

## The Association of Femoral Neck Stress Fractures with Femoral Acetabular Impingement

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**INTRODUCTION:** Femoral neck stress fractures are common in runners and military recruits. The etiology of femoral neck stress fractures is hypothesized to be secondary to repeated forces above a certain threshold with insufficient time for internal bone response. The purpose of our study was to determine if there was an increased incidence of femoral acetabular impingement (FAI) in patients presenting with stress fractures of the femoral neck.

**METHODS:** After IRB approval, the imaging studies of 24 patients (21 females, 3 males, aged 19 - 39 yrs, mean age 27) presenting with a femoral neck stress fracture or stress reaction were evaluated for features suggestive of FAI. Xrays were assessed for the presence of a cross-over sign, posterior wall sign, coxa profunda, abnormal femoral head-neck junction, fibrocystic change, and os acetabuli. The center edge angle, and anterior offset ratio were measured in the affected hip. The MRI scans of each patient were reviewed to determine the grade of femoral neck stress injury. MR images were assessed for the presence of a labral tear, chondral injury, fibrocystic change, and abnormal femoral head-neck junction.

**RESULTS:** In the 24 hips (17 right, 7 left) there were 8 grade 2 stress injuries (33%), 5 grade 3 (21%), and 11 grade 4 (46%) with a visible fracture line. Labral tears were present in 14 (58%), chondral damage in 3 (13%), fibrocystic change in 2 (8%), and an abnormal femoral head-neck junction in 5 (21%). Radiographically, the presence of acetabular retroversion could only be assessed in 15 hips (neutral pelvic tilt where the tip of the coccyx 1-3cm above the top of the pubic symphysis) in 15 of 24 hips. A cross-over sign was seen in 5 (33%) and a posterior wall sign in 2 (13%). Coxa profunda was seen in 19 of 24 hips (79%), an abnormal femoral head-neck junction in 2 (8%), and an os acetabuli in 2 (8%). The center edge angle was  $> 35^\circ$  in 5 patient (21%). The alpha angle was  $> 50^\circ$  in 4 (17%), and the anterior offset ratio was  $< 0.18$  in 7 (29%), both features suggesting cam impingement.

**DISCUSSION:** There is an increased incidence of features associated with pincer-type FAI in patients with femoral stress reactions or stress fractures compared to the general population. Coxa profunda was seen in 79%, compared to 15.2% of males and 19.4% of females in an asymptomatic population. Acetabular retroversion was seen in 33%, compared to 6% in asymptomatic individuals. Over-coverage of the femoral head may place additional stresses on the femoral neck, predisposing athletes to stress injury. There may be increased leverage of the femoral neck on the acetabular rim in patients with pincer impingement, increasing tensile forces medially. In contrast patients with cam-type FAI have a relatively flat or convex femoral head-neck junction, which will not result in as much leverage.

**CONCLUSION:** Our study suggests that patient with femoral neck stress injuries have a higher incidence of bony abnormalities associated with pincer impingement, such as coxa profunda and acetabular retroversion.

**REFERENCES:** [1] Kuhn et al, Clin Orthop Relat Res 2010; 468(3):846-851. [2] Tannast et al. AJR 2007;188(6):1540-1552. [3] Hwang et al. AJR 2005;185:166-173.

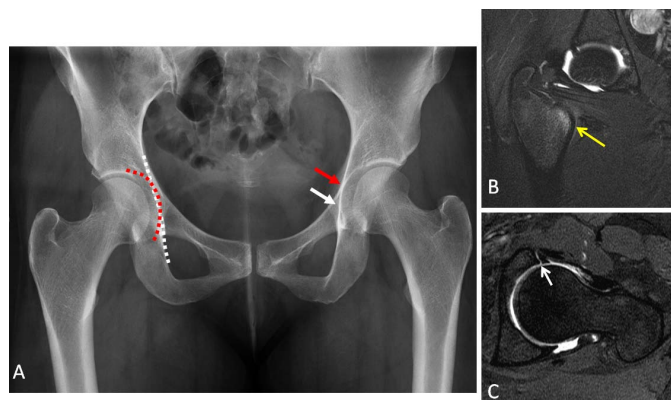


Figure 1: (A) Pelvic radiograph of a 22 year old woman with right hip pain and bilateral coxa profunda, where the medial wall of the acetabulum (red) touches or projects medial to the ilioischial line (white). (B) Coronal T2 FS image demonstrating a grade 3 stress reaction (yellow arrow). (C) Axial oblique T1 FS image shows chondrolabral separation anteriorly (arrow).

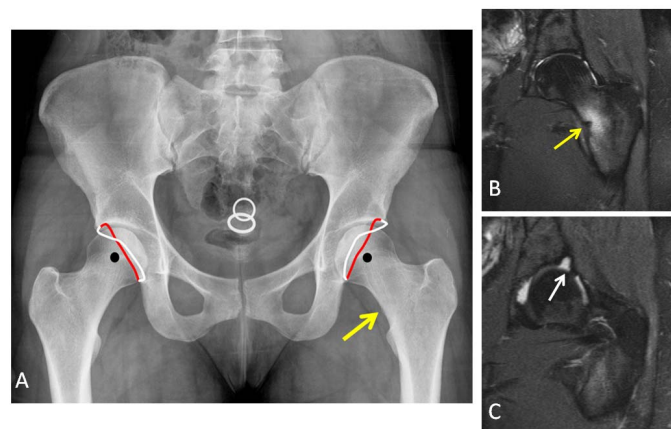


Figure 2: (A) Pelvic radiograph of a 20 year old female runner with left hip pain and a subtle femoral neck stress fracture (yellow arrow). There is a cross-over sign of the anterior (white) and posterior (red) acetabular margins. A posterior wall sign is also present, as the center of the femoral head (black circle) is lateral to the posterior wall. (B) Coronal T2 FS image showing a grade 4 stress fracture (yellow arrow). (C) Coronal T2 FS image demonstrating chondrolabral separation of the posterosuperior labrum (white arrow).