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The WCC Note™

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Volume 4, Number 6 – August 24, 2010

FEMOROACETABULAR IMPINGEMENT, PART 1

Femoroacetabular impingement (FAI) is acknowledged as a considerable cause of hip pain and labral tears in young adults. It is theorized to be a primary antecedent of hip osteoarthritis. While strong clinical evidence exists that surgical intervention relieves pain and improves function in FAI, understanding the optimal diagnosis and treatment of FAI, and its role in osteoarthritis development, is an evolving knowledge. (1)

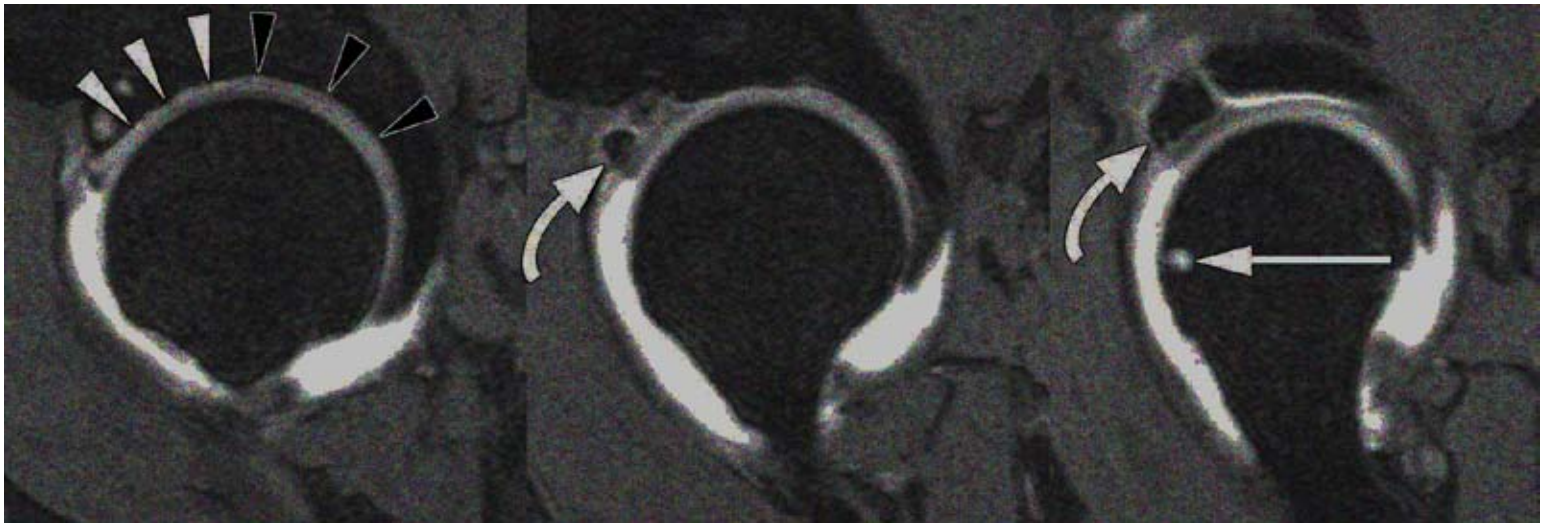
This issue of *The WCC Note* examines the definition, epidemiology, and presentation of femoroacetabular impingement.

FAI HISTORY

What is the history of FAI?

In 1935 at the Massachusetts General Hospital, Dr. Marius Nygaard Smith-Peterson recognized hip impingement in a 55-year-old woman with “bilateral intrapelvic protrusion of the acetabulum”. Dr. Smith-Peterson stated that her pain was due to the femoral neck on the anterior acetabular margin resulting in “traumatic arthritis.” He advocated removing the anterosuperior acetabular rim. (2)

The ideas of impingement and its treatment became reintroduced in the 1990s by Ganz and colleagues from Bern (2), and in 1999, Myers *et al* coined the term femoroacetabular impingement in the English literature. (1, 3)



Consecutive sagittal water excitation three-dimensional double-echo steady-state MR images (24.0/6.5, 25° flip angle) moving from medial (left) to lateral (right) in a patient with cam FAI. Note advanced acetabular cartilage damage at the anterior aspect of the acetabulum (white arrowheads). The cartilage is normal at the posterior aspect of the acetabulum (black arrowheads). An os acetabuli (curved arrow) is present at the anterosuperior aspect of the acetabular rim. Note the herniation pit (straight arrow) at the anterior femoral head-neck junction. (24)

WHAT IS FAI?

