

*Invited lecture/Review*

Femoroacetabular Impingement

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Abstract:

Femoroacetabular impingement (FAI) is an anatomical hip condition caused by malformations on femoral head and acetabular rim resulting in abnormal contact across the joint. FAI can cause the labral, cartilaginous, and tissue damage that leads to early osteoarthritis. FAI can be divided into three groups: cam (bump on femoral head-neck junction), pincer (acetabular over coverage), or mixed (most common) by the characteristic morphological changes of the bony structures. The exact ethology of FAI is still unclear, mostly considered as idiopathic. Cam lesions demonstrate a near 3:1 male predominance and are more often seen in the younger population. Pincer is typically seen in middle-aged women. A plain radiography of the pelvis and hips is considered as the primary imaging modality for diagnosing FAI, which can be used to quantify the severity. MRI and direct MRI arthrography allow assessment of concomitant labral and chondral injuries. Conservative treatment is typically considered first-line treatment for mild to moderate FAI syndrome, but usually not to successful. However, the outcomes following postoperative surgical intervention have demonstrated excellent results. The most common surgical treatment option for FAI is done arthroscopically, other procedures such as a reverse periacetabular osteotomy or surgical dislocation of the hip are rarely indicated.

Citation: Kovačić B, Zore LA, Stražar K. Femoroacetabular impingement. Proceedings of Socratic Lectures. 2023, 8; 53-57.
<https://doi.org/10.55295/PSL.2023.18>

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Keywords: Femoroacetabular impingement; cam, pincer; hip arthroscopy

1. Introduction

Twenty years ago, first papers were presented describing anatomical hip condition caused by malformations on femoral head and acetabular rim resulting in abnormal contact across the joint (Beck et al., 2005). At the beginning in the focus were young adults with early onset osteoarthritis because it was later shown that femoroacetabular impingement (FAI) can cause the labral, cartilaginous, and tissue damage that leads to early osteoarthritis (Ganz et al., 2003; Ganz et al., 2008).

FAI can be divided into three groups: cam (bump on femoral head-neck junction), pincer (acetabular over coverage) (**Figure 1**), or mixed (most common) by the characteristic morphological changes of the bony structures (Kassarjian et al., 2007). In the case of cam FAI abnormally shaped femoral head repeatedly impinging upon an acetabulum that cannot accommodate the increased radius of the femoral head.

It typically occurs with flexion of the hip joint as this lesion is usually situated in the anterior aspect of the head-neck junction of the femur. In pincer FAI over-coverage could be global as in coxa profunda and acetabular retroversion or localised as in an anterior osteophyte. The repeated intersection of this abnormally shaped femoral head and/or acetabular rim on the labro-chondral junction generates shear forces in this region which in turn may lead to a labral tear, labro-chondral separation, articular cartilage peeling off the bone and in the longer term osteoarthritis (Khanduja et al., 2007).

