# Comparison of MRI findings with arthroscopic findings in femoroacetabular impingement

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**Objectives**
To correlate MRI findings and arthroscopic findings in femoroacetabular impingement.
**Patients and methods**
A retrospective analysis of the accuracy of MRI findings compared with arthroscopic findings in 60 patients with femoroacetabular impingement.
**Results**
Chondral lesions were identified in 19 of 60 patients on MRI and were identified in 30 of 60 patients on arthroscopy. MRI had a sensitivity of 53.33%, a positive predictive value of 84.21%, a specificity of 90%, a negative predictive value of 65.85%, and an accuracy of 71.67% for the detection of chondral lesions. Labral tears were identified in 48 of 60 patients on MRI and were identified in 54 of 60 (90%) patients on arthroscopy. MRI had a sensitivity of 81.4%, a positive predictive value of 91.67%, a specificity of 33.33%, a negative predictive value of 16.67%, and an accuracy of 76.67% for the detection of labral tears.
**Conclusions**
MRI cannot be used to rule out a labral tear and chondral lesion when there is a high clinical suspicion and need for therapeutic test in equivocal cases and functional cartilage imaging can be considered in early detection of the disease.

**Keywords:**
arthroscopy, chondral lesion, femoroacetabular impingement, labral tear, MRI

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## Introduction

The femoroacetabular impingement (FAI) is considered by many as one of the important hip diseases recently, although previously desiccated and did not receive enough attention. In athletes, FAI has been known as an important cause of hip pain [1,2]. FAI syndrome is a motion-related clinical disorder of the hip with a triad of symptoms, clinical signs, and imaging findings. It represents symptomatic premature contact between the proximal femur and the acetabulum. FAI syndrome has three different anatomical types [3]. Cam-type FAI is a proximal femoral anomaly characterized by asphericity of the femoral head and decreased offset at the femoral head neck junction and pincer-type FAI is acetabular over-coverage or retroversion which may be focal or global retroverted acetabulum and mixed-type FAI is caused by coexisting cam-type FAI and pincer-type FAI [4]. The tool of choice for studying FAI syndrome is MRI because of its multiplanar imaging capabilities and superior soft tissue representation as MRI can identify bone marrow edema, chondral, and labral lesions, as well as indicate bony abnormalities related to FAI [5]. Some cartilage anomalies may be too challenging for standard MRI spatial resolution, making it difficult to assess hip cartilage on MRI and due to the low spatial resolution of MRI sequence compared with the thickness of hip cartilage, it remains great concern that partial volume artifacts may hinder the assessment [6,7]. Due to the labrum's oblique orientation, it might be challenging to identify some minor or nondisplaced tears on MRI so dynamic examination of the articular cartilage and labral lesion during arthroscopy with magnification and high resolution enables the surgeon to detect the location and extent of the chondral and labral lesions and to detect occult lesions easily missed by MRI [5]. The objective of this study was to compare MRI findings and arthroscopic findings in FAI.

## Patients and methods

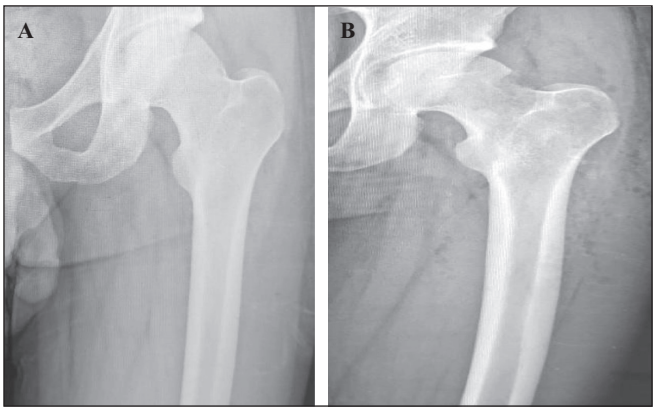
This study included 60 patients who underwent MRI with subsequent hip arthroscopy at institution with average time from MRI till arthroscopy ranged between 1 and 3 months and were retrospectively evaluated. The mean age was 32.18 ± 7.16 ranging from 18 to 46 years. There were 34 (56.7%) males and 27 (43.3%) females. Inclusion criteria were cam type FAI, pincer type FAI, mixed type, not more than 3 months interval between