What is FAI?

FAI is a hip disorder resulting from abnormal morphology of the proximal femur and acetabulum. It results in increased hip contact forces with hip motion, specifically flexion. (4) FAI causes abnormal contact of the anterosuperior acetabulum during activities that require a large hip range of motion. (5)

The abnormal contact causes developmental changes in the acetabulum, femoral neck, and labrum. Hip mechanics alter, leading to chondral damage and eventual osteoarthritis. (6)

The most frequent location is the anterosuperior rim, and most critical motion is internal rotation of the hip in 90 degrees flexion. (7) FAI is a cause of labrochondral disease and secondary osteoarthritis. (8)

TYPES OF FAI

What are the types of FAI?

1. Impingement comes from two types: femoral causes (cam) or acetabular causes (pincer). (9)
    a. Cam
        i. The impact originates from a nonspherical shape of the femoral head combining with insufficient femoral head-neck offset.
        ii. Shear forces result in acetabular cartilage injury, especially via forced flexion and internal rotation. (10)
    b. Pincer
        i. Acetabular overcoverage or other variant configuration or shape of the acetabulum causes the impact.
        ii. The femoral head shape is spherical.
        iii. The proximal femoral neck abuts the labrum and acetabular rim anteriorly. (10)
2. Mixed cam and pincer
3. In addition, it can be due to rotational anomalies with reduced femoral neck antetorsion and reduced acetabular version or an overcorrection after periacetabular osteotomy called “Bernese disease.” (10)

CAM

Discussion of CAM in Greater Detail

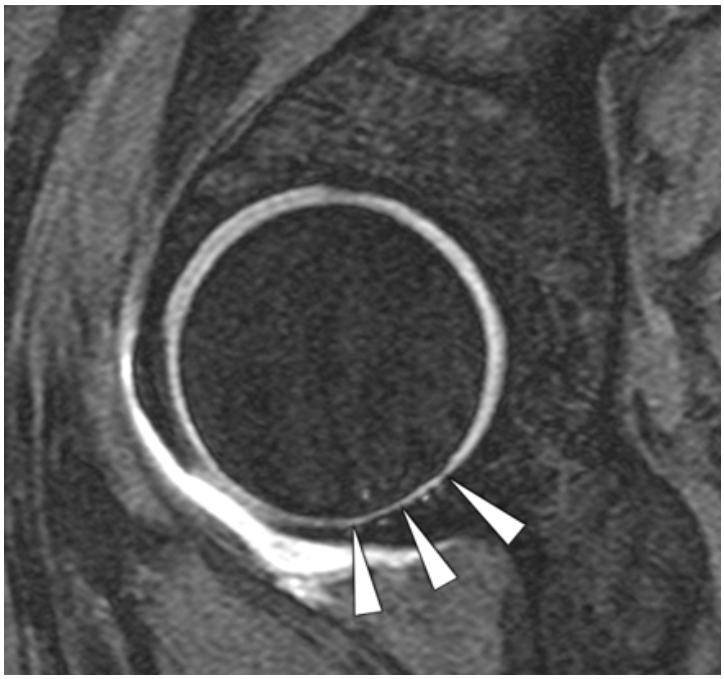
1. Femoral causes include (9):
    a. Posterior placement of the femoral head on the femoral neck with inadequate anterior femoral head-neck offset. This leads to contact between the femoral neck and acetabulum in flexion or internal rotation. (9)
    b. Insufficient femoral head-neck offset
        i. The offset means the difference between the widest diameter of the femoral head and the most prominent region of the femoral neck. (9)
    c. Mild displacement of the femoral epiphysis (9)
    d. Associated disorders including slipped capital femoral epiphysis (SCFE), Legg-Calve-Perthés disease, posttraumatic retrotorsion of the femoral head, coxa vara, pistol-grip deformity, head-tilt deformity, post-slip deformity, femoral retroversion, and growth abnormality of the femoral epiphysis (11)
    e. Postsurgical or traumatic deformities (9)
2. The contact of the acetabular rim and femoral neck is due to the abnormal acetabulum (such as acetabular retroversion) and leads to anterior overcoverage of the femoral head. (9)
3. The term “pistol grip” means a flattened femoral head-neck junction. (9)
4. It produces an outside in delamination of the acetabulum. (7)

PINCER

Discussion of PINCER in Greater Detail

Acetabular causes include the following findings:

1. An acetabular rim syndrome has been described in association with developmental hip dysplasia (DDH). (9)
2. It is produced by more linear impact between a local (retroversion of the acetabulum) or general over coverage (coxa profunda/protrusio) of the acetabulum. (7)
3. Associated disorders include bladder extrophy, proximal femoral focal deficiency, posttraumatic dysplasia, chronic residual dysplasia of acetabulum, Legg-Calve-Perthés disease, SCFE, after acetabular reorientation procedures, and idiopathic retroversion. (11)



Sagittal water excitation three-dimensional double-echo steady-state MR image (24.0/6.5, 25° flip angle) in a patient with pincer FAI. Note cartilage damage (arrowheads) at the posteroinferior aspect of the acetabulum. (25)

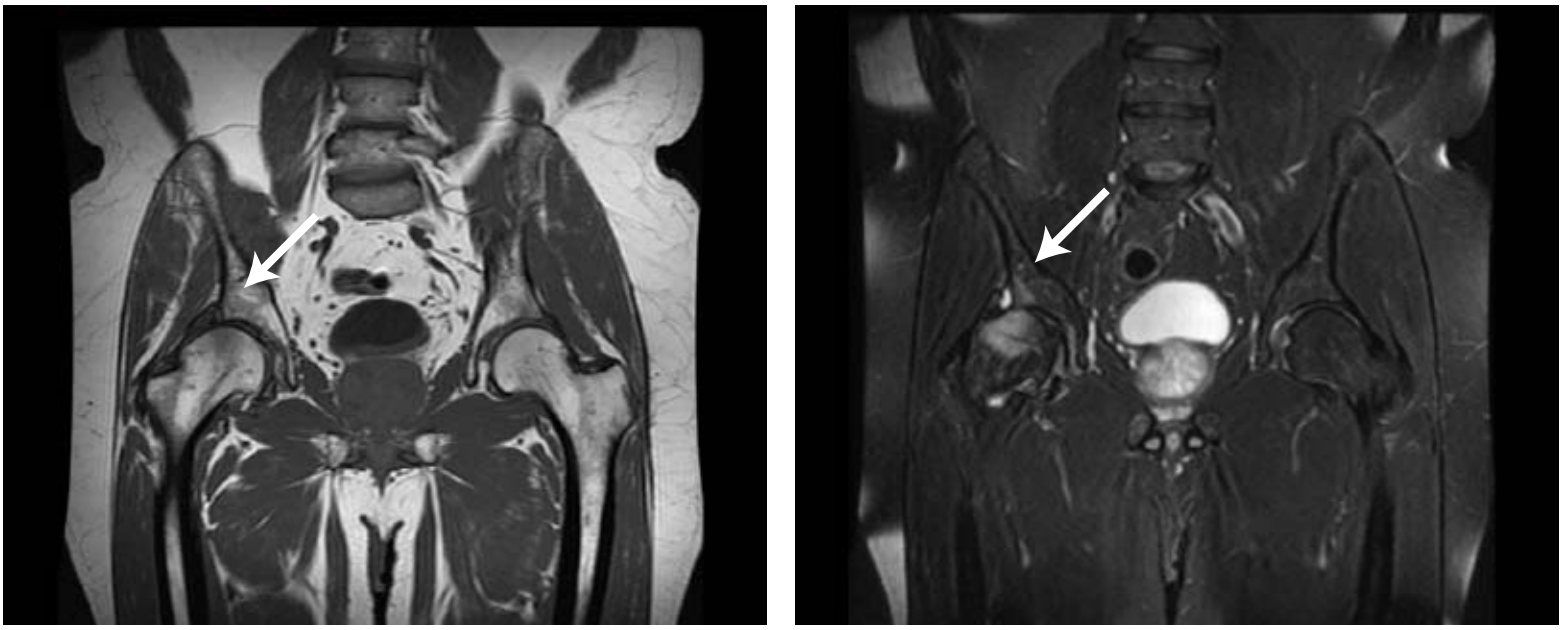
4. A shallow acetabulum, with insufficient acetabular coverage of the femoral head, increases load on the acetabulum. This can result in labral tears, cartilage lesions, acetabular pseudocyts, and bone fragmentation (os acetabuli). (9)
5. Overcoverage can result from acetabular retroversion, coxa profunda, or protrusion acetabuli by increasing the relative acetabular depth. (9)
6. When the femoral head abuts the acetabulum, degeneration of the labrum or ossification of the acetabular rim can worsen the overcoverage. (9)
7. “Contre-coup” cartilage injury can occur posteroinferiorly in the acetabulum. (9)

FAI PATIENTS

Who does FAI affect and how do they present?

