

Eye On Skeletal Imaging.

Femoro-Acetabular Impingement: recently recognized cause of Premature Osteoarthritis of the Hip.

Femoro-Acetabular Impingement (FAI) is a recently recognized condition that predisposes to the development of early osteoarthritis in young adults. The condition results from a mechanically disadvantageous shape of the acetabulum and / or femoral head leading to abutment of articular surfaces during extremes of range of motion (which is also often reduced as compared to normal individuals). Given advances in treatment, it is increasingly important to recognize the early signs of this condition before the development of irreversible osteoarthritis.

Patients are typically young and present with the insidious onset of hip and or groin pain. Physical findings are exacerbated in the so called "impingement position" of hip flexion with internal rotation. In most patients the pain gradually increases and is typically activity dependent. Certain sports including soccer, kickboxing, tennis, baseball, and volleyball have been associated with FAI. The prevalence of the condition has been estimated to be as high as 10-15% of the population. (1)

Two principal types of acetabular impingement have been identified. One has a femoral cause and has been referred to as Cam Impingement. The second has an underlying acetabular cause and is referred to as Pincer Impingement. A combination of cam and pincer impingement is identified in 86% of cases. (2) Cam impingement refers to the presence of a bump at the femoral head/neck junction and has been analogized to the cam shaft of an automobile with its eccentric lobes or cams. In order to have the widest range of motion, the femoral head should be circular on transverse sections, and the femoral head should be spherical in three dimensions.

A second deformity of the femoral head / neck junction associated with cam impingement has been referred to as a gun or pistol grip type deformity. In this condition, the normal gentle concavity of the lateral margin of the femoral neck is absent (referred to as femoral neck deficiency) and the resulting appearance resembles an antique gun (and hence the name). MRI has become increasingly popular for the detection and quantification of the deformity resulting from the bump or femoral neck deficiency. (3) A special oblique axial plane is prescribed along the long axis of the femoral neck. The so called "alpha" angle is calculated by drawing a circle around the femoral head and a point marked where the cortex leaves the circle anteriorly (Figure).



(Figure 2) MR Arthrogram demonstrating a linear chondrolabral lesion (arrow) of anterior superior labrum.

The presence of a bump along the side of the femoral neck, or if the femoral head is non spherical, can result in the impingement of the abnormal femoral head / neck junction into the acetabulum. A non spherical femoral head is observed radiographically as a bump at the anterolateral femoral head-neck junction. This finding may be initially interpreted as a "spur", but in a relatively young patient with hip pain and no joint space narrowing, FAI should be suggested. The findings are more apparent on cross sectional imaging studies such as MRI and CT.

BIOGRAPHY

Dr. Vu Bui and,
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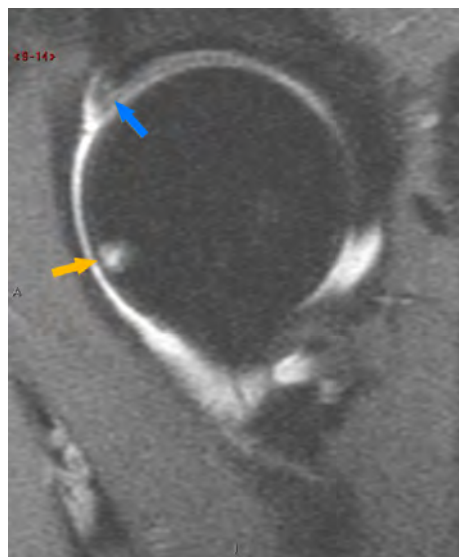
Dr. Vu Bui (top) was recruited to Mink Radiology from the University of Colorado Health Sciences Center where he was an Associate Professor of Radiology. Prior to that, he had taken a musculoskeletal fellowship at the Brigham and Womens Hospital in Boston. In addition to Dr. Bui's expertise in musculoskeletal imaging, he has extensive experience with musculoskeletal interventional procedures such as spinal interventional procedures and biopsies. Jerrold Mink (bottom), MD, has written more than forty original articles that have been published in the radiology, orthopedic, sports medicine, and rheumatology literature. In addition, he has co-authored four textbooks on musculoskeletal applications of MRI including the first specialty texts on the knee and foot and ankle. His general text, *MRI of the Musculoskeletal System*, was reviewed in the *New England Journal of Medicine* as the "essential textbook to own for anyone interpreting musculoskeletal MRI". Dr. Mink currently directs the Mink Radiologic Centers in Beverly Hills and Marina Del Rey.