radiology and arthroscopy, and no history of previous surgical intervention in the hip. Exclusion criteria were osteoarthritis, previous metal work in hip, neoplasia, infection, and radiating pain secondary to involvement of lumbar spine. The study was conducted from 2019 until 2022. MRI was performed for all patients 'suspected to have FAI' with Siemens Magnetom Sempra 1.5 T scanner (Shenzhen, China). Unilateral high resolution sequence protocol using 8 channel phased array flex body coil. Small field of view (FOV) was used with 320 image matrix. Protocol consists of axial PD-FS, coronal PD-FS, oblique coronal PD, coronal oblique MEDIC (Multi-Echo Data Image Combination) 3D gradient sequence, sagittal PD and axial oblique PD sequences. To avoid interobserver bias in analysis MRI was recorded by single radiology consultant and all cases were operated by single surgeon, the first author. The surgeon knew the MRI data and the diagnosis before the operations and applied the conventional hip arthroscopy approach and inspection procedures using The Non-Arthroplasty Hip Registry form to achieve an effective correlation between arthroscopic findings and MRI findings and divide the acetabular zone into six zones: anterior–inferior zone (zone 1), anterior–superior zone (zone 2), central–superior zone (zone 3), posterior–superior zone (zone 4), posterior–inferior zone (zone 5), and acetabular notch (zone 6) for the right and left hip [8]. The sensitivity, specificity, positive predictive value, and negative predictive value of MR for diagnosing the acetabular chondral labral tears were calculated using McNemar and marginal homogeneity test, using the results of hip arthroscopy as the gold standard. Informed consent was taken from every patient involved in the study as usual according to our institute protocol.

### Operative technique

All the patients were subjected to the same surgical technique and the same surgeon. All patients were positioned on a traction table and were subjected to moderate traction to distract the affected hip. Traction was applied to the operative side with the hip in 10° of flexion and 30° of abduction and internal rotation to distract the hip, followed by using fluoroscopy to ensure early enough distraction was obtained then the internal rotated flexed hip was brought into neutral position and fine traction was applied if more traction was needed. The operative table was placed in 15°–20° in Trendelenburg position, if possible, to minimize counterpressure at perineum. Two standard arthroscopic portals were used during the procedure: the anterolateral, and the mid anterior portals. Labral tears debridement or repair and femoroplasty were done to patients accordingly (Fig. 1).

**Figure 1**




Radiograph of 32-year-old male patient with cam impingement had femoroplasty (a) prefemoroplasty (b) postfemoroplasty.

## Results

Forty-nine (81.7%) patients of cases had cam deformity, four (6.7%) patients had pincer deformity, and seven (11.7) patients had mixed deformity. Chondral lesions were identified in 19 of 60 patients on MRI and were identified in 30 of 60 patients on arthroscopy as shown in Table 1. MRI had a sensitivity of 53.33%, a positive predictive value of 84.21%, a specificity of 90%, a negative predictive value of 65.85%, and an accuracy of 71.67% for the detection of chondral lesions. The locations of chondral lesions in MRI were mainly found between anterior–superior zone (zone 2), central–superior zone (zone 3), and posterior–superior zone (zone 4) with 52, 42, and 6%, respectively. After arthroscopy, it was found that about 50% of the chondral lesions were identified in zone 2 (anterior–superior), 34% of the chondral lesions were identified in zone 3 (central–superior), and about 16% of the chondral lesions in zone 4 (posterior–superior).

It was found that about 70% of chondral lesions were grade 2, 25% of chondral lesions were grade 1, about 3% of chondral lesions were grade 3, and 2% of chondral lesions were grade 4.

