



Femoroacetabular impingement syndrome

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ABSTRACT

Femoroacetabular impingement (FAI) syndrome is a recently understood hip condition that describes the pathologic contact between the femoral neck and the acetabular rim. Previously, it was also called “acetabular rim syndrome” or “cervicoacetabular impingement syndrome”. It is characterized by a developmental disorder affecting the femoral neck, acetabular rim and labrum. The chronic irritation on the hip joint causes chondral damage and mechanical changes, and these degenerative changes eventually lead to osteoarthritis. Two types of FAI have been described: Cam type and pincer type. Treatment options for FAI are conservative, open, mini open and arthroscopic surgery.

Key words: Cam type, cross-table lateral view, Dunn view, femoroacetabular impingement, pincer type

Introduction

Femoroacetabular impingement (FAI) syndrome is a recently understood hip pathology that describes the pathologic contact between the head-neck junction of the femur and acetabular rim. Previously, it was also called “cervicoacetabular impingement syndrome” or “acetabular rim syndrome” [1,2]. It is characterized by a developmental disorder of the femoral neck, acetabular rim and labrum. The chronic irritation on the hip joint causes chondral damage and mechanical changes and these degenerative changes lead to osteoarthritis [3,4].

In 2003 FAI was described as a cause of osteoarthritis by Ganz et al. However, it was Stulberg et al. who first described the relationship between anatomic ab-

normalities in the hip joint and osteoarthritis [3,4]. In 1986, Harris observed 75 patients with idiopathic hip osteoarthritis and showed that 80% of patients had demonstrable abnormalities in their hip joint [5].

Etiology

FAI can be described as an abnormal contact between the femoral head-neck junction and the acetabulum. Geographical variations, genetics, previous femoral neck fractures, previous periacetabular and femoral osteotomies, acetabular retroversion, Perthes' disease, slipped upper femoral epiphysis, hip dysplasia and septic hip are the main potential etiological factors. However, in most cases the predisposing factors have not been identified.

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Classification

Two different types of FAI have been defined:

Cam type: Usually seen in young, physically active males. The pathology is a bump on the femoral head-neck junction leading to abnormal shear forces on the acetabular rim and giving rise to labral degeneration, labral tears and avulsions. Recurrent impingement and trauma lead to damage especially on the anterosuperior acetabular cartilage.

Pincer type: Usually seen in athletic middle-aged females. The pathology leading to abnormal contact is the acetabular over coverage on the femoral head. There is a local labral degeneration in the beginning. Recurrent pressure causes labral degenerative changes which results in overdeep acetabulum and further labrum and cartilage degeneration.

The most common form (86% of the patients) is the mixed type, which is combining pathological features of two forms [6]. Morphological anomalies result with abnormal contact between femur and acetabulum that causes labral and cartilage degeneration in both two types.

Clinical Findings

FAI is usually seen in physically active young and middle aged patients [7]. The patients usually present with unilateral groin pain, which increase with activity or prolonged sitting. Pain after participating in sporting activity is common. The patients pinpoint the location of pain putting their hand just above the great trochanter between abducted thumb and forefinger in the shape of “C” – this is called the “C sign” [8]. Some of the patients present with trochanteric pain radiating in the lateral thigh. Mechanical symptoms like catching and locking can be seen with pain. These are typical for labral pathologies.

Physical Examination

The physical examination must begin with the inspection of the patient posture while stance and gait. Gait pattern must be observed for the presence of gait disturbance like antalgic gait. The range of motion (ROM) should be tested. ROM is limited and painful in flexion, adduction and internal rotation. Limitation of ROM, especially in internal rotation, is very specific for FAI.

Neurovascular examination is very important to

eliminate spinal and other neural causes of groin and hip pain. Neurovascular exam is normal in FAI. There are some specific tests for diagnosis.

To look for FABER test the hip is flexed, abducted and internally rotated. If there is pain with a combination of these movements, not only FAI, but also intraarticular, psoas and sacroiliac pathologies must be considered.

To look for the anterior impingement test, the patient is placed supine. The effected hip is flexed to 90° and then internally rotated and adducted. Pain may be elicited if there is an abnormal contact between anterosuperior acetabulum and femoral neck. In severe forms of anterior impingement, if there is passive external rotation of the hip while performing flexion, than the Drehmann's sign is positive.

The posterior impingement test is also performed in supine position. The patient dangles the legs off the end of an examination couch and extends the hip. The physician externally rotates the hip. Pain may be elicited if there is an abnormal contact between posterior acetabulum and femoral neck.

