Review Article

International Journal of Research and Review
Volume 11; Issue: 10; October 2024
Website: www.ijrrjournal.com
E-ISSN: 2349-9788; P-ISSN: 2454-2237

Femoroacetabular Impingement: A Literature Review

Leonardus William Kuswara[1], Putu Feryawan Meregawa[2]

[1]Resident of Orthopaedics and Traumatology Department, [2]Consultant of Orthopaedics and Traumatology Department,
Faculty of Medicine, Udayana University, Prof. Dr. I.G.N.G. Ngoerah General Hospital, Denpasar, Indonesia

Corresponding Author: Leonardus William Kuswara

DOI: https://doi.org/10.52403/ijrr.20241020

ABSTRACT

Femoroacetabular impingement (FAI) is a hip condition characterized by abnormal contact between the femoral head and the acetabulum, often leading to joint damage and osteoarthritis. This literature review explores the pathophysiology, diagnosis, and treatment options for FAI, synthesizing current research findings from clinical and biomechanical studies. FAI is classified into two primary types: cam impingement, caused by deformity of the femoral head, and pincer impingement, due to acetabular over-coverage. Mixed types involving both mechanisms are also common. Advancements in imaging modalities, such as MRI and CT, have improved diagnostic accuracy, allowing for earlier detection and better differentiation between types of FAI. Conservative treatment options, including physical therapy and anti-inflammatory medications, are often first-line therapies. However, surgical intervention, particularly arthroscopy, has gained prominence for symptomatic patients, demonstrating favorable outcomes in restoring hip function and delaying the progression of osteoarthritis. Despite the success of surgical interventions, challenges remain in understanding the long-term outcomes, particularly concerning the recurrence of symptoms and the risk of joint degeneration. This review also highlights controversies regarding the optimal management of asymptomatic FAI, as the risk-benefit balance of surgical treatment in such cases remains unclear. Overall, FAI remains a significant clinical issue requiring a multidisciplinary approach to optimize patient outcomes, and further longitudinal studies are necessary to assess the efficacy of treatment strategies over time.

Keywords: Femoroacetabular, Impingement, Joint

INTRODUCTION

FAI is a clinical syndrome characterized by inappropriate contact between the femoral head and/or the acetabulum during hip motion, particularly in positions of hip flexion and rotation. This aberrant contact causes cartilage and labral damage as well as hip discomfort.[1] FAI can result in three different kinds of morphologic abnormalities: Cam, Pincer, and Mixed. The proximal femur's aberrant, spherical shape is indicative of cam deformity. The localized or widespread over coverage of the femoral head by the acetabulum is the hallmark of pincer deformity. The third type of FAI, known as mixed FAI, combines the characteristics of pincer and cam impingement.[1] A tear in the acetabular labrum and separation of the articular cartilage from the bone may occur as a result of improper contact between the femoral head and acetabular rim, which causes supraphysiologic tension.[2] Hip degeneration and the onset of hip OA are caused by this recurrent mechanical injury to the articular tissues over time.[3]

EPIDEMIOLOGY

Numerous large-scale cohort studies have shed light on the prevalence of pincer and cam malformations in the general population by using a number of radiological criteria. The alpha angle is used to measure the degree of cam deformity in the femoral head, while the lateral center edge angle (LCEA) is used to measure the amount of pincer deformity in the acetabulum. Cam deformity was found to be 14% common, with 79% of those affected being male, in an investigation by Hack et al. that involved 400 hips from 200 asymptomatic individuals who had no history of hip problems as children (mean age 29.4 years, 79% Caucasian, 55.5% female). A cam malformation was defined as an alpha angle greater than 50.5° as evaluated by magnetic resonance imaging (MRI).[4] In a study of 3,620 people (mean age 60 years, primarily Caucasian, 63.2% female) without a history of hip disease in infancy, Gosvig et al. used a radiographic metric called the triangle index to find that cam deformity was prevalent in 19.6% of men and 5.2% of females.[5] In a study conducted by Nardo et al., older males with an average age of 77 years were found to have a cam deformity prevalence of 57.2% when the impingement angle was less than 70° and the caput-collum diaphyseal (CCD) angle was less than 125°. The study also found a pincer deformity prevalence of 29% and a mixed cam/pincer deformity prevalence of 13.7% when the LCEA criterion was greater than 39° and a Tönnis angle greater than 0°.[6]

In the past, developmental abnormalities in the acetabulum and proximal femur have been linked to osteoarthritis (OA) of the hip. Agricola et al. studied 1,002 people with early-stage idiopathic hip or knee OA to see if there was a correlation between the condition and cam or pincer abnormalities. According to their findings, the odds ratio (OR) for advanced hip OA was 3.67 when the alpha angle was more than 60° and 9.66 when it was greater than 83° (19). A positive predictive value of 52.6% was observed for advanced hip OA when hip internal rotation < 20° and an alpha angle > 83° were combined. There was no correlation between pincer deformity (LCEA > 40°) and hip OA, according to their findings (20).[7] Nardo et al. found no link between cam deformity and radiographic hip OA in older men, however they did find a correlation between pincer and mixed abnormalities.[6] At present, the radiological definitions employed for assessing morphometric abnormalities, variations in radiographic perspectives, and the criteria for study population selection differ across published research, which may elucidate the disparate associations identified concerning the risk of hip OA.

