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Femoroacetabular Impingement: Caution Is Warranted in Making Imaging-based Assumptions and Diagnoses[1]

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Femoroacetabular Impingement: Does It Exist as an Imaging-based Diagnosis?

Femoroacetabular impingement (FAI) is a relatively new diagnosis (1,2) that may represent an important cause of hip osteoarthritis in young patients. It has generated intense interest among orthopedists and radiologists specializing in hip disorders and sports-related injuries. FAI continues to be the topic of numerous research investigations, scientific papers, and review articles (3–12). This commentary addresses several orthopedic controversies that raise questions about the role of imaging in the setting of FAI.

Impingement Syndrome: An Imaging-based Diagnosis?

Impingement syndromes occur in many joints and are the common topic of presentations at imaging continuing medical education meetings and refresher courses. Attendees learn about the radiographic and magnetic resonance (MR) findings that are associated with impingement and return to their practices enthusiastic about applying this knowledge in the interpretation of imaging studies of the shoulder, ankle, hip, and other joints.

In patients suspected of having impingement, however, the knowledge required to identify abnormalities is only a first important step in image interpretation. Should radiologists be confident in their imaging diagnosis of impingement? In the MR study of a shoulder, for example, findings might include os acromiale with hypertrophic pseudoarthrosis, bursal edema or fluid in the subacromial-subdeltoid space, and rotator cuff tendinopathy or tear. In the report to the referring orthopedist, should the conclusion indicate a diagnosis of external shoulder impingement? If the shoulder abnormalities include superior labral tear and biceps tendinopathy in combination with partial-thickness articular-side rotator cuff tear, should the impression specify a diagnosis of internal shoulder impingement? In the ankle, orthopedists recognize numerous impingement syndromes. Should the final imaging-based diagnosis be impingement if a large os trigonum shows bone marrow edema with surrounding effusion, a large spur projects anteriorly from the tibial plafond and abuts the talus with adjacent capsular scarring, or the anterior tibiofibular ligament is markedly thickened and partially torn? In the majority of cases, the answer is no. Is it different in the hip? Can radiologists diagnose FAI on the basis of the presence of a labral tear, a cartilage flap, an ossicle along the acetabular rim, and cystic or bony proliferative changes at the femoral head-neck junction?

Imaging abnormalities alone are not sufficient. Clinical symptoms and signs are essential to the diagnosis of FAI and other impingement syndromes. FAI is proposed to result from abnormal mechanical abutment between the femur and the acetabular rim. Patients complain of groin pain that occurs during athletic activities or prolonged sitting. Episodes of locking may occur. At physical examination, the impingement test reveals a decreased range of motion and painful limitations during flexion, internal rotation, and adduction of the hip. Similar to the sensitivities and specificities of these findings for impingement syndromes in other joints, the sensitivities and specificities of these clinical observations for FAI remain unknown.

There are other reasons to be cautious when assessing the importance of acetabular labral tear, cartilage flap, ossicle along the acetabular rim, and cystic or bony proliferative changes at the femoral head-neck junction. First,

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See also the article by Anderson et al in this issue.

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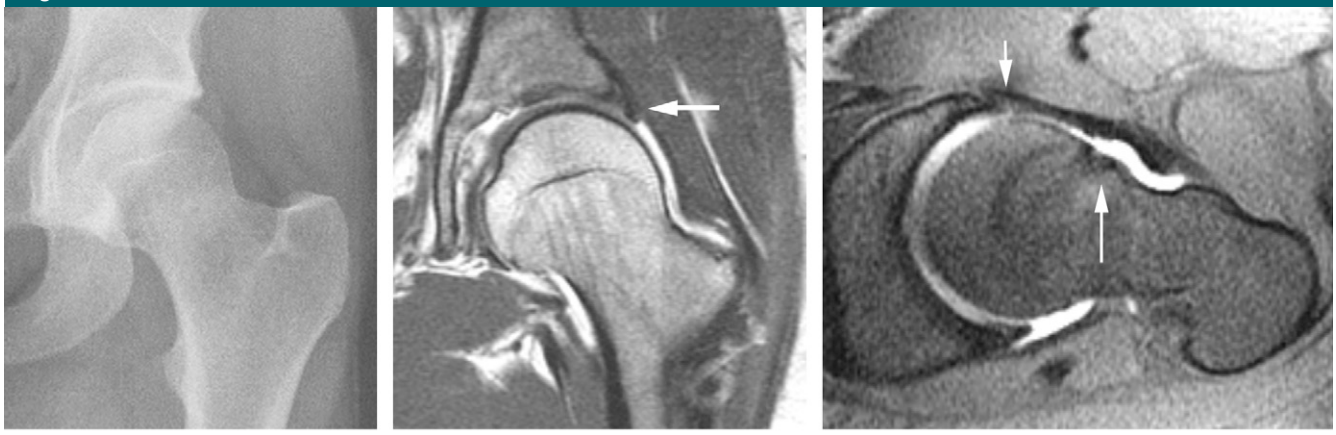
Figure 1



