have been less well characterized. This may be caused by the periarticular and growth plate-related issues that are

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particular to the skeletally immature patient. In 1977, Gross³ described his early experience with hip arthroscopy in a variety of childhood conditions and found that the procedure did not aid in diagnosis or therapeutic intervention, thus perhaps diminishing early efforts in its application to younger patients.

However, 2 series in 1981 and 1986 reported more favorable results in the use of arthroscopy in the pediatric hip for juvenile chronic arthritis. These reports showed that arthroscopy was effective in diagnosing the cartilage damage and severity of the synovitis.^{4,5} Schindler et al⁶ reviewed 24 arthroscopies for varied diagnoses and conclude that hip arthroscopy was effective for synovial biopsy and loose body removal; however, as a diagnostic procedure, arthroscopy only supported the diagnosis in 54% of patients. This has been supported in a larger series on adults in which diagnostic hip arthroscopy was useful in only specific cases, and the authors note that the improvements in imaging modalities may decrease the indications for diagnostic arthroscopy.⁷

As the understanding of hip diseases and arthroscopic experience continues to evolve, the use of hip arthroscopy will undoubtedly rise. The surgeon must be precise in the role of hip arthroscopy for diagnosis and treatment and carefully weigh the options of open versus arthroscopic procedures.

Anatomy

The acetabulum is the convergence point of 3 bones: the ischium, pubis and ilium. The triradiate cartilage assumes a Y-shape with the anterior slanted portion of the "Y" dividing the ilium and pubis, the posterior slanted portion separating the ilium and ischium and the inferior limb separating the ischium and pubis. The physis of the triradiate cartilage is bipolar, with the germinal zone running in the center of each arm of the "Y."⁸ The bone adjacent to each physis is analogous to the metaphysis and is capable of great remodeling. There is an intricate relationship between the acetabular, articular, and triradiate cartilage that allows the progressive expansion of acetabular concavity in response to growth of the proximal femur. Thus, the major role of the triradiate cartilage is to facilitate a radial increase in size of the acetabulum while maintaining spherical congruency. As adolescence is reached, secondary ossification centers develop in the periphery of the acetabulum within the arms of the triradiate cartilage.⁹

The physis of the proximal femur is usually contained within the sphericity of the femoral head. The greater trochanter also develops a secondary ossification center directly above the lateral metaphysis. Around age 8, an indentation in the ossification center where the ligamentum attaches forms, and the final anteversion of the proximal femur is determined. Of the active growth regions around the proximal femur, the capital femoral physis is the first to close, beginning centrally.

Physical Examination and Imaging

The history and physical examination of the hip is usually the most useful and effective way to diagnose and treat hip disorders. The clinician must be able to determine the frequency, severity, location, inciting factors, and radiation of symptoms. Factors that exacerbate or relieve the symptoms and the chronicity or acuteness of symptoms can aid in the diagnosis. However, in pediatric and adolescent patients, hip pain may not be the presenting symptom. Because of the referral pattern of pain, hip pathology should be strongly suspected with knee pain, especially in those patients with a normal examination of the knee. Another frequent presentation is the limping child with no known injury. A history of preceding illness should direct the physician to consider the diagnosis of transient synovitis; however, septic arthritis should be ruled out.¹⁰

Mechanical symptoms, such as clicking and locking can be seen with labral tears, audible or visible snapping may be associated with coxa saltans interna or externa. Intra-articular hip pain usually presents as groin pain and may radiate to the anterior thigh although patients can describe pain on the lateral thigh or even the buttocks.^{11,12} Pain from the lateral thigh and buttocks must also be investigated for a neurogenic or spinal cause.^{13,14} Pain with passive flexion and internal rotation of the hip has been identified as predictors of intra-articular pathology, which has been corroborated in young patients.

The physical examination should be thorough. The patient's gait should be noted and any leg-length discrepancies assessed. Examination of the lumbar spine, including motor function, sensation, range of motion, reflexes, and straight-leg raises, must be performed to rule out lumbar spine pathology as the cause of symptoms. The hip examination begins with palpation of bony prominences about the hip and assessment of the range of motion. The impingement test (flexion to 90°, maximal internal rotation, and adduction) should be performed in the supine position. Comparison to the contralateral hip should be a part of each examination.

Imaging

Plain radiographs are the most useful imaging tool for the initial evaluation of hip complaints. Radiographs can show degenerative changes, bony lesions, dysplasia, the presence of osteochondral loose bodies, and bony prominences that predispose to FAI. Additionally, a morphologic change of the acetabulum such as retroversion, coxa profunda, and protrusion acetabuli can be identified. Radiographic evaluation should include an anteroposterior pelvis, a lateral radiograph (we prefer the Dunn lateral), and false profile views¹⁵ (Fig 1). Although it has been shown that there is no difference in the weight-bearing surface of an anteroposterior pelvis taken supine versus standing,¹⁶ a standing anteroposterior pelvis can emphasize the evidence of mild dysplasia. The lateral radiograph is useful for the examination of the anterolateral head-neck junction, whereas the false

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