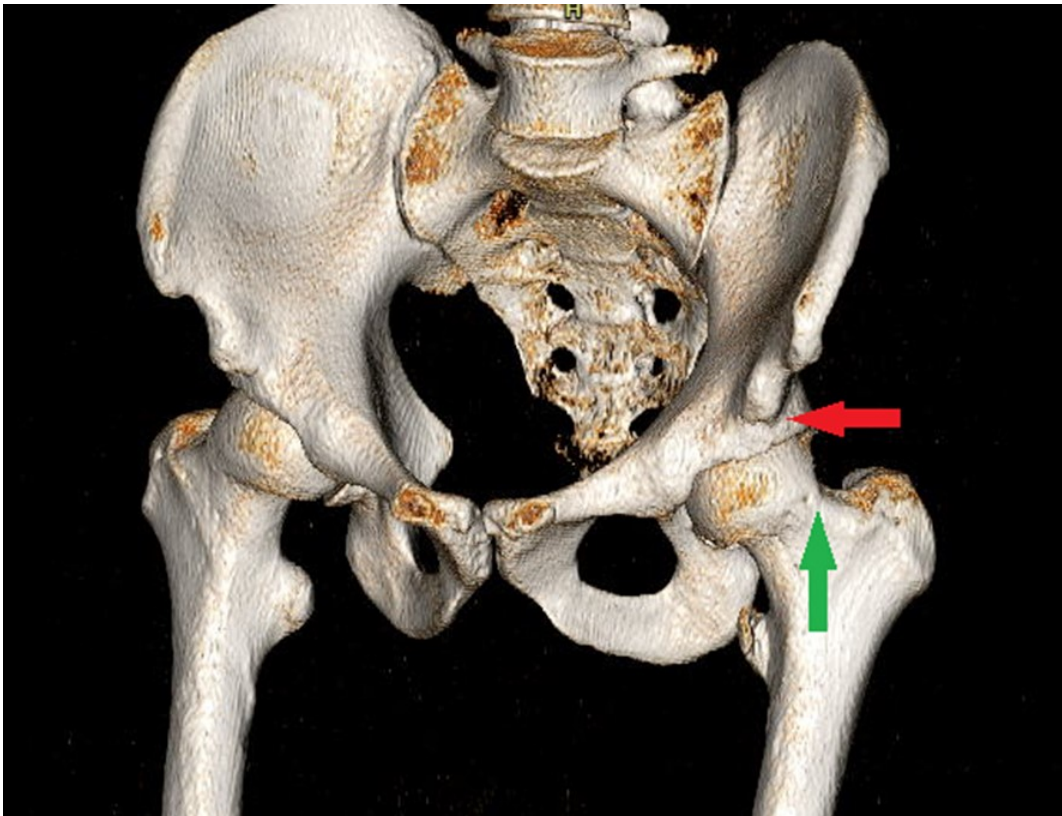


Figure 1. 3D computer reconstruction of CT scan of pelvis and hips showing mixed type of FA impingement: cam (green arrow) and pincer (red arrow).

The exact ethology of FAI is still unclear: genetic predisposition, trauma, paediatric hip disorders such as slipped capital femoral epiphysis (SCFE), and Legg–Calvé–Perthes disease (LCPD) have been shown to predispose to the development of cam impingement in adulthood. Despite that, it is most often idiopathic, and particularly common in the athletic population. Cam lesions demonstrate a near 3:1 male predominance and are more often seen in the younger population. Pincer is typically seen in middle-aged women (Gosvig et al., 2010; Leunig et al., 2000).

Studies show that athletes with excessive participation in high-impact sports (soccer, basketball and ice hockey during adolescence when the skeleton matures, have a higher prevalence of FAI when compared to non-athletes. (Agricola et al., 2012). Proposed mechanism for development of the cam deformity in adolescent athletes is thought to be either new bone formation at the anterosuperior head-neck junction or changes in the shape of the growth plate as a reaction on high shear forces at the growing hip during these athletic activities (Siebenrock et al., 2011).

In the clinical presentation, chronic, persistent groin pain is the most frequent initial symptom. On physical examination, patients will typically have a positive FADIR test (flexion, adduction, internal rotation), described as a positive impingement sign (Jager et al., 2004; Jaber et al., 2007).

2. Radiology

Radiographic findings suggestive of a cam FAI: a pistol grip deformity on a standard AP pelvic view and increased alpha angle and decreased femoral head-neck offset on a lateral view (cross-table, frog-leg, or 45° Dunn view) (**Figure 2**).