Hip OA has long been linked to developmental anatomic abnormalities in the proximal femur and acetabulum.[8] Agricola et al. conducted an estimation of the correlation between hip OA and cam and pincer deformities in a cohort of 1.002 subjects with early hip or knee idiopathic OA. They discovered that an alpha angle over 60° was related with a 3.67 odds ratio (OR) for end-stage hip OA, while an alpha angle above 83° was associated with a 9.66 OR.[8] The positive predictive value for end-stage hip OA was 52.6% when hip internal < 20° and alpha angle > 83° were combined. They didn't find any evidence that pincer deformity (LCEA > 40°) is associated with hip OA.[8] Diseases including sliding capital femoral epiphysis (SCFE), developmental dysplasia of the hip (DDH), and Legg-Calvé-Perthes disease (LCPD) may further increase the risk by deforming the natural structure of the hip. Epiphyseal sliding in SCFE and physis remodeling due to ischemia in LCPD are the causes of femoral head/neck deformity, respectively. Because of the intrinsic acetabular distortion caused by DDH, the femoral head makes improper contact with the acetabulum.[9]

PATHOGENESIS

At the root of many hip disorders lies the acetabulo-femoral joint, a ball-and-socket arrangement that connects the femoral head to the acetabulum. Impingement, caused by abnormalities in the shape of the femur and acetabulum, causes discomfort that becomes noticeable while doing the same things over and over again. Such abnormal skeletal anatomy may result from excessive bone growth during developmental periods, exemplified by the formation of aberrant bone spurs along the proximal femur and/or acetabulum. This disruption of the natural physiological articulation within the hip joint between its constituent bones leads to subsequent impingement and associated discomfort.[10]

In the long run, the aberrant articulation's friction and mechanical stress may cause labral tears, joint depth erosion, fibrous capsule degeneration, and instability. Osteoarthritis of the hip may develop in the early stages if the resulting damage is not addressed. Patients suffering from femoroacetabular impingement syndrome (FAIS) are more likely to develop osteoarthritis (OA) and other musculoskeletal problems. An increased risk of OA progression was seen in individuals with cam-type deformities and an α angle greater than 60˚, according to one research. The altered pelvic tilt and increased pressure on the hamstring tendons make FAIS a risk factor for hamstring tendon injury.[11,12]

Various factors have been proposed to contribute to these conditions, including genetic predispositions, participation in high-impact sports during developmental years, and pediatric hip disorders. There may be an increased likelihood of cam-type femoroacetabular impingement when SCFE occurs. Also, pincer-type impingement may occur in rare cases when hip dysplasia is surgically overcorrected.[13] New research indicates that femoroacetabular impingement is more common among high-impact sports players who participate in them during adolescence, while the bones are still developing, as opposed to those who do not participate in these activities.[14] The average age of the professional soccer players studied by Agricola et al. was 14.4 years, and they found a greater occurrence of cam malformation, as shown by an increase in the alpha angle from 59.4° to 61.3°, throughout a two-year period.[15]

After the activity of the proximal femoral growth plate stopped, the cam deformity did not become worse or more common. A possible way to stop cam anomalies in their tracks would be to alter physical activity levels when the skeleton is still developing. Other researchers have found similar higher alpha angles when comparing top-tier ice hockey and basketball players to controls of the same age. One possible explanation for why some teenagers develop cam deformity while playing sports is that their growing hips experience significant shear stresses while competing, which can change the shape of the growth plate. Another possible cause is that new bone grows at the anterosuperior head-neck junction.[16]

The hereditary implications associated with Femoroacetabular Impingement (FAI) have also been scrutinized. According to Pollard et al., siblings of individuals afflicted with cam or pincer-type FAI exhibited a relative risk greater than 2 for developing a similar deformity. Furthermore, European women demonstrated a higher propensity than their Chinese counterparts to display morphometric indicators of FAI. There exists a correlation between proximal femur morphology and the onset of hip osteoarthritis in later life with genetic polymorphisms linked to wnt/Beta-catenin signaling antagonists, which are pivotal in the regulation of bone and joint development.[17,18]

CLINICAL EXAMINATION

Young adults engaged in regular physical activity represent the primary demographic affected by FAI. One common symptom that develops over time as a consequence of the femoral head and acetabulum grinding together more and more is persistent groin discomfort. This pain is often the first symptom that people with FAI experience. Minor injuries, sustained physical effort, athletic activity, or lengthy periods of walking may aggravate the discomfort, which is usually intermittent in nature. Joint pain may also be caused by sitting or resting in one position for long periods of time or by applying pressure to the joint in any way.[19]

Symptoms of FAI often include hip discomfort, which may originate on the outside or inside of the hip and spread to other areas, such as the groin or even the front of the leg. Patients may show their hip pain from the front or back by making a "C sign," which is a hand cup over the afflicted hip. Children may encounter challenges in accurately localizing their symptoms, with hip pathology potentially presenting as knee or thigh pain, limping post-exercise, or other related symptoms. Adults frequently attribute their hip discomfort to associated "stiffness." Consequently, actions and postures requiring hip flexion and/or internal rotation tend to intensify hip pain. Activities such as sitting, driving, and squatting are particularly likely to aggravate symptoms. When there is enough intra-articular damage, as might happen with a labral tear or chondral injury, mechanical symptoms like clicking or catching in the hip may develop. During the evaluation of hip range of motion, a patient with a taut psoas tendon or a tight iliotibial band may or may not feel hip discomfort; however, the patient may or may not report this feeling. During the physical examination, we measure the patient's gait pattern, hip range of motion, and strength in their lower extremities so that we can compare them.[20]

An upright assessment that evaluates the patient's posture and ambulation can provide essential insights for diagnosing hip disorders. Standing facilitates the observation of the positioning of the hips and adjacent joints. It is crucial to document any noticeable lumbar flattening or pronounced lumbar lordosis. Irritation of the hip joint may be suggested by the affected hip and the corresponding knee being in a slightly flexed position. The patient might maintain their hip in a flexed position to avoid weight-bearing and loading, contingent upon the underlying cause of their discomfort (for instance, in cases of femoral neck stress reactions). Hip flexion also improves the joint's intracapsular volume, which is noticeable in septic arthritis and other similar disorders.[21]

Because it calls for the hip abductors to be engaged, a unipodal posture may expose injuries such gluteal tendon rips (gluteus medius and minimus). When a patient stands on one leg and the other pelvis descends because their abductors aren't working properly, it's called a positive Trendelenburg sign. As a result, it's not uncommon for the torso to sway to the side that's hurting. The examination is carried out by the authors while sitting behind the patient. They use their hands to wrap around the iliac crest and their thumbs to feel the posterosuperior iliac spine. After then, for a minimum of thirty seconds, the patient is to stand with one foot elevated. A positive Trendelenburg sign is seen when the contralateral hemipelvis is raised over the support side pelvis. On the other hand, a normal test would be considered if the pelvis stays level.[21]

