Femoroacetabular impingement on plain radiograph from a general radiologist point of view

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Femoroacetabular impingement (FAI) is a major cause of hip pain and consequent early osteoarthritis of the hip in young and very active individuals. It is possible to intervene early if diagnosed early and avoid long term consequence. The primary portal of contact for these patients is GP with plain radiograph being the baseline investigation. MRI or MR arthrography can then be used to confirm or exclude labral tears, cartilage damage, and other pathologic signs of internal hip derangement if impingement is suspected.

The symptoms in FAI are due to contact of the abnormal morphologic features of either sides of the hip joint. It is characterized by an early pathologic contact during hip joint motion between skeletal prominences of the acetabulum and/or the femur that limits the physiologic hip range of motion, typically flexion and internal rotation. During sports and daily living activities, repetitive microtrauma of these osseous convexities can cause recurring irritation leading to labral degeneration at the labral-cartilage junction and subsequent labral avulsion and irreversible chondral damage. It manifests as hip pain, restricted motion, positive impingement test results, and appropriate imaging findings; and it can be successfully treated in specific cases without advanced osteoarthritis.

There are two clinical types of FAI, pincer and cam types. Pincer impingement is characterised by acetabular abnormality with focal or generalised over coverage of the acetabulum around the femoral head. This occurs more commonly in women aged 30-40 years. It is associated with anterior superior labral avulsions and a thin rim of adjacent cartilage lesion, which is often less than 5 mm in width. Cam impingement is due to femoral abnormality characterised by abnormal contour of the femoral head with aspherical ridge of bone causing impingement. Cam impingement can be caused by an osseous bump on the femoral head-neck junction or by a retroverted femoral neck or head. Osseous bumps are typically located either in the lateral or in the anterosuperior portion of the femoral head-neck junction. This form of hip impingement is more commonly seen in men aged 20-30 years and is more commonly associated with larger areas of labral avulsion and broader areas of cartilage lesions, which are often greater than 1 cm in width. The osseous bumps that give an appearance of 'pistol grip' deformity lead to a decreased femoral head-neck offset, which is defined by the distance between the widest diameter of the femoral head and the most prominent part of the femoral neck. Focal cartilage delamination called carpet phenomenon, is associated with cam impingement. It is not uncommon for the patients to have a combination of both forms of impingement.

The role of radiograph in femoroacetabular impingement is to evaluate the hip for abnormalities associated with impingement and to exclude arthritis, avascular necrosis, or other joint problems. For the anteroposterior pelvic radiograph, the patient is in the supine position with the legs 15° internally rotated to compensate for femoral antetorsion and to provide better visualization of the contour of the lateral femoral head-neck
The film-focus distance is 1.2 m; the central beam is directed to the midpoint between a line connecting both anterosuperior iliac spines and the superior border of the symphysis.

General acetabular overcoverage is correlated with the radiologic depth of the acetabular fossa. A normal hip appears on an anteroposterior pelvic radiograph with the acetabular fossa line lying laterally to the ilioischial line. A coxa profunda is defined with the floor of the fossa acetabuli touching or overlapping the ilioischial line medially. Protrusio acetabuli occurs when the femoral head is overlapping the ilioischial line medially. Both forms relate to an increased depth of the acetabula. The excessive acetabular coverage can be measured on plain radiograph by the lateral center edge angle (LCEA). LCEA is the angle formed by a vertical line and a line connecting the femoral head center with the lateral edge of the acetabulum. A normal LCEA varies between 25° and 39°. Less than 25° is likely to represent dysplasia and more than 39° likely to represent acetabular over coverage contributing to pincer impingement.

The measurement of cam impingement (femoral head asphericity) can be done by measuring the # angle. # Angle is the angle between the femoral neck axis and a line connecting the head center with the point of beginning of asphericity of the head-neck contour. It can be measured on radiographs. An angle exceeding 50° is an indicator of an abnormally shaped femoral head-neck contour.
Fig. 1: Normal configuration of hip with sufficient joint clearance allows unrestricted range of motion (top). In pincer impingement, excessive acetabular overcoverage leads to early linear contact between femoral head-neck junction and acetabular rim, resulting in labrum degeneration and significant cartilage damage. Posteroinferior portion of joint is damaged (contrecoup) due to subtle subluxations (center). In cam impingement, aspherical portion of femoral head-neck junction is jammed into acetabulum (bottom).

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Fig. 2: Angle # is the angle between the femoral neck axis and a line connecting the head center with the point of beginning asphericity of the head-neck contour. Angle more than 50 degrees is considered abnormal.

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Fig. 3: The lateral center edge angle is the angle formed by a vertical line and a line connecting the femoral head center with the lateral edge of the acetabulum. A normal lateral center edge angle varies between 25° and 39°.
Fig. 4: Bilateral coxa profunda

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Fig. 5: Right sided protrusio acetabuli.

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**Fig. 6:** Right sided cam impingement in a 30 year old woman who presented with right hip pain.

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Fig. 7: Right aided cam impingement in the same woman (fig 6) with progressive osteoarthritic changes.

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Fig. 8: Total hip replacement for progressive osteoarthritis in the same patient (figs 6 & 7) with cam impingement.

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Fig. 9: Right sided pincer impingement with increased lateral centre edge angle.

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**Fig. 10:** Right sided combined cam and pincer impingement with established osteoarthritis of the left hip joint.

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Methods and Materials

This is a retrospective study performed in a teaching hospital looking at young people (18 to 30 years old) with inclusion criterion being non traumatic hip pain referred by general practitioners over a period of 12 months for hip x-rays. The patient demographics, reason for referral, radiograph report were tabulated. The radiographs were revisited and LCEA and # angle were measured. A note was made of coxa profunda and protrusio acetabuli. The results were analysed, compared and conclusion was drawn.
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Fig. 3: The lateral center edge angle is the angle formed by a vertical line and a line connecting the femoral head center with the lateral edge of the acetabulum. A normal lateral center edge angle varies between 25° and 39°
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**Fig. 5:** Right sided protrusio acetabuli.

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Results

Over a period of 12 months, a total of 75 plain hip/pelvis radiographs performed from the above cohort were revisited and reviewed. The age range was 18 to 30 with an average of 24.5 years. 73 x-rays had a radiologist report (Consultant Radiologist 44, Associate Specialist 18, and Trainee Radiologist 11) and all 73 reports had no description of FAI, 4 were reported as dysplasia and 2 were auto reported for clinicians' attention.

Upon reviewing the radiographs with appropriate FAI measurements, there were 17 (22.6%) pincer, 13 (17.3%) cam and 2 (2.6%) combiner pincer/cam type of FAI. Remaining 38 (50.6%) x-rays had no FAI. Acetabular dysplasia noted in 5 (6.6%) x-rays.
Images for this section:

Fig. 11: Chart showing the staff grade reporting the cohort

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Fig. 12: Chart showing the FAI and normal radiographs.

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Conclusion

A significant proportion of radiological signs associated with FAI in young people were not reported on the plain radiograph by general radiologists. While general radiologists cater for majority of plain film reporting, no mention of FAI in 100% of reports suggest a lack of awareness of FAI amongst the general radiologists. It is essential to continually educate all the reporting radiologists and radiographers regarding FAI.

If FAI is picked up early on the plain radiograph, MRI or MR arthrography can then be used to confirm or exclude labral tears, cartilage damage, and other pathologic signs of internal hip derangement if impingement is suspected. FAI can be successfully treated in specific cases without advanced osteoarthritis.
References


