

## Report of Breakout Session: Coxa Profunda/Protrusio Management

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### Where Are We Now?

Architectural abnormalities of the acetabulum that lead to overcoverage of the femoral head may predispose the femoral neck toward direct impaction on the acetabular rim complex during terminal hip motion. These alterations cause pincer-type femoroacetabular impingement (FAI). The arthritic process is initiated by the damage to the labrum and acetabular rim cartilage caused by femoral neck impaction as well as from contre coup cartilage damage that occurs when the neck levers against the rim. Appropriate management of global overcoverage such as coxa profunda or protrusio requires identification of the underlying pathoanatomy, assessment of clinical signs and symptoms, and the application of contemporary surgical techniques.

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Pincer FAI caused by global acetabular overcoverage, or global pincer FAI, may exist as a spectrum of pathologies. One extreme is reflected by acetabular protrusio, in which the femoral head migrates medial to Kohler's line. The medial migration of the femoral head can occur in association with rheumatoid arthritis, osteomalacia, or Marfan's syndrome but is most frequently idiopathic ("Otto pelvis"). In sufficiently symptomatic patients, THA is indicated for global pincer FAI or protrusio associated with autoimmune arthritis. However, global pincer FAI can also occur as a developmental or posttraumatic deformity in young adults, in which the articular cartilage is still intact but in a prepathologic state. These patients are candidates for joint preservation surgery if the posteroinferior joint space is still normal. The surgery is challenging, especially if the acetabular roof inclination is negative. The mechanical situation must be normalized, the impingement alleviated, and the roof orientation addressed.

Symptoms of pincer FAI occur more frequently in middle-aged women and typically have a gradual onset. Symptoms are often first noticed after physical activity such as impact sports or sports demanding hypermobility or, less commonly, after distortional trauma. Pain is most commonly localized to the groin but may also occur over the greater trochanter or in the gluteal/buttock region. ROM, mainly internal/external rotation, is usually limited in areas of overcoverage and provocative maneuvers during the physical examination will recreate symptoms at the extremes of motion. The clinical picture can include dramatic pain from the contused, inflamed, and cystic labrum. This is in contrast to that of patients with cam-type FAI, in which the labrum is not involved in the early stages of impingement.

The radiographic evaluation begins with a standardized set of plain radiographs. A correctly oriented AP pelvis

radiograph is used to assess the acetabular index or Tönnis angle, the lateral center-edge angle, posterior wall sign, crossover sign, and ischial spine sign. The radiographic diagnosis of protrusio is made when the femoral head lies medial to Kohler's line (ilioischial line). Another parameter for quantifying femoral overcoverage is the femoral head extrusion index, which is defined as the percentage of the femoral head that is uncovered as compared with the total diameter of the femoral head. Although coxa profunda had been considered a form of overcoverage in the not-so-distant past, the defining radiological finding of the depth of the acetabular fossa being at or medial to Kohler's line is common, even in hip dysplasia, which, by definition, is undercoverage. The projection of the acetabular fossa relative to the ilioischial line is strongly related to the version of the acetabulum. Thus, a false-positive coxa profunda can be observed in a dysplastic hip with an excessively anteverted acetabulum. Consequently, the relationship of the acetabular fossa to the ilioischial line alone (isolated coxa profunda) should not be viewed as an indicator of acetabular overcoverage. Additional projections must be considered as well. The Dunn and crossstable lateral views show indentations at the head-neck junction corresponding to the area of impaction. The false profile view is helpful for showing posterior joint space narrowing resulting from a contre coup lesion, which is not visible on an AP pelvis radiograph [6].

High-resolution MRI of the hip with intraarticular gadolinium currently provides the best visual representation of surrounding soft tissue structures. MR arthrography of the hip is not only superior to plain pelvic or hip MRI for detection of labral pathology, but also is able to detect articular cartilage damage that cannot be seen with plain radiographs. Plain MRI is specific but less sensitive for detecting articular cartilage damage and is less sensitive than a MR arthrogram for detecting labral pathology. Radial slices are essential to completely evaluate bone apposition at the acetabular rim [2] and abnormalities at the femoral head-neck junction that could potentially contribute to impingement. Moreover, acetabular depth can be quantified from the radial sequences.