When walking, crouching, or ascending stairs, people with femoroacetabular impingement (FAI) have different hip biomechanics than when they are not injured. As long as the patient is able to walk alone, a dynamic strength and balance evaluation using a double-leg squat may be conducted. With minimal additional guidance, requesting the patient to execute a double-leg squat can yield significant information regarding their stability, technique, and posture. It is important to observe any coronal plane adjustments in the trunk, valgus collapse at the knee joint, and the depth of the squat. The ambulatory hip extension period was shorter in FAI patients, and their squat velocities were lower throughout the climb and descent phases of double-leg squats. Additionally, their hip flexion loading moments were higher.[21]

The prone examination may be done before or after the standing evaluation. When looking for hip pathology, the log roll test is one of the most precise assessments. If the patient feels pain, which indicates intra-articular disease, the test is deemed positive. The leg is gently twisted back and forth to mobilize the femoral head within the acetabulum. The tester should do the test with their hand on the thigh so as not to confuse it with possible knee problems. For patients complaining of hip pain, this test is a good place to start since it doesn't put undue stress on the surrounding muscles.[21]

After that, the hip range of motion test is carried out. When measuring passive hip flexion, the examiner bends at the knee and hips toward the patient's chest, creating a range of motion usually measured at around 120 degrees. Hip flexion without impingement is likely to be lower than this figure, however. Passive hip flexion in asymptomatic young adult females was shown to include labral deformation at 72° and bony impingement at 101°, according to a dynamic ultrasound study. The most important thing to remember is that the proximal femur's version influences hip rotation. Both the prone and supine postures are suitable for taking measurements of the internal and external rotation of the hips. Strong inter-observer reliability is shown by the fact that the results for hip rotation are similar in the prone and supine positions. After that, while the patient is lying down, with their knees bent at a 90-degree angle, their hips are rotated internally and externally to measure their range of motion. Hip disorders such femoro-acetabular impingement, arthritis, and slipping capital femoral epiphysis may cause obligatory external rotation, which occurs when passive hip flexion occurs at the same time as external rotation of the hip. This might be an indication of irritation inside the hip joints. Hip internal rotation less than 10° is associated with imaging alterations of progressing osteoarthritis in young athletes and may be a sign of femoroacetabular impingement. The patient is best assessed for hip extension when lying on their side in a decubitus posture. In order to measure hip extension, which usually falls between the 5 to 10° range, the examiner passively extends the upper limb with the knee flexed at 90°.[21]

Patients suffering with femoroacetabular impingement (FAI) often show a positive result on the Flexion Adduction Internal Rotation (FADIR) test, which is also known as a positive impingement sign, when examined physically. During this examination, the patient is placed on their back, and the doctor will bend their leg to a 90-degree angle, bring the whole limb in toward the patient's midline, and then bring the calf and foot in toward the doctor, all the while keeping the knee still. For this last motion to be considered successful, the patient must disclose any hip discomfort they may be experiencing. The FABER test, which measures flexion abduction external rotation, is often positive in patients with FAI. The technique requires the patient to lay face down while flexing, abducting, and externally rotating the afflicted limb. The afflicted limb is subjected to a downward push while the examiner steadies the contralateral pelvis. If the afflicted limb's knee lifts in response to the downward force, then the test is considered affirmative.[22]

As you go through the focused hip exam, be sure to ask the patient to confirm that each test mimics the pain they normally feel. When you palpate bone landmarks like the greater trochanter or extend your hamstrings or hip flexors, you may feel deep, anterior, or anterolateral groin discomfort. However, the pain you feel from FAI is often different.

It must be recognized that femoroacetabular impingement (FAI) symptoms and physical exam results might be quite similar to those of acetabular dysplasia and other hip disorders. Acetabular dysplasia patients may also exhibit signs of labral pathology, such as an abductor lurch and a positive anterior impingement test. However, compared to acetabular dysplasia, FAI usually causes more severe restrictions in hip range of motion, especially in flexion and internal rotation.

IMAGING

Patients often experience a plethora of screening tests and further diagnostic investigations due to the vague nature of hip pain clinical indications and symptoms. Nevertheless, there is no universal agreement on objective standards or conclusive diagnostic criteria that can accurately diagnose FAI syndrome because of the wide variety of patient symptoms and underlying physiological processes.

Standard Imaging

Plain radiographic imaging should be the next step in the evaluation of a patient who presents with hip pain if the patient's history and physical examination point to an intra-articular cause for the pain. Plain radiographs are a basic tool for evaluating acetabular and femoral morphology and for diagnosing hip osteoarthritis. In order to get standardized anteroposterior (AP) pelvic radiographs, the patient is placed supine with their limbs internally rotated at a 15° angle, and the x-ray beam is centered between the femoral heads. Standing AP pelvis radiographs might provide useful information on the hips' functional orientation because individuals with hip dysfunction may adjust their pelvic tilt when standing to compensate. Approximately three to five millimeters should be measured between the superior edge of the pubic symphysis and the sacrococcygeal joint in appropriately tilted and positioned anterior pelvic radiographs.[23]

In instances when cam deformity is suspected, it is crucial to evaluate the morphology of the proximal femur using many radiographic images of the hip. Fig. 1a shows the most noticeable cam deformity at the anterolateral side of the femoral head-neck junction in the 45° Dunn lateral view, whereas Fig. 1b shows the best presentation of any anterior cam deformity in frog-leg lateral hip radiographs. Using these lateral radiographs, we can analyze the alpha angle (Fig. 1a), which measures the degree of asphericity at the femoral head-neck junction. The alpha angle has been extensively studied for applications in computed tomography and radiography, after having first been described on axial magnetic resonance imaging. The alpha angle has been suggested with a variety of thresholds, from 50° to 83°, with 55° being the most often mentioned. Hip internal rotation during flexion is reduced and acetabular articular cartilage degradation is more severe when the alpha angle is more than 60 degrees, according to research and surgical observations.[24]