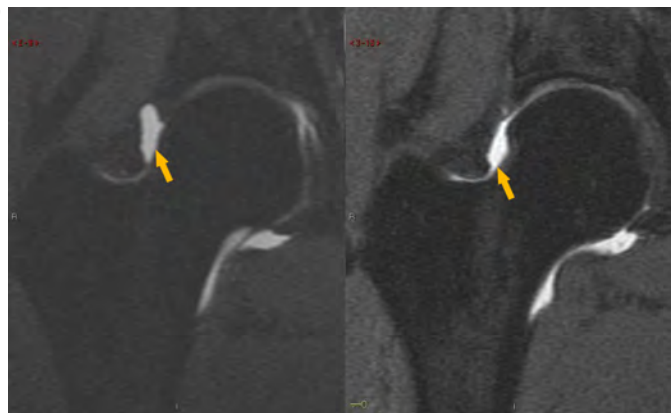
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The prominence of bone at the femoral head / neck junction abuts the anterolateral acetabular margin during flexion and contributes to lesions of the fibrocartilagenous acetabular labrum. The labrum lifts or detaches allowing the bone to impinge the adjacent articular cartilage. This results in delamination of the articular cartilage which can roll back like a carpet. MR Arthrography can be utilized to directly depict both the labral abnormalities as well as the cartilage flaps. Surgical management of cam impingement is directed toward reshaping the femoral head-neck junction.

The second major type of acetabular impingement is referred to as Pincer Impingement and occurs when the acetabulum is too deep or overhangs too much, both conditions leading to abutment on the femoral neck. The most extreme case of this class of deformity is protrusion acetabuli, a condition that can be developmental but is often associated with inflammatory arthropathies (e.g. rheumatoid arthritis) and bone softening disorders (Paget disease, osteomalacia). A less obvious deformity is referred to as coxa profunda (deep hip) which can be recognized radiographically when the medial wall of the acetabulum projects medial to the radiographic landmark ilioischial line.



(Figure 3) There is a fibrosystic lesion at the femoral head neck junction (blue arrow) that is commonly associated with cam impingement. Additionally, note a tear of the anterosuperior labrum (orange arrow) on this MR arthrogram.



(Figure 4) MR Arthrographic image pre and post (right) osteoplasty. Note the increased concavity of the femoral neck on the post surgical study compared to the earlier exam.

Finally, retroversion of the acetabulum (relative posterior tilt of the acetabular cup) can be associated with impingement as the anterior acetabular rim overhangs and abuts the femoral neck on flexion, creating pincer impingement.

The abutment of the femoral neck upon the anterior acetabulum in pincer impingement causes large labral tears and detachments. The articular cartilage is secondarily damaged but usually without the flaps and delamination seen in cam impingement. When the femoral head levers back posteriorly and can abut the inner margin of the posterior acetabulum, a "contrecoup" posterior cartilage defect can be created. With chronic impingement, labral ossification and osseous hypertrophy of the acetabular rim can occur.

Femoro-acetabular impingement is clearly an important and previously unrecognized cause for premature osteoarthritis of the hip. The diagnosis, however, depends upon both clinical and imaging evidence. Currently, the prevalence of FAI imaging findings is unknown among asymptomatic individuals. Not all acetabular labral and or chondral lesions are caused by FAI and not all patients with abnormal alpha angle or acetabular retroversion have FAI and require anatomical correction. An intensive area of investigation, the next decade will provide much more insight into this condition.

1. Leunig M, Ganz R. Unfallchirurg 2005; 108:9-17.
2. Beck M. et.al. J Bone and Joint Surgery Br 2005; 87:1012-18.
3. Notzi HP et. al. . The contour of the femoral head-neck junction as a predictor for the risk of anterior impingement. J Bone and Joint Surgery Br 2002; 84:556-560.