Labral tears were identified in 48 of 60 patients on MRI and were identified in 54 (90%) of 60 patients on arthroscopy as shown in Table 2. MRI had a sensitivity of 81.4%, a positive predictive value of 91.67%, a specificity of 33.33%, a negative predictive value of 16.67%, and an accuracy of 76.67% for the detection of labral tears. The locations of labral lesion in MRI were mainly found associated with chondral lesion locations between anterior–superior zone (zone 2), central–superior zone (zone 3), and posterior–superior zone (zone 4) with 52, 37, and 11%, respectively. After arthroscopy, it was found that about 64% of the labral

**Table 1 Comparison between MRI and arthroscopic findings (chondropathy)**

| Chondropathy | MRI [*n* (%)] | Arthroscopic [*n* (%)] | $^{McN}P$ |
|---|---|---|---|
| No | 41 (68.3) | 30 (50.0) | 0.013* |
| Yes | 19 (31.7) | 30 (50.0) | |

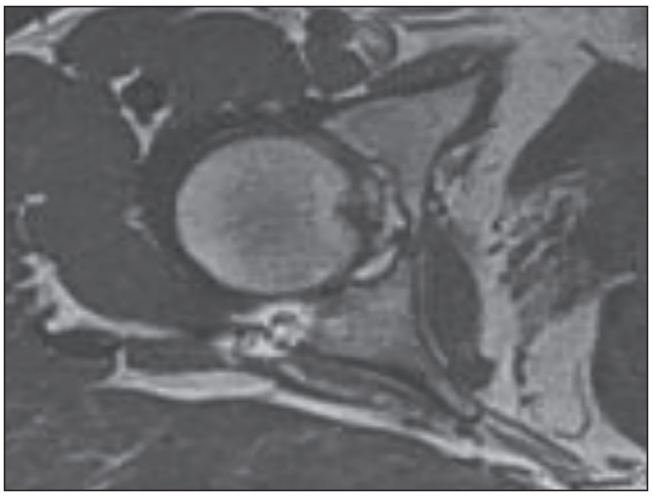
McN, McNemar test.
*P*: *P* value for comparing between MRI and arthroscopic.
*Statistically significant at *P* value less than or equal to 0.05.

**Table 2 Comparison between MRI and arthroscopic findings (labral tear)**

| Labral tear | MRI [*n* (%)] | Arthroscopic [*n* (%)] | $^{McN}P$ |
|---|---|---|---|
| No | 12 (20.0) | 6 (10.0) | 0.180 |
| Yes | 48 (80.0) | 54 (90.0) | |

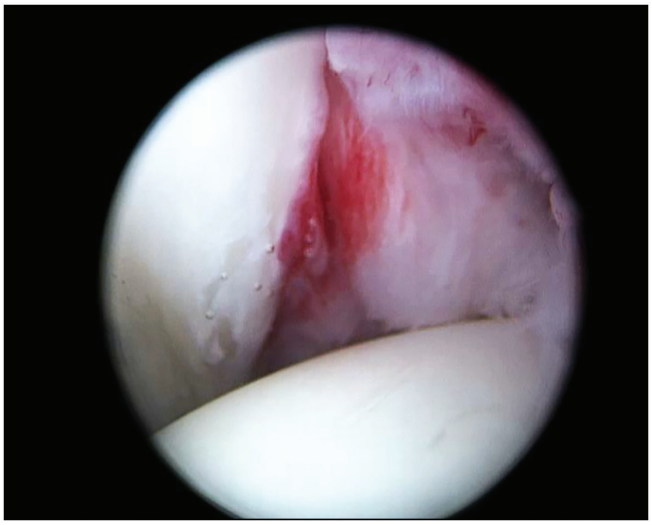
McN, McNemar test.
*P*: *P* value for comparing between MRI and arthroscopic.

**Figure 2**



Axial cut of noncontrast MRI of 33-year-old male patient demonstrates labral degenerative tear between 12 and 3 o'clock positions.

**Figure 3**



Arthroscopic view of the patient demonstrates the degenerative labral tear.

lesions were identified in zone 2 (anterior–superior), 23% of the labral lesions were identified in zone 3 (central–superior), and about 11% of the labral lesions in zone 4 (posterior–superior; Figs 2–3).