Consideration of all of these clinical and radiographic aspects is crucial for developing a proper treatment plan. If there is still doubt as to whether the symptoms are the result of intraarticular pathology, some surgeons use a diagnostic injection of local anesthetic to confirm the diagnosis. Although for advanced osteoarthritis (OA) a high sensitivity of 96% has been reported [3], no information is available on the accuracy of this diagnostic test for FAI. Patients with extraarticular impingement are unlikely to benefit from intracapsular procedures and, therefore, alternate surgical strategies for these patients might be beneficial. Conversely, patients with anatomic

intraarticular impingement are unlikely to respond to nonsurgical treatment and are potential surgical candidates.

Historically, for the skeletally immature patient, triradiate fusion (occasionally combined with intertrochanteric osteotomy) provides good results [7]. For the young adult, valgus intertrochanteric proximal femoral osteotomy has been recommended [5]. In the older adult, this procedure may provide an acceptable result if there is minimal arthritis. For patients with more advanced arthritis, THA with lateralization of the cup to a normal position provides a predictable long-term solution. More recently the surgical treatment of pincer FAI has shifted to procedures directly addressing overcoverage by trimming of the acetabular rim in combination with labral refixation techniques [4]. These patients may benefit from a redirection of the periacetabular osteotomy (PAO) in those with a negative acetabular roof angle and a high fossa [4]. If a medial shift of the femoral head is present, valgus intertrochanteric osteotomy might still be warranted, but iatrogenic posterior impingement should be prevented.

Despite the widespread use of arthroscopy and miniopen techniques in treating FAI, only mild global pincer FAI can be safely and adequately managed arthroscopically because entering a deep socket and performing posterior rim resection is technically difficult if not impossible. As a result, open surgical techniques remain the mainstay of treatment for global overcoverage. We recommend that the majority of cases be treated with surgical hip dislocation. Trimming of the entire acetabular rim during open surgical dislocation will reduce the depth of the acetabulum, and, when appropriate, labral refixation and, if absent, labral reconstruction using a graft can be performed. Based on the current literature, preservation of the labrum seems as critical to the overall result as performing appropriate bony resection. Care should be taken to preserve the labrum before acetabular rim resection so that after the acetabular rim has been resected, the labrum can be reattached with suture anchors to a base of bleeding cancellous bone. The suction-seal of the hip and the resultant fluid film lubrication are dependent on an intact labrum. Some patients may also benefit from osteochondroplasty of the head-neck junction or relative lengthening of the femoral neck with trochanteric advancement to increase the femoroacetabular clearance.

If the MR arthrogram demonstrates extension of the acetabular fossa in the weightbearing zone in a patient with a small negatively inclined roof, rim trimming may be insufficient for reducing acetabular overcoverage, because this situation should be viewed as medial dysplasia. Depending on the morphology, a femoral-sided osteotomy (ie, valgus intertrochanteric osteotomy) or a pelvis-sided osteotomy (ie, a reverse PAO) may be appropriate and can be performed in the same surgery. The surgeon should be

aware that a reverse PAO for protrusio is substantially more demanding than the classic PAO for a dysplastic acetabulum. In a reverse PAO, manipulation of the acetabular fragment is more difficult. Long-term followup for all of these surgeries is necessary to determine the efficacy of these procedures in maintaining hip function and potentially delaying the degenerative process.

The understanding of pincer FAI-associated disease processes has evolved through clinical and surgical experience, and the current philosophy of treating intraarticular impingement is based mainly on open surgical techniques. This is not meant to dismiss the emerging role for arthroscopy in some situations. The goals of treatment are the same regardless of approach: to safely and precisely correct morphologic abnormalities, to alleviate the symptoms of FAI, and to stop or slow the progression of early osteoarthritis.

### Where Do We Need to Go?

The two principal goals of FAI treatment are to lessen symptoms (pain and restricted motion) and decelerate the degenerative process. Despite conceptual confirmation of FAI and documented pain reduction in the majority of patients treated for FAI, there are no long-term data showing whether or not OA can be delayed/prevented by surgical treatment. No conventional radiographic cutoff values, comparable to those defined for acetabular dysplasia, are given for acetabular overcoverage. Improved clinical and imaging techniques are required to depict subtle bony abnormalities and the degree of the arthritic process. Sensitive outcome measures designed for the young cohort of patients should determine whether or not patient expectations and satisfactions can be achieved by surgical treatment.

### How Do We Get There?

Several centers have been or still are working on the development of patient-related outcome measures useful for FAI. Advanced imaging techniques such as dGEMRIC and T2 mapping have become available and have been proposed as prognosticators of outcomes of joint-preserving surgery [1]. Well-designed case-control studies using the mentioned tools should identify which treatments allow reduction of symptoms and deceleration of the development of hip OA. These studies will also reveal whether or not additional prospectively randomized trials will be required.

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