

The diagnostic accuracy of pelvic and hip radiographs in early detection of femoroacetabular impingement using MRI hip as standard investigation for patients presenting with painful hip

(Amun Iqbal, Hafiza Mehr un Nisa)

Dr. Sulaiman Alhabib Hospital Riyadh, Saudi Arabia

BACKGROUND

Femoroacetabular impingement (FAI) involves abnormal hip contact between the femoral head-neck junction and the acetabular rim. It is classified into three structural morphologies:

- Cam Type: Aspherical femoral head-neck junction creates a clearance limitation.
- Pincer Type: Local or general overcoverage of the femoral head by the acetabulum.
- Mixed Type: A combined pathology involving both Cam and Pincer alterations.

FAI causes significant hip pain, restricted range of motion, and frequently leads to progressive labral tears and early-onset osteoarthritis. While initial diagnosis relies heavily on radiographs and MRI to evaluate bone morphology and joint cartilage damage, baseline data indicated a high rate of undocumented or missed structural bony deformities on plain films.

METHODS & QI FRAMEWORK

A retrospective search was conducted using hospital Centricity software to track 168 patients presenting over a 1-year period who met strict inclusion criteria. The quality improvement framework was executed across two distinct surgical and reporting phases:

Phase 1: Baseline Audit (6 Months)

Evaluated plain radiographs of 56 patients against gold-standard MRI findings documented by senior musculoskeletal (MSK) radiologists. This phase confirmed a clear clinical gap in radiographic detection.

Targeted QI Intervention (2 Weeks)

- Updated imaging protocols to mandate high-quality AP pelvic and true hip radiographs to maximize anatomical visualization of the alpha angle and acetabular coverage.
- Implemented targeted online educational training for reporting registrars and radiographers.
- Launched a dedicated FAI diagnostic checklist on the hospital intranet system.
- Deployed visual reference diagrams near reporting workstations as continuous cognitive aids.

Phase 2: Post-Intervention Tracking (6 Months)

Evaluated a subsequent cohort of 112 patients to actively measure the diagnostic accuracy and clinical impact of the newly introduced radiographic standards.

ANATOMICAL & RADIOGRAPHIC PATHOLOGY

- Pincer Impingement: Characterized by an over-coverage of the femoral head by the acetabular rim, causing a linear impact crush during hip flexion.
- Cam Impingement: Relates to a prominent bony elevation along the femoral head-neck junction (the 'Cam bump'), which shears the acetabular cartilage.
- High-Quality AP Pelvis & True Hip Views: Required to visualize variations in the alpha angle and safely document acetabular coverage borders.

RESULTS

Post-intervention data from the Phase 2 cohort (n=112) demonstrated excellent alignment between plain films and advanced imaging. Radiographic findings suggested FAI in 60 patients (53.57%), which perfectly matched the 60 cases (53.57%) independently confirmed by the MRI reference standard.

Statistical analysis via contingency cross-tabulation demonstrated strong diagnostic power ($p = 0.0001$):

- True Positives: 56 cases | False Positives: 4 cases
- True Negatives: 48 cases | False Negatives: 4 cases

DIAGNOSTIC PERFORMANCE METRICS

- Sensitivity: 93.33%
- Specificity: 92.31%
- Positive Predictive Value (PPV): 93.33%
- Negative Predictive Value (NPV): 92.31%
- Overall Diagnostic Accuracy: 92.86%

Table-1: Post-Intervention Contingency Table and Diagnostic Performance Metrics

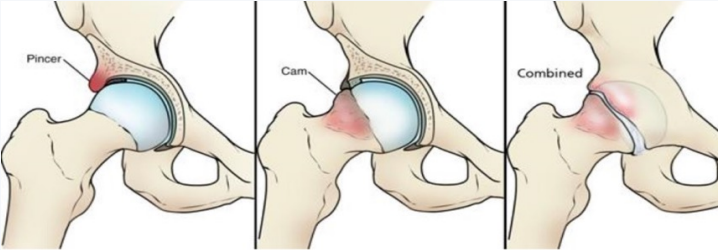
MRI Reference Standard (Confirmed FAI)	Radiograph Index Test (Positive FAI)	Radiograph Index Test (Negative FAI)	Total Patients
FAI Present	56 (True Positive)	4 (False Negative)	60
FAI Absent	4 (False Positive)	48 (True Negative)	52
Total	60	52	112

Statistical Performance Summary ($p = 0.0001$)

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- Specificity: 92.31%
- Positive Predictive Value (PPV): 93.33%
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CONCLUSION & CLINICAL IMPACT

Standardizing radiographic protocols, conducting staff education, and introducing workplace cognitive aids successfully optimized the early detection of FAI. The post-intervention diagnostic accuracy of 92.86% allows the department to confidently fast-track symptomatic patients with positive X-rays to hip MRIs, preventing irreversible cartilage damage. Furthermore, the high negative predictive value (92.31%) safely reduces unnecessary advanced imaging costs and efficiently streamlines the clinical pathway for painful hip evaluations.



(Left) Pincer impingement. (Center) Cam impingement. (Right) Combined impingement.



CAM Type FAI

Pincer Type FAI