a. b. c.

Figure 1: Preoperative images of left hip in 19-year-old man with clinical signs and symptoms suggesting FAI. **(a)** Anteroposterior radiograph shows no degenerative change. **(b)** On coronal T1-weighted MR arthrogram (repetition time msec/echo time msec, 550/14), acetabular labrum (arrow) and adjacent articular cartilage show no tear or defect. **(c)** On oblique axial fat-suppressed T1-weighted MR arthrogram (625/15), small size and irregular contour of anterior acetabular labrum (short arrow) suggest degeneration and tear. Bony proliferative changes (long arrow) involve head-neck junction of proximal femur.

although the majority of patients with FAI demonstrate abnormalities that support the clinical diagnosis, identical abnormalities can be seen in patients without the symptoms and signs of impingement syndrome (13).

Second, orthopedists who specialize in hip disorders—even those who practice in the same group or institution—often have divergent opinions about the importance of these imaging findings in preoperative decision making. For some orthopedic surgeons, for example, an ossicle along the acetabular rim would indicate an unequivocal pincer lesion, explain the cause of the symptoms, and confirm the diagnosis of primary FAI. For other orthopedic surgeons, the symptoms would be explained by a labral tear or cartilage defect. The ossicle would represent an accessory bone or heterotopic ossification only and have nothing to do with the prognosis, the origin of the symptoms, or the development of other hip abnormalities. Therefore, for patients with the same imaging findings, the treatment plans would be different. Orthopedists who diagnose primary FAI are likely to recommend ossicle resection and acetabular labral detachment with rim reconstruction, labral refixation, and femoroplasty (bumpectomy). Other orthopedists are more likely to recommend conservative treatment or debridement of the labrum and articular cartilage. These differences in treatment approaches are profound and should be taken into account by radiologists who report labral, chondral, and osseous abnormalities in the hip.

Orthopedic Controversy, Imaging Uncertainty

FAI was initially described as a complication of total hip arthroplasty (14–20). Reinhold Ganz, a Swiss orthopedist, is recognized as having first described FAI as a unique condition in the native hip, proposed its mechanisms, and illustrated its imaging findings. Ganz, his colleagues, or his students authored most of the original papers on FAI (1–12). On the basis of unprecedented treatment experience and hundreds of surgical hip dislocations, he continues to amass the largest number of publications on FAI. Ganz has presided over the training of numerous residents, fellows, and visiting international fellows, who leave sharing a strong diagnostic bias and aggressive treatment culture. The "disciples" of Ganz have had a global influence on the treatment management of young patients with hip pain. They have returned to their practices embracing new surgical interventions that hold the promise of preventing the progression of osteoarthritis. Optimism and opportunity have converted many of their colleagues into FAI believers.

Other orthopedists have questioned the role of surgical intervention for treatment of a newly described condition. Decades of experience support the causal relationships between osteoarthritis and structural abnormalities of the hip such as dysplasia, slipped capital femoral epiphysis, Legg-Calvé-Perthes disease, and malunited femoral neck fracture. With regard to FAI, on the other hand, the divergent opinions reflect the lack of data on the natural history of this abnormality and the lack of prospective, controlled trials showing the long-term clinical outcomes. A much longer time is required to follow-up osteoarthritis and establish treatment effectiveness than is afforded by the relatively recent introduction of the corrective surgeries proposed by Ganz and colleagues.

