International Journal of Innovative Technologies in Social Science

e-ISSN: 2544-9435

Scholarly Publisher
RS Global Sp. z O.O.
ISNI: 0000 0004 8495 2390

Dolna 17, Warsaw,
Poland 00-773
+48 226 0 227 03
editorial_office@rsglobal.pl

ARTICLE TITLE	DIAGNOSIS OF FEMOROACETABULAR IMPINGEMENT SYNDROME
ARTICLE INFO	Michał Ciołkosz, Tomasz Antczak, Monika Gajda-Bathelt, Monika Dąbek, Katarzyna Jania, Zuzanna Perlicka, Karolina Smolińska, Paulina Sadkowska, Julia Kulczycka, Weronika Popow. (2025) Diagnosis of Femoroacetabular Impingement Syndrome. *International Journal of Innovative Technologies in Social Science*. 3(47). doi: 10.31435/ijitss.3(47).2025.3538
DOI	https://doi.org/10.31435/ijitss.3(47).2025.3538
RECEIVED	29 June 2025
ACCEPTED	09 August 2025
PUBLISHED	13 August 2025
LICENSE	The article is licensed under a **Creative Commons Attribution 4.0 International License.**

DIAGNOSIS OF FEMOROACETABULAR IMPINGEMENT SYNDROME

Michał Ciołkosz *(Corresponding Author, Email: michal.ciolkosz1@gmail.com)*
Czerniakowski Hospital, Stępińska 19/25, 00-739 Warszawa, Poland
ORCID ID: 0009-0008-7330-7069

Tomasz Antczak
Warsaw Medical University, Poland
ORCID ID: 0009-0006-3407-0981

Monika Gajda-Bathelt
Beskid Oncology Center - Municipal Hospital of John Paul II in Bielsko-Biała, Wyzwolenia 18, 43-300 Bielsko-Biała, Poland
ORCID ID: 0009-0006-6231-607X

Monika Dąbek
Mazovia Rehabilitation Center STOCER Włodzimierz Roefler Hospital, Warsztatowa 1, 05-800 Pruszków, Poland
ORCID ID: 0009-0008-4403-556X

Katarzyna Jania
Powiatowe Centrum Zdrowia w Otwocku Sp. z.o.o., Batorego 44, 05-400 Otwock, Poland
ORCID ID: 0009-0004-4399-1016

Zuzanna Perlicka
Beskid Oncology Center - Municipal Hospital of John Paul II in Bielsko-Biała, Wyzwolenia 18, 43-300 Bielsko-Biała, Poland
ORCID ID: 0009-0000-6153-7299

Karolina Smolińska
University Clinical Centre of the Medical University of Warsaw, The Infant Jesus Clinical Hospital, Lindleya 4, 02-005 Warszawa, Poland
ORCID ID: 0009-0001-4115-0297

Paulina Sadkowska
Samodzielny Publiczny Zespół Zakładów Opieki Zdrowotnej w Kozienicach, Aleja Generała Władysława Sikorskiego 10, 26-900 Kozienice, Poland
ORCID ID: 0009-0000-7409-2460

Julia Kulczycka
Mazovia Rehabilitation Center STOCER Włodzimierz Roefler Hospital, Warsztatowa 1, 05-800 Pruszków, Poland
ORCID ID: 0009-0009-9624-8273

Weronika Popow
ORLIK Medical Clinic Sp. z.o.o., Motorowa 6, 04-041 Warszawa, Poland
ORCID ID: 0009-0005-6680-0750

ABSTRACT

Femoroacetabular impingement (FAI) syndrome is a frequent source of hip and groin pain in young and active populations. It arises from abnormal contact between the femoral head–neck junction and the acetabular rim, often due to cam, pincer, or mixed morphologies. Over time, this mechanical conflict can cause labral and cartilage damage, potentially leading to early osteoarthritis. Diagnosis requires a combination of patient history, physical examination, and imaging. While clinical impingement tests offer initial insights, they lack specificity and must be interpreted alongside radiographs and, when necessary, MRI. Parameters such as the alpha angle and acetabular coverage are key radiographic markers, but thresholds remain debated. Intra-articular anesthetic injections can help differentiate joint-related symptoms from other sources. Treatment options include conservative physiotherapy—focused on education, targeted exercise, and activity modification—as well as arthroscopic surgery, which aims to correct bony abnormalities and repair damaged tissue. Although surgical outcomes often show greater symptom improvement in the short and medium term, non-surgical care remains effective for many and avoids procedural risks.