Diagnostic Imaging

Plain radiographs

A true anteroposterior (AP) pelvic view (hips internally rotated 15°) and either a frog leg or an axial cross-table lateral view are first line investigations in FAI. To investigate anterior femoral head-neck junction pathologies a Dunn/Rippstein view can be obtained.

The AP pelvic view is obtained in supine position while the legs rotated 15° internally. The film-focus distance is 1.2 m and the distance between coccygeal tip and superior aspect of symphysis pubis must be 4-5 cm [9]. The central beam is focused on the center of the line between spina iliaca anterior superior of both sides [10]. The contour of lateral femoral head and junction, degenerative changes and profunda socket can be seen, especially with the AP pelvic view. Acetabular version can also be assessed on AP view.

For the axial cross-table lateral view the legs are rotated internally and the central beam is focused towards the inguinal fold. The film-focus distance is 1.2 m. The axial cross-table lateral pelvic view provides better visualization of the anterior femoral head-neck offset (concavity, fibrocystic changes).

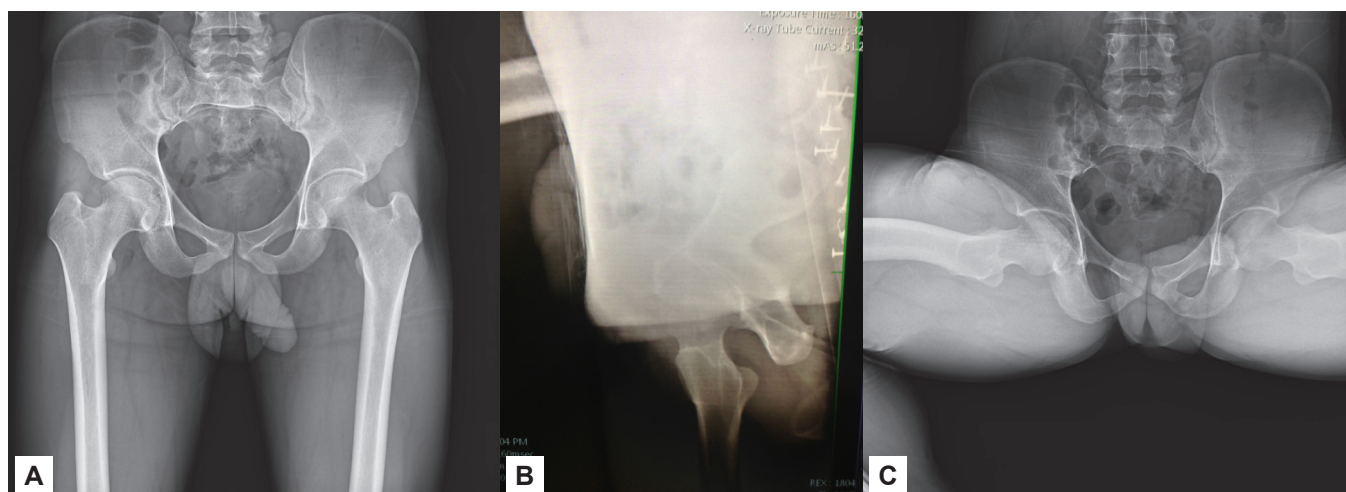


Figure 1. Radiographic views (A) Anteroposterior pelvic view, (B) Cross-table lateral view, (C) 90° Dunn view.

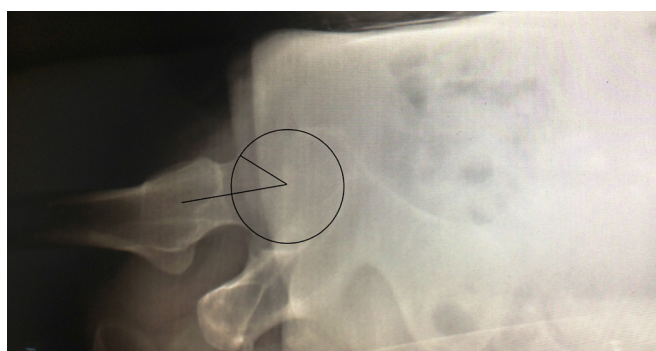


Figure 2. Cross table lateral view showing normal alpha angle.