1. Patients with FAI are young, often in their 20s to 40s. (11) The estimated prevalence is 10-15%. (11, 12)
2. Cam-type FAI is more prevalent in young males. Pincer-type FAI is reported as more prevalent in middle-aged women. (7)
3. FAI can occur in the following settings:
    a. Developmental hip dysplasia (DDH)
    b. Slipped capital femoral epiphysis
    c. Legg-Calve-Perthés
    d. Posttraumatic deformity when there is a mismatch between the acetabulum and the femoral head-neck junction
    e. In patients without preexisting hip disease possibly due to
        i. Variations in normal anatomy
        ii. Developmental anomalies (9)

4. A prospective evaluation of 51 patients with symptomatic FAI revealed an average age of 35 years and 57% male. Symptom onset proved insidious (65%) and related to activity. Groin pain predominated as the symptomatic site (83%). Mean time from symptom onset to definitive diagnosis was 3.1 years. Anterior impingement test proved painful in 88% of hips. (8)
5. Most hips show mixed FAI pattern with cam predominance. (7)
6. Adolescents are affected; one study finding girls and pincer type more prevalent. The University of Colorado reported a study of adolescents with FAI, all complaining of anterior groin pain. The 30 girls and 5 boys all participated in a sport/activity that contributed to the symptoms, such as dancing. Pincer type with crossover sign or acetabular retroversion was dominant in 43%; cam was the primary type in 6%; and mixed occurred in 51%. (4)
7. Patients with cam FAI cannot squat as low as controls. (5)
8. Radiographic evidence of FAI is common in active patients with hip symptoms. (13)
9. Acetabular retroversion has been found associated with FAI and femoral neck stress fractures in military recruits. (14)
10. Genetics plays a role, as reported in a study of siblings with FAI. (15)



54-year-old man with four-year history of right hip pain. No history of trauma. Pain localized to lateral aspect of the right hip. ABOVE LEFT: Coronal T1 non-contrast MR showing abnormal enlargement of the lateral aspect of the femoral head/neck junction on the right (arrow). ABOVE RIGHT: Coronal T2 MR of the same patient showing abnormally high T2 signal in the superior/lateral aspect of the acetabulum and the adjacent portion of the femoral head. (26)

FAI SYMPTOMS

Can patients have FAI anatomy without symptoms?

Yes. Authors from New Zealand examined the abdominal CT scans of patients with abdominal trauma or pain who had no known hip problems. Of 50 hips, 39% had at least 1 bony morphologic feature predisposing to FAI. (16)

A study from Copenhagen University examined a database of 4151 people from an osteoarthritis cohort and examined their radiographs. The prevalence of a deep acetabular socket and pistol grip deformity were common and associated with increased risk of hip OA. The authors found no significantly increased prevalence of groin pain in those patients with hip joint malformations. (17)

A study from University of Ottawa, Canada examined 113 patients age 55 years or less with hip pain and radiographs. They found cam-type bilaterally in 77.8%, with only 26.1% with bilateral hip pain. As a note, patients with cam-type also had pincer deformity in 42%. (18)

FAI EFFECTS

What symptoms or consequences can FAI have?

1. FAI has association with long-standing adductor-related groin pain in athletes. (19)
2. Of labral tears in 111 patients with sport injuries, 73% had FAI. Of these, the cam-type were in 56%, average age 23 years, and more often men (87%). Of the 12% who had pincer-type, the average age was 26 years, and they were usually women (60%). Two were mixed.(20)
3. The cause of hip labral tears includes FAI. (As a side note, other causes of labral tears are trauma, capsular laxity/hip hypermobility, dysplasia, and degeneration.) Labral tears present as anterior or groin pain or possibly buttock pain. (21)
4. A study from the University College London Hospital reported that acetabular cartilage lesions had high prevalence in cam-type FAI (78.8%) with 59.6% having labral tears. (22)
5. A study from the United Kingdom followed patients with pistol-grip deformity of the femur and mild or moderate osteoarthritis. After a minimum of ten years, one-third did not show progression. The authors concluded that not all cam impingement is destined for end-stage OA. (23)

CONCLUSION

***Conclusion:* For over the past decade, femoroacetabular impingement has elevated in medical scrutiny and understanding. It takes two major forms, cam-type due to femoral causes and pincer-type due to acetabular ones. While cam predominates in young men and pincer in middle age women, the types often coexist.** ■

The next issue of *The WCC Note* will review the diagnosis and imaging findings of FAI.

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THE WCC NOTE™: Volume 4, Number 6 – August 24, 2010
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