KEYWORDS

Femoroacetabular Impingement Syndrome, Hip Pain, Hip Joint, Diagnosis

CITATION

Michał Ciołkosz, Tomasz Antczak, Monika Gajda-Bathelt, Monika Dąbek, Katarzyna Jania, Zuzanna Perlicka, Karolina Smolińska, Paulina Sadkowska, Julia Kulczycka, Weronika Popow. (2025) Diagnosis of Femoroacetabular Impingement Syndrome. *International Journal of Innovative Technologies in Social Science*. 3(47). doi: 10.31435/ijitss.3(47).2025.3538

Introduction.

Femoroacetabular impingement (FAI) syndrome is a movement-related hip disorder characterized by a triad of symptoms, clinical signs, and imaging findings. The main symptom is motion-related or position-related pain in the hip or groin [1]. In the presence of specific morphologic abnormalities of the hip, pathological contact between the proximal femur and the acetabular rim during terminal hip motion can result in damage to the acetabular labrum and/or adjacent cartilage [2]. This conflicting contact may over time lead to the early development of osteoarthritis (OA) of the hip [3]. FAI can be classified into three morphologic types: cam, pincer, and mixed. Cam-type morphology is characterized by an aspherical femoral head. Pincer-type morphology involves acetabular retroversion and/or excessive acetabular coverage of the femoral head [4]. Mixed-type, which includes features of both cam and pincer morphologies, is more frequently observed than cam or pincer types occurring alone [5]. There are many hip impingement tests used in diagnosis of FAI syndrome including (FADDIR), Flexion-Abduction-External Rotation (FABER) and Hip range of motion (ROM) [1]. To confirm a clinical suspicion of FAI, the minimum recommended imaging consists of an AP pelvic radiograph along with a lateral view of the hip [6]. Treatment options for FAI are generally divided into surgical, typically hip arthroscopy, and non-surgical approaches. The primary non-surgical option is physiotherapist-led conservative care, referred to as Personalized Hip Therapy [7, 8]. This includes patient education (e.g., avoiding impingement-provoking positions during sitting, standing, and sleeping), a physiotherapist-led, individualized, and progressive exercise program focused on muscle control, strengthening, and stretching, as well as pain management with anti-inflammatory medications and simple analgesics when needed [8]. Arthroscopic surgery for FAI syndrome aims to correct structural abnormalities and manage associated labral and cartilage damage, with the goal of alleviating pain and restoring unrestricted, impingement-free hip motion. Both treatment approaches offer benefits to patients; however, those who underwent arthroscopic hip surgery reported more significant symptom improvements at short-term [7, 8] and mid-term [9] follow-ups.

Epidemiology

Accurately determining the true prevalence of FAI syndrome is challenging due to variations in radiologic criteria and differences in study population selection across published research. In a cross-sectional study of 894 athlete patients with chronic hip and groin pain, approximately 40% of hip joint pathologies are related to FAI syndrome, making it the most common cause [10]. In another cross-sectional study of 1,076 patients undergoing surgery for symptomatic FAI at clinical centers in the United States found cam-type deformities in 47.6% of cases, mixed cam and pincer morphology in 44.5%, and isolated pincer morphology in 7.9% [11]. Cam morphology is approximately three times more prevalent in athletes compared to the general population and is more frequently observed in males [12]. Pincer morphology occurs less often among athletes and tends to be more prevalent in women [13].

Symptoms

The most common presenting symptom of FAI syndrome is pain in the hip or groin that is triggered by specific motions or positions [1]. Pain can also be present in lumbar region, gluteal area, or thigh. Adults commonly associate hip discomfort with a feeling of stiffness [4]. In a diagnostic study of patients with symptomatic anterior hip impingement, the majority experienced an insidious onset of pain. Pain severity was reported as moderate, severe, or disabling in 81% of affected hips [14]. Another clinical features that may occur are clicking, catching, locking, restricted range of motion or giving way [1]. The “C sign” refers to a characteristic patient gesture in which the hand is cupped over the hip, spanning from the anterior to the lateral aspect above the greater trochanter, to localize deep-seated hip pain—forming a shape resembling the letter “C” [5]. Over time, the progression of symptoms leads to significant activity limitations, including limping, reduced tolerance for sitting, restricted walking distance, and a requirement for a banister for support when climbing stairs [14]. Hip pain tends to intensify during positions or activities that involve hip flexion and/or internal rotation [4]. These factors may contribute to the development of kinesiophobia in patients with FAI syndrome. Increased levels of kinesiophobia were linked to poorer self-reported physical function, although no significant association was found with hip range of motion [15].