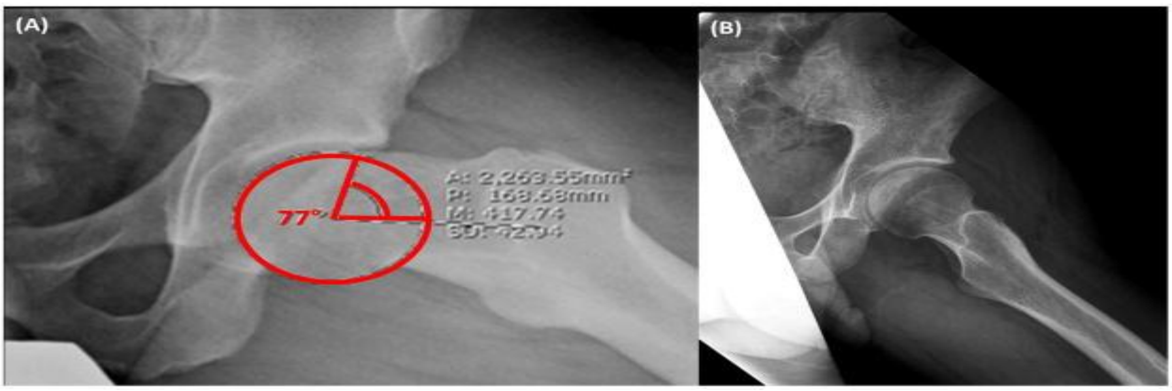

Figure 1. Lateral Hip Radiograph (A) 45° Dunn A lateral hip radiograph with measurement of the alpha angle. Firstly, the femoral neck axis is established as the line that connects the centre of the femoral head with the midpoint of the narrowest section of the femoral neck. Next, a circular shape is fitted to the head of the femur. The Alpha angle is determined by measuring the angle formed by the femoral neck axis and the line from the center of the circle to the precise location where the bony contour emerges outside the circle that best fits the data. Figure B: Frog Leg A lateral radiograph.

A lateral center-edge angle (LCEA) larger than 40° and a Tönnis angle less than 0° are diagnostic criteria for pincer deformity, which manifests as worldwide acetabular overcoverage. By taking an AP pelvis radiograph, the LCEA and Tönnis angle may be assessed. Figure 2a shows the lateral coverage of the femoral head as measured by the left collateral elongation angle (LCEA), and Figure 2b shows the slope of the acetabular roof as measured by the Tönnis angle. The usual range for the left circumferential elongation (LCEA) and the Tönnis angle in an acetabulum is 25–35° and 0–10°, respectively.[24]

Acetabular retroversion causes the femoral head to be too covered in the direction of the body's anterior and posterior cruciates. According to Reynolds and colleagues, this anomaly might be a cause of hip pain, labral and chondral injuries. In the traditional acetabular shape, the back of the joint meets in the middle of the femoral head, and the front and back of the joint meet at the acetabulum's lateral edge. Reynolds et al. provided a very helpful examination of acetabular retroversion. All three of these signs—a positive crossing (Figure 2c), a positive posterior wall (Figure 2d), and a positive ischial spine (Figure 2e)—are indicative of an acetabulum that has retroverted.[24]