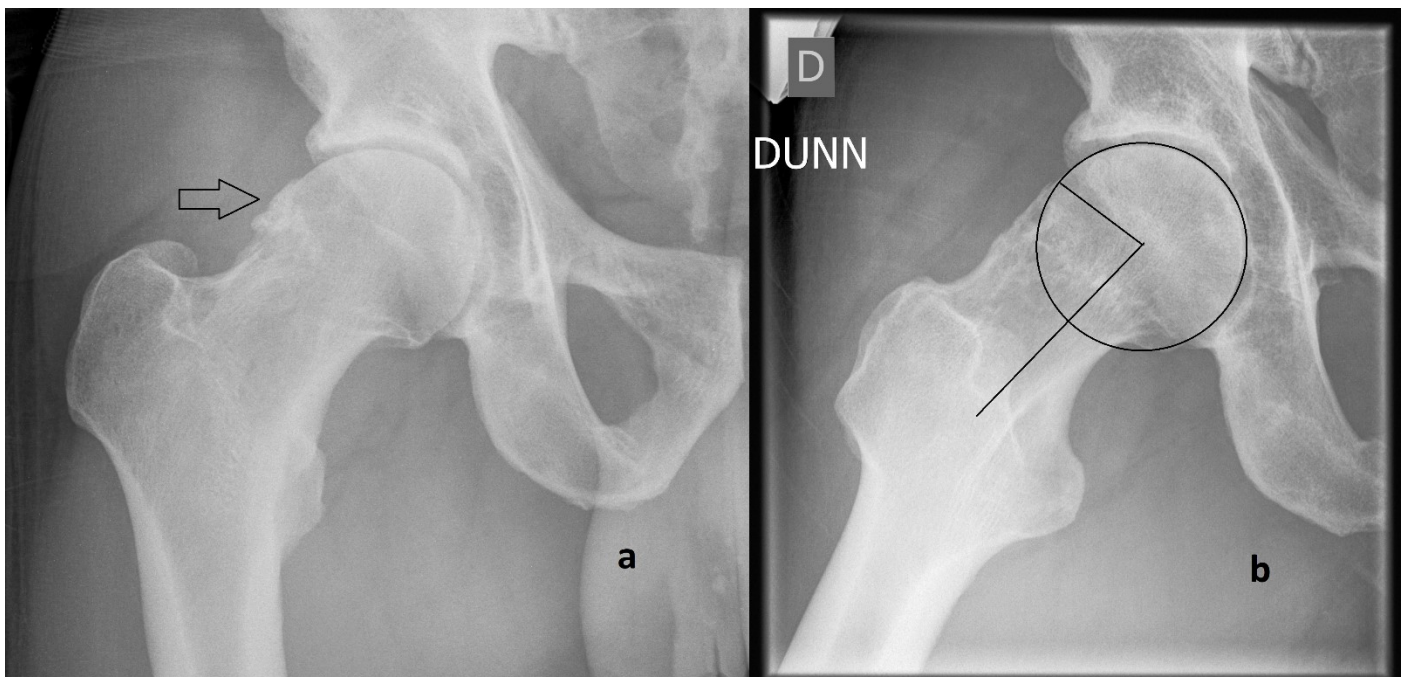


Figure 2. Standard x- ray AP (a): typical pistol grip deformity (arrow) and Dunn view (b): increased α angle; radiological signs of cam impingement.

On standard AP view, radiographic findings for a pincer impingement include: acetabular over coverage (increased lateral center-edge angle and acetabular inclination angle, retroversion and/or protrusion (crossover sign, posterior wall sign, and ischial spine sign) and coxa profunda (Zhou et al., 2020; Diesel et al., 2015).

Both CT and MRI allow the assessment of cam and/or pincer morphology through objectifying alpha angle and femoral head-neck offset for cam and acetabular retroversion for pincer FAI. A 3D sequence of the hip can be made for more accurate visualization of the femoral neck changes and proper evaluation of the acetabulum and operative planning. MRI and direct MRI arthrography allow assessment of concomitant labral and chondral injuries like chondrolabral separation or carpet lesion and changes associate to FAI such as paralabral cysts, head- neck junction cyst and bone edema. (Bredella et al., 2013)

3. Treatment

Conservative treatment is typically considered first-line treatment for mild to moderate FAI syndrome as it can provide marked symptomatic relief, but it is not significantly helpful in most patients with FAI syndrome.