To evaluate symptoms, their impact on patients' lives, and treatment effectiveness, patient-reported outcome questionnaires are a useful tool. The International Hip Outcome Tool (iHOT-33) and the Hip and Groin Outcome Score (HAGOS) are recommended for assessing patients with FAI syndrome [1]. The iHOT-33 is a patient-reported outcome measure designed to assess quality of life in young, active individuals with hip pathology. It encompasses domains such as symptoms and functional limitations, sports and recreational activities, occupation-related issues, and social, emotional, and lifestyle concerns. Lower scores indicate a greater negative impact of the condition on overall quality of life [16]. HAGOS is a self-reported questionnaire designed for physically active patients, young to middle-aged, with persistent hip and groin pain. It evaluates symptom severity, including pain and stiffness, functional ability in daily and athletic activities, engagement in physical activity, and the overall quality of life associated with hip and groin issues [17].

Clinical sings

Physical examination involves assessment of the patient’s gait and single-leg balance. Although palpation of the painful area often provides limited diagnostic value in FAI, it can be useful in identifying alternative pain sources such as the lumbar spine, lateral hip structures, or the pubic symphysis. Evaluating hip range of motion along with a series of provocative maneuvers, known as impingement tests, is an important part of a detailed assessment.

Flexion-Adduction-Internal Rotation (FADDIR)

FADDIR is the most prevalent test [1]. This maneuver is performed with the hip in flexion, adduction, and internal rotation in supine or lateral recumbent position. The test is deemed positive if pain is reproduced [18]. Test is sensitive (80%) but not specific (24%) [19]. The FADDIR maneuver performed at 90° of hip flexion is sometimes termed the anterior impingement test (AIMT) [18].

Flexion-Abduction-External Rotation (FABER)

The assessment is conducted with the patient in the supine position, during which the affected hip is passively brought into flexion, abduction, and external rotation. A positive finding is defined as either a reduction in range of motion compared to the contralateral side or the provocation of pain [18]. The sensitivity and specificity of the test are reported as 54% and 38%, respectively [19].

Passive hip range of motion

Evaluation of passive hip flexion involves the examiner guiding the patient's hip and knee toward the chest, with a normal flexion range approximating 120°. Internal and external rotation are examined in the supine position, with the hip and knee both flexed to 90° [18]. Internal and external rotation can also be evaluated with neutral hip position [19]. Abduction is assessed by moving the limb laterally away from the midline of the body [20]. Hip extension is most accurately evaluated in the lateral recumbent position, where the examiner passively extends the upper leg while maintaining 90° of knee flexion; typical extension values range from 5° to 10° [18]. A positive test is defined as a reduction in range of motion, with or without associated pain [19].

Table 1. The sensitivity and specificity for the hip impingement tests [19]

Hip impingement tests	Sensitivity	Specificity
FADDIR	80%	26%
AIMT	80%	24%
FABER	54%	38%
Passive ROM		
• Flexion	51%	68%
• Internal rotation with 90° hip flexion	56%	63%
• Internal rotation in neutral hip position	29%	94%
• External rotation with 90° hip flexion	37%	79%
• Abduction	46%	79%

Radiographic Diagnosis of Cam Impingement

Anteroposterior (AP) pelvic radiography combined with the Dunn 45° view represents the preferred initial imaging approach for evaluating the femoral head–neck (FHN) junction when FAI is clinically suspected. MRI is typically performed in cases where further diagnostic clarification is required. At present, there is insufficient evidence to recommend routine lumbar spine imaging in the evaluation of suspected FAI [21]. The primary radiographic criterion for identifying cam morphology is an alpha angle exceeding 60° at any point along the anterosuperior aspect of the FHN junction. Additional parameters, such as the head–neck offset and the offset ratio, are utilized less frequently [22].

Alpha Angle

The alpha angle is defined as the angle between the axis of the femoral neck and a line connecting the center of the femoral head to the point where the head–neck contour first becomes aspherical. Various studies have reported differing threshold values for a pathological alpha angle, leading to inconsistencies in diagnostic criteria and limiting the comparability of research findings. Previous studies have commonly used an alpha angle of 55° as the diagnostic cutoff [23]. A threshold of 60° is recommended for the alpha angle, as higher values have been associated with greater clinical relevance [6]. Alpha angles lack sufficient diagnostic specificity to differentiate cam-type FAI from asymptomatic individuals [24]. MRI in a plane parallel to the femoral neck axis is considered the gold standard for alpha angle measurement. CT offers comparable accuracy and reliability. Radiographic measurements show variable performance, though reliability improves with multiple views. Ultrasound demonstrates poor accuracy and low reliability [23]. However, according to a different study, ultrasound demonstrates comparable reliability to plain radiographs for diagnosing cam-type FAI, while eliminating radiation exposure [25]. Although the alpha angle retains a role in the diagnosis and management of FAI, future developments will likely focus on improved three-dimensional standardization, automated analysis, and dynamic assessment of these parameters [23].