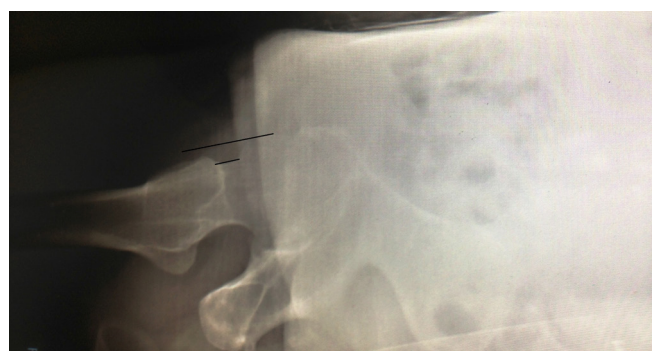


Figure 3. Cross table lateral view showing normal head neck offset.

The Dunn view can be obtained with hip in neutral position, 45° of flexion and 20° of abduction. This position provides better visualization of femoral head neck asphericity [11] (Figure 1).

Radiography – Cam type

The Cam type FAI is characterized by femoral head asphericity and osseous bump on the femoral head. The osseous bumps can be located either lateral or AP part of the femoral head and neck junction. Axial cross-table lateral view shows anterosuperior bumps and AP pelvic radiographs shows lateral bumps better. Abnormal sloped configuration of femoral neck with an antero-lateral prominence is called the pistol grip deformity, which was first described by Stulberg et al. in 1975 [12].

The most frequently cited parameter is the “alpha angle” described by Nötzli et al. [13] It is the angle between two lines, the first from the center of the femoral head through the center of the femoral neck, and the second from the center of the femoral head to the anterior head/neck junction (Figure 2). Measuring the alpha angle is a sensitive method of diagnosing cam lesions.

The average alpha angle is 42° in normal femur and 65–70° in Cam deformity [14]. More than 55° is accepted as a sign of Cam impingement [10]. The angle can be measured by radiography, magnetic resonance imaging (MRI) and computerized tomography (CT) too.

Another parameter for Cam FAI is the “head-neck offset,” the difference between two parallel lines on the lateral view, one anterior radius of the femoral head and the other anterior radius of the femoral neck (Figure 3). More than 7 mm is considered indicative of Cam impingement.

Eijer et al. in 2001 described a method for the measurement of anterior head–neck offset and anterior head–neck offset ratio on cross-table lateral radiographs [15]. The “anterior offset” is the perpendicular distance between the anterior cortex of femoral neck and the outer part of the femoral head. The “anterior offset ratio (AOR)” can be measured by dividing AOR by femoral head diameter. It is 0.21 ± 0.03 in normal population and 0.13 ± 0.05 in Cam impingement [10].

Radiography – Pincer type

The crossover sign and posterior wall sign (PWS)

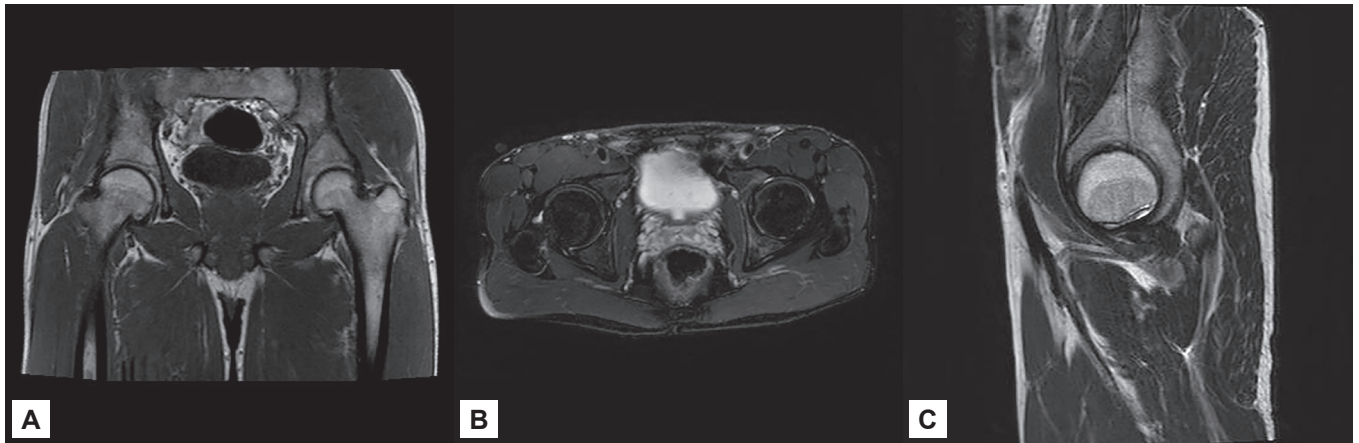


Figure 4. MRI views (A) Coronal view, (B) Axial view (C) Sagittal view.

on an AP pelvic radiograph are useful in diagnosing acetabular retroversion.