## Discussion

FAI syndrome is a motion-related clinical disorder of the hip with a triad of symptoms, clinical signs, and imaging findings. It is recently considered as a primary chondral disease with or without labral lesion. Articular cartilage has a principal role in distribution of the load across the joint. So early detection of chondral lesions is crucial for hip joint function as the load bearing capacity of the joint is reduced with increased duration of symptoms consequently preservation of the joint [9]. So the role of functional cartilage imaging, which is noninvasive method for articular cartilage matrix evaluation, can be considered in the early diagnosis of such chondral diseases [10]. The acetabulum labrum is an important structure in the hip joint, which deepens acetabulum fossa and helps to maintain the joint stability and articular cartilage nutrition [11]. In healthy individuals, the normal cartilage thickness through the whole circumference of the acetabulum is different and it ranges in different values. Consequently, some cartilage anomalies may be too challenging for standard MRI spatial resolution, making it difficult to assess hip cartilage [6]. In this study, MRI (noncontrast 1.5 T with small FOV) is performed with subsequent arthroscopy in 60 patients with average time from MRI till arthroscopy ranged between 1 and 3 months and compared the results. In this study it was found that MRI had a sensitivity of 53.33%, a positive predictive value of 84.21%, a specificity of 90%, a negative predictive value of 65.85%, and an accuracy of 71.67% for the detection of chondral lesions. Linda *et al.* [12] in their study on 42 patients in 2014 found that MRI (noncontrast 3–T with FOV 13–15 cm) had a sensitivity of 94%, a specificity of 67%, an accuracy 90%, a positive predictive value of 94%, and a negative predictive value of 67% for the detection of chondral lesions. Sutter *et al.* [13] in their study on 28 patients in 2014 found that MRI (noncontrast 1.5 T with FOV 16 cm) had a sensitivity of 58.83%, a positive predictive value of 100.91%, a specificity of 100.50%, a negative predictive value of 29.33%, and accuracy of 64.79% for the detection of chondral lesion. In this study, it was found that that MRI (noncontrast 1.5 T with small FOV) had a sensitivity of 81.4%, a positive predictive value of 91.67%, a specificity of 33.33%, a negative predictive value of 16.67%, and an accuracy of 76.67% for the detection of labral tears. MRI has a poor negative predictive value and cannot be used to rule out a labral tear when there is a high clinical suspicion.

Saied *et al*. [14] in their retrospective study on 490 hips stated that MRI (noncontrast 1.5 T) had a sensitivity of 66.9%, a positive predictive value of 90.6%, a specificity of 82.6%, a negative predictive value of 50.0%, and an accuracy of 71.4% for the detection of labral tears. Sutter *et al*. [13] in their study on 28 patients in 2014 stated that MRI (noncontrast 1.5 T with FOV 17 cm) had a sensitivity of 77.89%, a positive predictive value of 95.96%, a specificity of 50%, a negative predictive value of 14.25%, and accuracy of 75.86% for the detection of labral tears. They concluded also as this study that MRI has a poor negative predictive value and cannot be used to rule out a labral tear when there is a high clinical suspicion. So diagnostic intraarticular injection of anesthetic drug is very helpful in equivocal cases with equivocal diagnosis. The variety in the results through the literature is mostly attributed to different imaging modality techniques including different resolution protocols and FOV with image matrix and different cut-off point for detection of the lesions with wide arc of injury through the hip. MRI interpretation may be operator dependent. McGuire *et al*. [15] also showed that musculoskeletal radiologists achieved a higher accuracy than general radiologists in detecting chondral and labral lesions. Sutter *et al*. [13] in their study also showed discrepancy in their accuracy results analyzed between two different readers. This study also has some limitations. As it is a retrospective study, a control group of both absence of FAI and asymptomatic FAI could not be included. Also, small samples for the study do not give a high chance for wide detailed scale of comparison and detection of the sensitivity for different grades and extent of chondral lesion. Using the imaging modality (noncontrast 1.5 T MRI with small FOV with 320 image matrix) may affect the results. The results of this study support the idea that diagnosis FAI patient with labral and chondral disease requires a high level of clinical suspicion. The value of a thorough patient history and physical examination has to be considered in all cases. MRI is a useful imaging modality that can provide some diagnostic information but still cannot rule out the disease. So therapeutic test with local injection in hip joint can aid in diagnosis especially in negative MRI cases.

## Conclusions

MRI cannot be used to rule out a labral tear and chondral lesions when there is a high clinical suspicion and the need for therapeutic test in equivocal cases. FAI syndrome is a primary chondral disease with or without labral lesion so functional cartilage imaging can be considered in early detection of the disease. Arthroscopy remains the most accurate means of evaluating hip joint chondral and labral lesions.

**Abbreviations:**

FAI, femoroacetabular impingement;
FOV, field of view

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Nil

### Conflicts of interest

There are no conflicts of interest.

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