Orthopedists influence radiologists because they control diagnostic decision-making algorithms and treatment strategies—not to mention, imaging referrals. Currently, orthopedic surgeons lack consensus on the treatment management of patients with classic FAI imaging findings such as labral tear, cartilage flap, ossicle at the acetabular rim, and cystic or bony proliferative changes at the femoral head-neck junction. Some

Figure 2

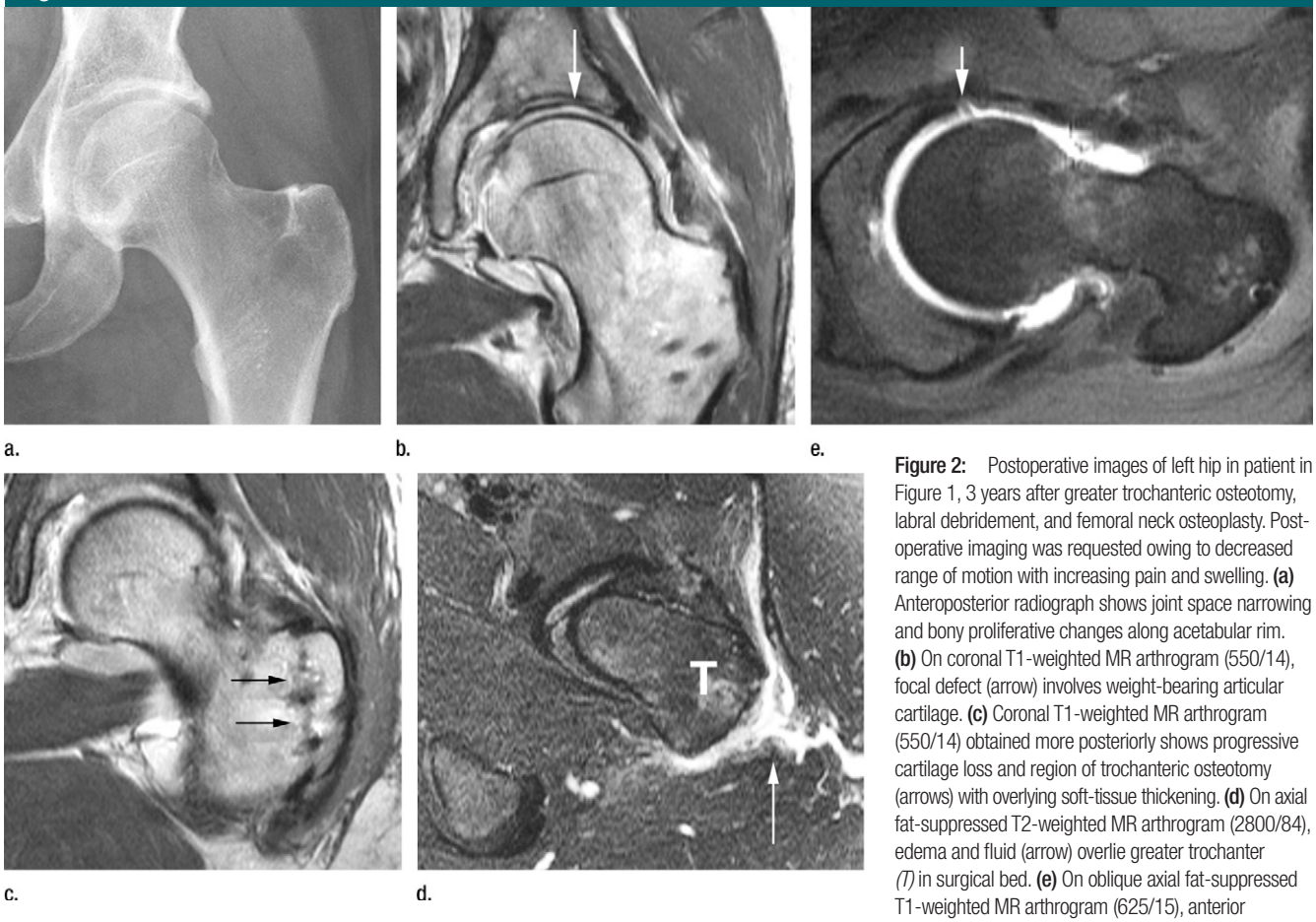


Figure 2: Postoperative images of left hip in patient in Figure 1, 3 years after greater trochanteric osteotomy, labral debridement, and femoral neck osteoplasty. Postoperative imaging was requested owing to decreased range of motion with increasing pain and swelling. **(a)** Anteroposterior radiograph shows joint space narrowing and bony proliferative changes along acetabular rim. **(b)** On coronal T1-weighted MR arthrogram (550/14), focal defect (arrow) involves weight-bearing articular cartilage. **(c)** Coronal T1-weighted MR arthrogram (550/14) obtained more posteriorly shows progressive cartilage loss and region of trochanteric osteotomy (arrows) with overlying soft-tissue thickening. **(d)** On axial fat-suppressed T2-weighted MR arthrogram (2800/84), edema and fluid (arrow) overlie greater trochanter *(T)* in surgical bed. **(e)** On oblique axial fat-suppressed T1-weighted MR arthrogram (625/15), anterior acetabular labrum (arrow) shows deficiency and tear. Postoperative changes involve femoral head-neck junction.