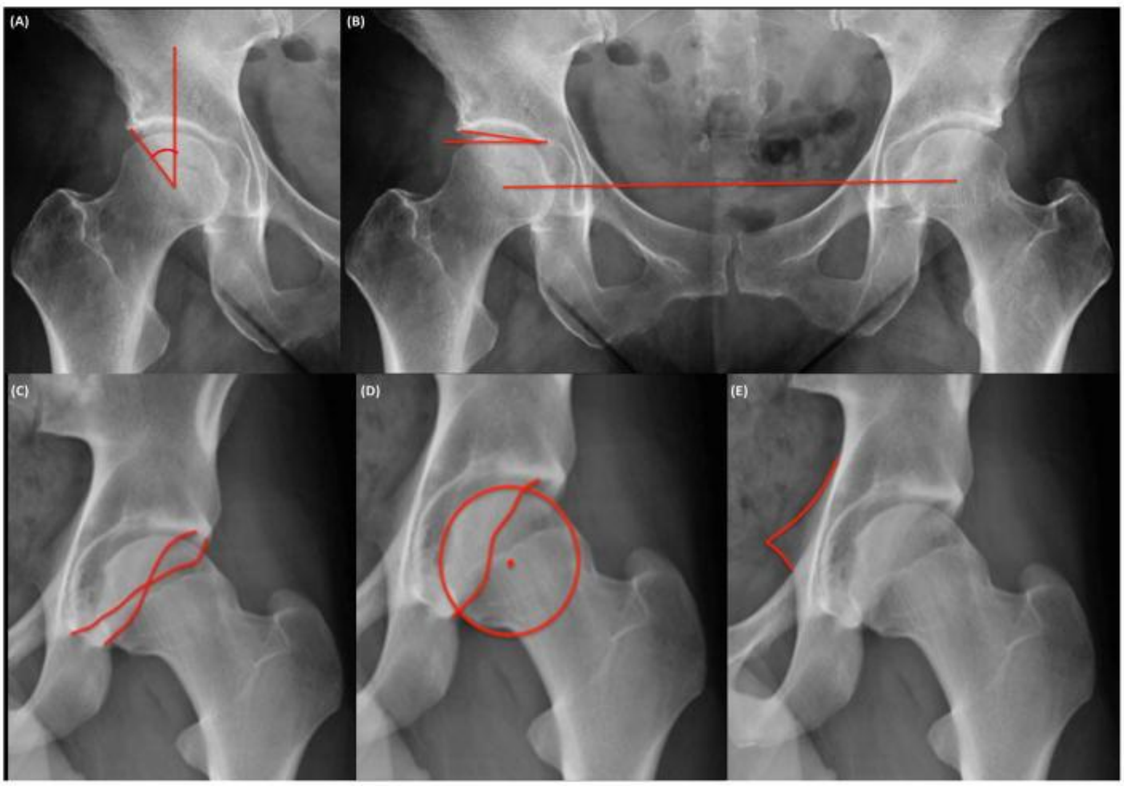

Figure 2. Apical acetabular measurements Cropped pelvic radiographs The Lateral Center Edge Angle (LCEA) is the angle formed by a vertical line to the pelvis and another line, extending to the lateral extent of the acetabular roof, with its vertex at the center of the femoral head. The Tönnis angle is formed by a horizontal line connecting the two femoral heads and a line connecting the medial and lateral extents of the acetabular roof. The crossover sign is characterized by the anterior wall extending laterally to the posterior wall before merging at the lateral acetabulum. The posterior wall sign is characterized by the posterior acetabular wall being positioned medially to the center of the femoral head. The ischial spine sign is recognized by the visibility of the ischial spine within the pelvic inlet on the anterior pelvis.

Hip articular tissues are vulnerable to damage from these skeletal anomalies due to the high volume of hip motion seen in everyday life and athletic endeavors. Patients with FAI need to undergo magnetic resonance imaging (MRI) or a magnetic resonance angiography (MRA) since radiography fails to detect cartilage or labral abnormalities. The hip joint's additional articular tissues are worn down by the everyday and athletic use of these skeletal abnormalities. Radiography cannot identify labral or cartilage abnormalities in FAI patients, hence magnetic resonance imaging (MRI) or magnetic resonance angiography (MRA) are required for diagnosis.

Clinical Magnetic Resonance Imaging (MRI)

Preoperative magnetic resonance imaging (MRI) and magnetic resonance arthrography (MRA) can help find damaged labral and articular cartilage, give a three-dimensional view of the bony deformity, reveal whether there are impingement cysts, and aid in surgical planning when plain radiographs reveal morphometric abnormalities in the proximal femur or acetabulum and the patient's history and physical examination point to femoral arthroplasty (FAI). Hip fibroadenomyalgia (FAI) may be assessed using a variety of magnetic resonance imaging (MRI) techniques (59-64). On the other side, MRI may help rule out FAI as a cause of hip pain when other tests, such as a physical exam, plain radiography, or clinical manifestations, fail to provide a definitive diagnosis. Possible diagnoses include psoas tendinitis, abductor tendinopathy, and greater trochanteric bursitis, as seen by T2-weighted imaging, which show higher signal in the affected anatomical locations.[24]

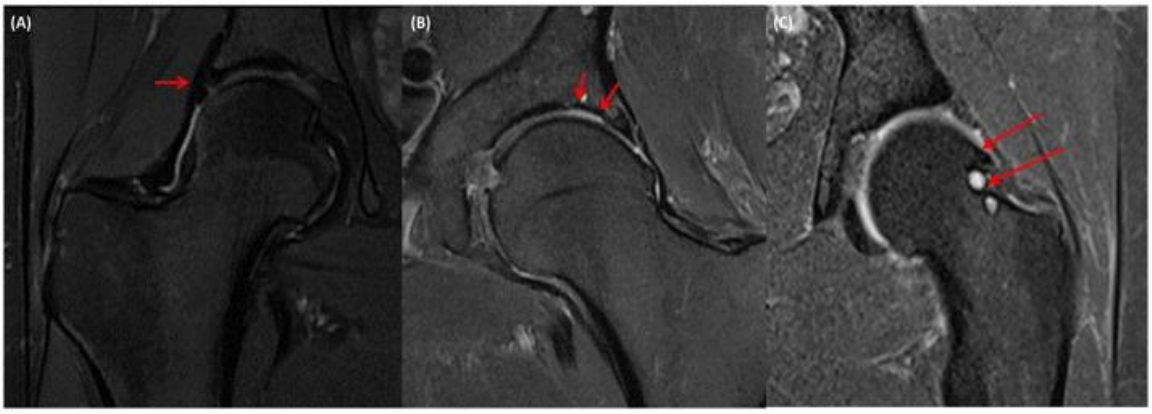

Figure 3. Imaging of the hip using coronal MRI revealed a labral tear, a cartilage lesion, and radial reformatted MRI indicating cam deformity and impingement cysts at the femoral head-neck junction.

Preoperative MRI and MRA can shed light on labral and articular cartilage abnormalities, offer a three-dimensional assessment of the bony deformity and the presence of impingement cysts, and aid in surgical planning when plain radiographs reveal morphometric abnormalities in the proximal femur or acetabulum and the history and examination point to a femoral artery injury (FAI). Hip fusion-associated injury (FAI) may be evaluated using magnetic resonance imaging (MRI) methods. But when a diagnosis cannot be made by normal radiography, physical examination, or clinical presentation alone, MRI may help rule out FAI as a possible cause of hip pain. T2 weighted imaging may detect psoas tendinitis, abductor tendinopathy, and greater trochanteric bursitis by highlighting the affected areas with elevated signals.[24]

Using a field strength of 1.5 Tesla, a series of 28 individuals underwent preoperative magnetic resonance imaging (MRI). For the purpose of detecting labral tears that were confirmed following hip surgery, the research found that Magnetic Resonance Angiography (MRA) had a higher sensitivity (81% and 69% for 2 readers) and specificity (50-100% for both readers) than conventional non-contrast MRI (sensitivity and specificity of 50% for both readers).[25] The efficacy of magnetic resonance imaging (MRI) and magnetic resonance angiography

(MRA) in reliably detecting labral tears at a 1.5 Tesla magnetic field intensity was evaluated in a meta-analysis of 19 trials. With a sensitivity of 83%, MRA outperformed conventional MRI (which had a sensitivity of 70%) in detecting labral tears, according to the statistical analysis.[26]

When comparing magnetic resonance imaging (MRI) and magnetic resonance angiography (MRA) for the purpose of diagnosing abnormalities in the femur and acetabulum cartilage, the results showed that MRA had a better sensitivity (71% and 92% for 2 readers) and specificity (100 percent and 25 percent, respectively) for detecting abnormalities in the acetabular cartilage than MRI (58% and 83%, respectively). On the other hand, arthroscopic confirmation of femoral cartilage abnormalities was as accurate as expected.[26]