The goal of FAI surgery is to re-establish the normal relationships between the femoral and acetabular part of the hip joint to restore normal function. The most common surgical treatment option for FAI is hip arthroscopy: femoral osteochondroplasty to resect a cam deformity (**Figure 3**), debridement and selective acetabular rim resection and arthroscopic labral repair. (Hartmann et al., 2009; Philippon et al., 2009; Philippon et al., 2010).

In case of global acetabular overcoverage and cam deformity that is not accessible by arthroscopy, a surgical dislocation of the hip, in which the femoral head is surgically dislocated from the acetabulum is indicated. An acetabular retroversion causing pincer FAI, is addressed by reverse periacetabular osteotomy (PAO), a surgical method of completely reorienting the acetabulum (Clohisy et al., 2008; Mardones et al., 2005).

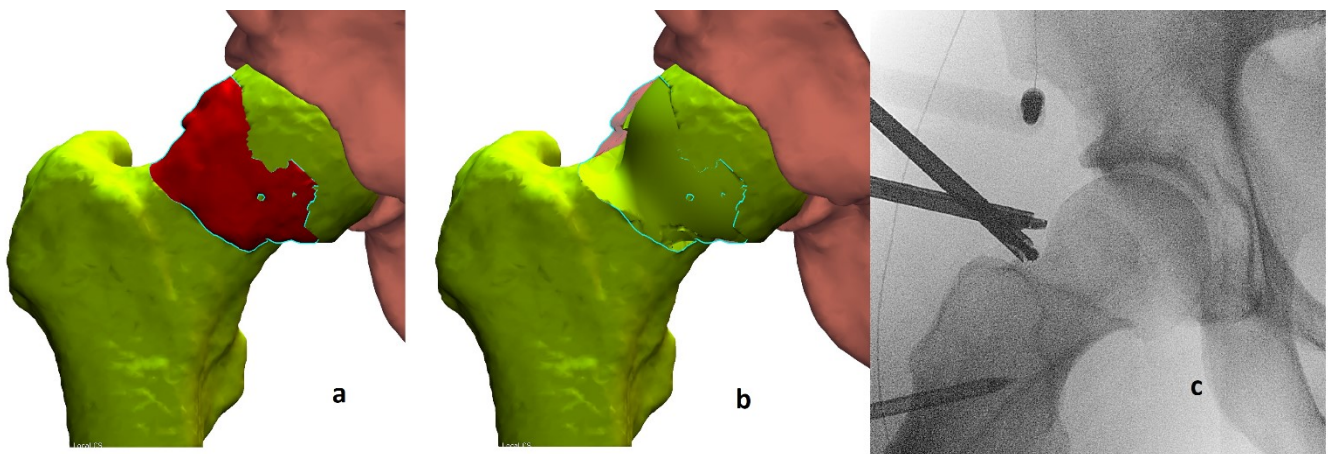


Figure 3. 3 D reconstruction model of right hip from CT scan with a cam lesion shown in red (a), preoperative projection of the needed resection of the lesion (b) and an intraoperative x-ray during the arthroscopic osteochondroplasty in the same patient.

In Ljubljana Medical Centre at Orthopedic Clinic standard for the treatment of the FAI is the use of a computer assisted hip arthroscopy. With the help of currently available software that provides preoperative identification of hip deformity on a CT-based 3-D model and planning of the surgical correction using kinematic protocols. This protocol provides a real-time intraoperative 3-D orientation, and exact execution of surgical correction either with navigation of surgical tools (Figure 3.) or with printed templates. First clinical experiences of its use in treatment of femoroacetabular impingement are promising (Stražar et al., 2021).

Conflicts of Interest: The authors declare no conflict of interest.

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