orthopedists would diagnose FAI and recommend arthrotomy with open osteotomy or osteoplasty to correct the structural abnormalities, restore the normal anatomy, and prevent the progression of degenerative joint disease (Figs 1, 2). Others, however, who challenge the assertion of impingement as a primary diagnosis, would place diagnostic emphasis on the labral and chondral lesions. They might recommend arthroscopy for the debridement of these lesions and the removal of loose bodies, expecting short-term symptomatic relief, functional improvement, and rapid postoperative recovery. A third cohort of orthopedists might recommend conservative treatment and eventual hip replacement with the presumption that osteoarthritis cannot be delayed and the joint cannot be preserved with any intervention. For this third cohort, the risks and potential complications of aggressive intervention would outweigh any benefits of surgery (Figs 1, 2).

The current orthopedic and radiologic literature is strongly weighted toward articles favoring the diagnosis and aggressive treatment of FAI. In clinical practice, however, there is an obvious lack of consensus among the orthopedic community. This inconsistency sometimes happens with newly described disorders, when expectations outpace experience. Until experience with FAI increases, radiologists should avoid making the following unproved assumptions:

1. Because clinical symptoms and signs are essential in the diagnosis of impingement syndromes, do not assume that FAI can be accurately and consistently diagnosed on the basis of MR imaging findings alone, that all patients with an abnormal alpha angle have impingement and require anatomic correction, or that all patients with acetabular retroversion have impingement and require rim resection or reconstruction.

2. Although FAI is proposed to be the result of abnormal mechanical abutment between the femur and the acetabular rim, do not assume that the surgical outcomes for labral and chondral tears depend on the treatment of osseous impingement. In a large series of hip arthroscopies in patients with pain, mechanical symptoms, labral tears, and acetabular cartilage defects, the majority (85%) of patients reported decreased or absent pain after 2 years (21,22). Treatments included debridement of torn labral and chondral flaps. No patients underwent acetabular reconstruction or femoroplasty. Currently, the most important determinant of treatment success is cartilage loss. In patients with labral tears, the best outcomes have occurred

in the setting of low-grade cartilage lesions confined to the acetabulum (23–25). Diffuse chondral damage has been associated with the worst outcomes.

3. Because the causes of labral tears and chondral defects can be trauma and exercise related in both young and older individuals (26), do not assume that all labral lesions are caused by osseous impingement or that chondral lesions do not occur in the absence of impingement.

4. Because the radiographic positioning of the pelvis and hip can be difficult, even for experienced technologists working closely with orthopedic surgeons who specialize in the hip (27), do not assume that the findings on routine radiographs of the pelvis and hip are reliable indicators of FAI, acetabular overcoverage, acetabular version, or sphericity of the femoral head.

Conclusions

The diagnosis of FAI is becoming increasingly common despite the paucity of data on its natural history and its relationship with osteoarthritis. The prevalence of imaging findings of FAI is unknown among asymptomatic individuals. Interventional techniques vary widely from surgeon to surgeon, and there are no long-term data demonstrating the benefit in preserving the hip and preventing osteoarthritis. The diagnostic criteria and orthopedic management will become more uniform as the body of literature continues to expand beyond that of Ganz and his followers and as the long-term treatment results become known through controlled multicenter clinical trials.

Owing to limited understanding of FAI and unproved assumptions, caution is warranted when interpreting images. It is worth remembering that the diagnosis of FAI depends on both clinical and imaging evidence. Since referring physicians may have divergent opinions on the importance of the imaging findings, the mechanisms of impingement, and the appropriate surgical treatments, the quality and effectiveness of dictated reports depend heavily on communication savvy. Radiologists should recognize and describe imaging abnormalities that may be associated with FAI, but it may be prudent to avoid any reference to FAI in the report.

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