MANAGEMENT

Non-surgical

Patients with mild to severe FAI are often recommended to begin with conservative treatment because of its symptom-relieving capabilities. In conservative treatment, the patient's symptoms are addressed by a comprehensive, long-term physical therapy program. In 2020, researchers looked explored the efficacy of physical therapy in preventing and treating faciitis anatomical injuries (FAIs). The study revealed that positive results were contingent upon the implementation of tailored exercises. Furthermore, when compared to an alternative approach that does not include core strengthening, this study revealed that implementing an active regimen specifically designed to enhance core muscles is associated with a higher level of effectiveness.[27] Conservative therapy seeks to alleviate hip pain, enhance symptoms, and minimize disability through the adoption of activity modification, retraining of movement patterns, improvement of muscle flexibility, strengthening of muscles, and effective pain management. Wall et al. conducted a comprehensive analysis of the existing research on non-surgical treatments for femoral artery injury (FAI). The authors concluded that patients with FAI may benefit from exercise-based physical therapy regimens that are structured into tiers, together with education and analgesic treatment.[28]

However, not every patient should start with conservative therapy as their only option. On the contrary, the decision-making process could be guided by the particular morphology. As an example, compared to other types of FAI conditions, empirical evidence shows that conservative treatment has unsatisfactory outcomes for persons with a cam malformation.[29]

Recommendations for the management of hip joint pain other than arthritis have been recently issued by the Orthopaedic section of the American Physical Therapy Association (APTA). Injury to the hip may be caused by a variety of sources, including structural instability, chondral lesions, ligamentous rips, labral tears, or traumatic arthritis. These suggestions are based on theoretical/foundational evidence and expert judgment since there haven't been any randomised controlled studies on physical therapy for femoral-articular injury (FAI) and hip pain. Patient education and counseling on joint safety and avoiding symptom-causing activities should be given top priority, according to the APTA's recommendations. Manual therapy should be used to alleviate capsular limitations and eliminate internal rotation and end-range flexion. Therapeutic exercises should be incorporated, including cardio-respiratory endurance exercises, stretching, and strengthening exercises based on rotational asymmetry. Finally, neuromuscular re-education should be implemented to improve movement coordination, with a specific focus on multi-joint patterns. Individuals with frontal arthritic injury (FAI) may benefit from physical therapy after arthroscopic surgery, according to at least one ongoing randomized controlled research. To support these suggestions, randomized studies of conservative treatment in FAI patients are needed.[30]

While some individuals with FAI may find relief from symptoms with conservative therapy, it is often ineffective for the majority of patients. Consistently better outcomes after surgical intervention are seen even with longer physical therapy regimens compared to physical therapy alone.[29]

A meta-analysis of six randomized controlled trials (RCTs) comparing the clinical outcomes of arthroscopy surgery to conservative treatment revealed that arthroscopic surgery has statistically superior results in terms of improvement in Hip Outcome Score (HOS) and International Hip Outcome Tool 33 (iHOT-33) metrics, as well as EQ-5D-5L index score. Significant heterogeneity was seen in the comparison of HOS (follow-up period of 6 months) and EQ-5D-5L index score.[31]

Surgical

The objectives of surgical intervention for femoral articular impairment (FAI) are to rectify any soft tissue injury caused by the anatomical abnormalities that causing abnormal mechanics of the hip joint. To prevent hip osteoarthritis, it is necessary to halt joint degradation by surgical intervention. Thorough evaluation of the extent of pre-existing joint damage is necessary for the good outcome of surgery. Hip arthroscopy is a minimally invasive procedure used to reconfigure the acetabulum and proximal femur, as well as to target damage within the joint. Novel arthroscopic methods have been devised to alleviate pressure on the conspicuous bone at the femoral head-neck junction in cam femoral aortic interbody implantation (FAI), as well as to remove the acetabular rim in pincer FAI. Published evidence exists on the short- and medium-term results of hip arthroscopy for the treatment of FAI abnormalities. Correction of a cam deformity by femoral osteochondroplasty reduced the mean alpha angle from 59.8° to 36.4°, resulting in a significant improvement in hip range of motion in flexion (3.8°; P =.002) and internal rotation (9.3°; P =.0002).[32]

Arthroscopic labral repair outperforms labral debridement, according to studies conducted over short and medium durations. The labral repair group outperformed the labral debridement group by 7.3 points on the Harris hip score (HHS), according to 96 patients assessed over an average of 2 years of follow-up by Schilders et al.[33] Subjective results were significantly improved for both groups compared to preoperative ratings, as shown in the case-control research by Larson et al. On the other hand, following an average of 3.5 years of follow-up, the group that had labral repair had far better pain ratings on the HHS, SF-12, and VAS than the group that underwent labral resection.[34]

Surgical dislocation of the hip is an excellent treatment for treating femoral cam deformity and global acetabular overcoverage that cannot be easily addressed with arthroscopic procedures. In order to access the pathophysiology of the FAI from all angles, this method requires surgically separating the femoral head from the acetabulum. Ganz and colleagues gave the first evidence of a safe surgical hip dislocation with few problems. By taking a worldwide view, this method provides thorough access to hip abnormalities both inside and outside the joint. Radiological metrics, clinical results, and hip range of motion are all improved to the same extent as after hip arthroscopy after surgical hip dislocation for femoral osteochondroplasty, acetabular rim-trim, and labral repair or debridement, with an intermediate term follow-up of three to five years.[35]