On AP pelvis view the posterior rim of acetabulum should be lateral to the anterior wall in normal population. If the anterior wall appears to cross over the posterior seen on plain radiographs than it is called the “crossover or figure eight sign” that shows acetabular retroversion.

Another parameter also shows acetabular retroversion is the “PWS.” The center of the femoral head lies medial to the posterior acetabular rim in normal population. If the center of the femoral head lies lateral to the posterior wall, than it is called the “PWS” [16].

MRI and Magnetic Resonance (MR) Arthrography

MRI and MR arthrography (with gadolinium joint injection) better visualize the pathologies of the labrum and acetabular cartilage. Morphological abnormalities of the head and neck, anterosuperior labral lesions, anterosuperior cartilage lesions are the triad of MRI findings in FAI that is described by Kassarian et al. [17]. Labral tears paralabral cysts, cartilage degenerations, fibrocystic changes of the femoral head-neck junction (Pitt’s pit) can be seen. Alpha angle and femoral head-neck ratio can also be measured with MRI (Figure 4).

CT

CT can provide three-dimensional visualization of the deformity and it is useful for planning for surgical resection.

Treatment

Conservative treatment

Non-operative treatment includes non-steroidal anti-inflammatory drugs, rest, activity modification. Physiotherapy is not recommended [18]. Conserva-

tive management may be effective in the short term temporarily but surgical management is recommended to prevent future damage.

Operative treatment

The aim of the surgery is to diminish the abnormal contact between the proximal femur and the acetabular rim. Open, mini-open and arthroscopic techniques have been described.

Open surgery

The patient is placed in the lateral decubitus position. Either a lateral or a posterolateral approach can be used by the surgeon. Care must be taken to keep short external rotators intact to avoid injury to the branches of medial femoral circumflex artery that provides the predominant blood supply of the femoral head. A trochanteric flip osteotomy is performed. After capsulotomy the hip must be dislocated. After surgical dislocation specific lesion should be treated. Avascular necrosis and femoral neck fractures are the main complications [19].

Mini-open surgery

Mini open technique is a combination of limited open (Smith Peerson approach or Huetter anterior approach) and arthroscopic procedures. The pathologies in the joint line are treated by arthroscopy. The pathologies of anterior acetabular rim and superior part of the head and neck junction can be evaluated well with this technique. The patient is placed in the supine position. A 6-8 cm of skin incision is made starting from 1-2 cm distal and lateral to spina iliaca anterior superior. The interval between tensor fascia latae and musculus sartorius is used by retracting tensor fascia latae laterally and musculus sartorius medially. After performing de-

tachment of reflected part of rectus femoris muscle a T-shape capsulotomy is done. Care must be taken to avoid injury to nervus cutaneus femoris lateralis

Arthroscopic surgery

Arthroscopic surgery is a minimal invasive procedure but there is a steep learning curve. Traction device and fluoroscopy are essential. Traction device is essential for the lesion of the central zone. For the peripheral zone lesions there is no need for traction device.

The labrum and the structures medial to the labrum are in the central zone. The structures lateral to the labrum (joint capsule, femoral head and neck) are in the peripheral zone.

Hip arthroscopy can be done either in supine or lateral decubitus position. Most of the surgeons prefer the supine position. The standard portals are anterior, anterolateral and posterolateral portals. Anterolateral portal, which is the safest, is the primary viewing portal. It is located at the anterosuperior margin of the trochanter major. Anterior portal, which is the second safest, is located at the intersection between the vertical line passing through spina iliaca anterior superior and the transverse line across the superior margin of trochanter major. Care must be taken to avoid injury to the branches of nervus cutaneus femoris lateralis. The posterolateral portal is located at the posterosuperior margin of the trochanter major. Care must be taken to avoid sciatic nerve injury.

Bryd and Jones [20] reported the results of 35 patients with a minimum follow-up of 2 years. Harris hip score improved 57-85 points with arthroscopic surgery. Botser et al. [21] compared open, arthroscopic and combined techniques and reported the mean improvement in the modified Harris hip score after surgical treatment 26.4 for arthroscopy, 20.5 for open surgery and 12.3 for combined technique respectively.

Conflict of interest statement

The authors have no conflicts of interest to declare.

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