If acetabular retroversion causes pincer femoral artery damage (FAI), a surgical surgery called reverse periacetabular osteotomy (PAO) may be used to straighten the acetabulum and relieve anterior impingement. In order to antevert the acetabulum and decrease lateral and anterior femoral head coverage, the reverse posterior acetabular osteotomy (PAO) delicately removes the bone around the acetabulum, separates it from the remainder of the pelvis, and then repositions it. Thirty years after acetabulum anteversion with reverse periacetabular osteotomy, Siebenrock and colleagues found significant improvements in clinical and radiological outcomes. On average, the Merle d'Aubigne score improved, and there was a notable increase in the range of motion for internal rotation (10°, p = 0.006), flexion (7°, p = 0.014), and adduction (8°, p = 0.017). Those hips when the posterior wall sign is positive, suggesting a weak posterior acetabular wall, can benefit greatly from this method. The acetabulum's size might be reduced by an acetabular rim-trim, which could lead to iatrogenic hip instability in some circumstances.[36]

Hip preservation surgery has a much lower success rate when FAI has produced severe osteoarthritis and the joint space width is smaller than 2 mm. For patients over the age of 50, the smallest joint space, as measured on pre-operative radiographs, is the best predictor of early hip arthroscopy failure. With a median follow-up of 54 months, it was anticipated that 31 out of 96 patients aged 50 and older who had hip arthroscopy would need a complete hip replacement, supposing a joint gap of 2 mm or less. In order to achieve long-term discomfort alleviation and overall functional improvement, total hip replacement is the optimal therapy for persons with moderate to severe radiographic and clinical symptoms of hip osteoarthritis (OA).[37]

Hip arthroscopy isn't the only less common surgical treatment option. Because the femoral head, labrum, and acetabulum are easily accessible and the surgical field is well-lit, open surgery has long been the go-to method for treating femoral acute infarction (FAI). When faced with a particularly difficult FAI condition and requiring more joint access than what can be achieved by an arthroscopy, an open surgical approach remains advantageous. Patients with significant and/or intricate cam or pincer anomalies often display this clinical manifestation. Moreover, it is commonly used for corrective operations that were originally performed using arthroscopy due to the insufficient accessibility of the defect utilizing arthroscopy.[38]

Anterolateral approaches, often known as the Watson-Jones technique, are a less commonly utilized procedure mostly employed for anterolateral anomalies. One advantage of this approach is that it allows for the preservation of the blood supply to the femoral head while providing direct access to anterior lesions. Moreover, a less common surgical procedure is the combination of mini-open surgery and arthroscopy. This technique effectively mitigates FAI deformity without the need for hip dislocation. This combined technique, although less intrusive than an open approach, is restricted to the treatment of cam-type lesions since it necessitates dislocation to provide precise access to the acetabulum.[38]

Declaration by Authors

Ethical Approval: Not Required

Acknowledgement: None

Source of Funding: None

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

REFERENCES

1. Ganz R, Parvizi J, Beck M, Leunig M, Notzli H, Siebenrock KA. Femoroacetabular impingement: a cause for osteoarthritis of the hip. Clin Orthop Relat Res. 2003;(417):112–20.
2. Ganz R, Leunig M, Leunig-Ganz K, Harris WH. The etiology of osteoarthritis of the hip: an integrated mechanical concept. Clin Orthop Relat Res. 2008;466(2):264–72.
3. Sankar WN, Nevitt M, Parvizi J, Felson DT, Agricola R, Leunig M. Femoroacetabular impingement: defining the condition and its role in the pathophysiology of osteoarthritis. J Am Acad Orthop Surg. 2013;21 (Suppl 1):S7–S15.
4. Hack K, Di Primio G, Rakhra K, Beaule PE. Prevalence of cam-type femoroacetabular impingement morphology in asymptomatic

volunteers. J Bone Joint Surg Am. 2010;92(14):2436–44.
5. Gosvig KK, Jacobsen S, Palm H, Sonne-Holm S, Magnusson E. A new radiological index for assessing asphericity of the femoral head in cam impingement. J Bone Joint Surg Br. 2007;89(10):1309–16.
6. Nardo L, Parimi N, Liu F, Jungmann PM, Nevitt M, Link TM, et al. The Prevalence of morphometric abnormities of Femoral Acetabular Impingement and their relation with radiographic hip osteoarthritis and hip pain in Elderly Men - The Osteoporotic Fractures in Men (MrOS) Study. Skeletal Radiol. 2014
7. Agricola R, Heijboer MP, Roze RH, Reijman M, Bierma-Zeinstra SM, Verhaar JA, et al. Pincer deformity does not lead to osteoarthritis of the hip whereas acetabular dysplasia does: acetabular coverage and development of osteoarthritis in a nationwide prospective cohort study (CHECK) Osteoarthritis Cartilage. 2013;21(10):1514–21.
8. Wenger DR, Kishan S, Pring ME. Impingement and childhood hip disease. Journal of Pediatric Orthopaedics B. 2006;15(4):233-243.
9. Weinstein S, Flynn J. Legg-Calvé-Perthes Syndrome. In: Lovell and Winter’s Pediatric Orthopedics. 7th ed. Lippincott Williams and Wilkins; 2014:1112-1164.
10. Shaw C. Femoroacetabular Impingement Syndrome: A Cause of Hip Pain in Adolescents and Young Adults. Missouri medicine. 2017;114(4):299-302.
11. Talathi N, LaValva S, Lopez-Garib A, Kelly JD IV, Khoury V. Correlation between femoroacetabular impingement and hamstring tendon pathology on magnetic resonance imaging and arthrography. Orthopedics. 2017;40(6):e1086-e1091.
12. Kraeutler MJ, Fioravanti MJ, Goodrich JA, et al. Increased Prevalence of Femoroacetabular Impingement in Patients With Proximal Hamstring Tendon Injuries. Arthroscopy. 2019;35(5):1396-1402.
13. Ziebarth K, Balakumar J, Domayer S, Kim YJ, Millis MB. Bernese periacetabular osteotomy in males: is there an increased risk of femoroacetabular impingement (FAI) after Bernese periacetabular osteotomy? Clin Orthop Relat Res. 2011;469(2):447–53.
14. Agricola R, Bessems JH, Ginai AZ, Heijboer MP, van der Heijden RA, Verhaar JA, et al. The development of Cam-type deformity in adolescent and young male soccer players.
15. Clohisy JC, Knaus ER, Hunt DM, Lesher JM, Harris-Hayes M, Prather H. Clinical presentation of patients with symptomatic anterior hip impingement. Clin Orthop Relat Res. 2009;467(3):638–44.
16. Siebenrock KA, Ferner F, Noble PC, Santore RF, Werlen S, Mamisch TC. The cam-type deformity of the proximal femur arises in childhood in response to vigorous sporting activity. Clin Orthop Relat Res. 2011;469(11):3229–40.
17. Pollard TC, Villar RN, Norton MR, Fern ED, Williams MR, Murray DW, et al. Genetic influences in the aetiology of femoroacetabular impingement: a sibling study. J Bone Joint Surg Br. 2010;92(2):209–16.
18. Dudda M, Kim YJ, Zhang Y, Nevitt MC, Xu L, Niu J, et al. Morphologic differences between the hips of Chinese women and white women: could they account for the ethnic difference in the prevalence of hip osteoarthritis? Arthritis Rheum. 2011;63(10):2992–9.
19. Matar HE, Rajpura A, Board TN. Femoroacetabular impingement in young adults: Assessment and management. Br J Hosp Med. 2019;80(10):584-588.
20. Martin HD, Shears SA, Palmer IJ. Evaluation of the hip. Sports Med Arthrosc. 2010;18(2):63–75.
21. Wong SE, Cogan CJ, Zhang AL. Physical Examination of the Hip: Assessment of Femoroacetabular Impingement, Labral Pathology, and Microinstability. Curr Rev Musculoskelet Med. 2022 Apr;15(2):38-52.
22. Philippon MJ, Maxwell RB, Johnston TL, Schenker M, Briggs KK. Clinical presentation of femoroacetabular impingement. Knee Surg Sports Traumatol Arthr. 2007;15(8):1041-1047
23. Siebenrock KA, Kalbermatten DF, Ganz R. Effect of pelvic tilt on acetabular retroversion: a study of pelves from cadavers. Clin Orthop Relat Res. 2003;(407):241–8.
24. Pun S, Kumar D, Lane NE. Femoroacetabular impingement. Arthritis Rheumatol. 2015 Jan;67(1):17-27.
25. Sutter R, Zubler V, Hoffmann A, Mamisch-Saupe N, Dora C, Kalberer F, et al. Hip MRI: how useful is intraarticular contrast

material for evaluating surgically proven lesions of the labrum and articular cartilage? AJR Am J Roentgenol. 2014;202(1):160–9.
26. Smith TO, Hilton G, Toms AP, Donell ST, Hing CB. The diagnostic accuracy of acetabular labral tears using magnetic resonance imaging and magnetic resonance arthrography: a meta-analysis. European radiology. 2011;21(4):863–74.
27. Hoit G, Whelan DB, Dwyer T, Ajrawat P, Chahal J. Physiotherapy as an Initial Treatment Option for Femoroacetabular Impingement: A Systematic Review of the Literature and Meta-analysis of 5 Randomized Controlled Trials. Am J Sports Med. 2020;48(8):2042-2050.
28. Wall PD, Fernandez M, Griffin DR, Foster NE. Nonoperative treatment for femoroacetabular impingement: a systematic review of the literature. PM R. 2013;5(5):418–26.
29. Casartelli NC, Bizzini M, Maffiuletti NA, et al. Exercise Therapy for the Management of Femoroacetabular Impingement Syndrome: Preliminary Results of Clinical Responsiveness. Arthritis Care Res. 2019;71(8):1074-1083.
30. Enseki K, Harris-Hayes M, White DM, Cibulka MT, Woehrle J, Fagerson TL, et al. Nonarthritic Hip Joint Pain: Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability and Health From the Orthopaedic Section of the American Physical Therapy Association. J Orthop Sports Phys Ther. 2014;44(6)
31. Zhu Y, Su P, Xu T, Zhang L, Fu W. Conservative therapy versus arthroscopic surgery of femoroacetabular impingement syndrome (FAI): a systematic review and meta-analysis. J Orthop Surg Res. 2022 Jun 3;17(1):296.
32. Bedi A, Dolan M, Hetsroni I, Magennis E, Lipman J, Buly R, et al. Surgical treatment of femoroacetabular impingement improves hip kinematics: a computer-assisted model. Am J Sports Med. 2011;39 (Suppl):43S–9S.
33. Schilders E, Dimitrakopoulou A, Bismil Q, Marchant P, Cooke C. Arthroscopic treatment of labral tears in femoroacetabular impingement: a comparative study of refixation and resection with a minimum two-year follow-up. J Bone Joint Surg Br. 2011;93(8):1027–32.
34. Larson CM, Giveans MR, Stone RM. Arthroscopic debridement versus refixation of the acetabular labrum associated with femoroacetabular impingement: mean 3.5-year follow-up. Am J Sports Med. 2012;40(5):1015–21.
35. Ganz R, Gill TJ, Gautier E, Ganz K, Krugel N, Berlemann U. Surgical dislocation of the adult hip a technique with full access to the femoral head and acetabulum without the risk of avascular necrosis. J Bone Joint Surg Br. 2001;83(8):1119–24.
36. Siebenrock KA, Schoeniger R, Ganz R. Anterior femoro-acetabular impingement due to acetabular retroversion. Treatment with periacetabular osteotomy. J Bone Joint Surg Am. 2003;85-A(2):278–86.
37. Philippon MJ, Briggs KK, Carlisle JC, Patterson DC. Joint space predicts THA after hip arthroscopy in patients 50 years and older. Clin Orthop Relat Res. 2013;471(8):2492–6.
38. Fortier LM, Popovsky D, Durci MM, Norwood H, Sherman WF, Kaye AD. An Updated Review of Femoroacetabular Impingement Syndrome. Orthop Rev (Pavia). 2022 Aug 25;14(3):37513.

How to cite this article: Leonardus William Kuswara, Putu Feryawan Meregawa. Femoroacetabular impingement: a literature review. *International Journal of Research and Review*. 2024; 11(10): 212-224. DOI: *https://doi.org/10.52403/ijrr.20241020*

******