Anterior Femoral Offset (FO)

FO refers to the relative width of the femoral neck in comparison to the femoral head [6]. On cross-table axial imaging of the proximal femur, anterior offset is defined as the measured radial difference between the anterior contours of the femoral head and neck [26]. Data on anterior FO remain limited; however, a value less than 8 mm is considered abnormal [22]. The offset ratio represents the anterior FO divided by the diameter of the femoral head [26], with a threshold value of ≤ 0.15 [22].

Radiographic Diagnosis of Pincer Impingement

Pincer morphology may result from acetabular retroversion and/or overcoverage. Imaging features indicative of retroversion includes the crossover sign, posterior wall sign, and ischial spine sign. Overcoverage may be identified by a lateral centre edge angle ≥ 40°, an acetabular index < 0°, or evidence of protrusio acetabuli [22]. An AP pelvic radiograph is the preferred initial modality for evaluating both acetabular version and coverage [6].

Crossover Sign

The crossover sign is defined radiographically by the anterior acetabular rim projecting lateral to the posterior rim at the most proximal aspect of the acetabular opening. As the rim contours extend medially and distally, the anterior line crosses over the posterior line [27].

Posterior Wall Sign

The posterior wall sign is present when the center of the femoral head lies lateral to the contour of the posterior acetabular rim on radiographic imaging [28].

Ischial Spine Sign

The ischial spine sign is considered positive when the ischial spine projects medially beyond the pelvic brim [29]. The sign demonstrates a sensitivity of 90% and a specificity of 71%, even in the presence of suboptimal pelvic tilt or rotation, with specificity 92% when pelvic orientation is neutral [30].

Lateral Centre edge Angle (LCEA)

LCEA is measured as the angle formed between a vertical line passing through the center of the femoral head and a line connecting the femoral head center to the lateral edge of the acetabulum [26,31].

Table 2. Classification of Acetabular Coverage based on the LCEA [31]

LCEA	Acetabular Coverage
<20°	dysplastic
≥20° and ≤25°	borderline dysplastic
>25° and ≤40°	normal
>40°	over-covered

Acetabular Index

The acetabular index is also known as the acetabular roof angle or Tönnis angle. To measure the acetabular index, a horizontal reference line is drawn along the pelvic axis at the medial edge of the sclerotic sourcil. A second line is then extended from this point to the lateral margin of the sourcil, forming the measured angle [32]. Angle values between 0° and 10° are considered normal, while values below 0° indicate decreased acetabular inclination and may suggest FAI syndrome [33].

Other Diagnostic Tools

During the diagnostic process, further evaluation of hip morphology and associated cartilage or labral lesions may be necessary. MRI provides detailed characterization of these structures and can also aid in identifying alternative causes of hip pain, particularly when clinical findings, physical examination, and plain radiographs are inconclusive. Direct MR arthrography is generally considered more effective than non-contrast MRI. However, recent studies indicate that non-contrast 3T MRI offers comparable diagnostic performance to 1.5T direct arthrography [6]. Multiple classification systems for labral lesions have been proposed, but none are supported by outcome-based evidence. Describing the lesion's location, shape, and size may offer clinical relevance. For cartilage defects, it is recommended to describe their extent, location, and morphology [7].

Anesthetic intra-articular injection is used to improve diagnostic assessment by distinguishing intra-articular hip pain from extra-articular sources, such as lumbosacral spine, muscles, tendons, and bursae, which often complicate the clinical picture. Pain relief after the injection supports a diagnosis of FAI syndrome when other diagnostic criteria are fulfilled [34]. A retrospective review of 40 patients showed a 90% accuracy for positive injection responses, which correlated with surgical findings observed during hip arthroscopy [35]. A different study revealed that nearly 25% of patients did not experience pain relief from the injection even though diagnostic imaging showed intra-articular pathology. Consequently, these patients were able to avoid unnecessary surgery and its associated risks [36].

Discussion

FAI syndrome constitutes a notable source of hip and groin discomfort, particularly affecting younger and active populations, particularly athletes. Despite its clinical significance, the diagnostic process is often overlong, delaying appropriate intervention. This review highlights the diagnostic complexities and challenges associated with FAI syndrome. Difficulty may lie in the overlap of symptoms with other intra- and extra-articular pathologies, which can obscure clinical suspicion. Furthermore, there is a lack of universally accepted threshold values for imaging parameters such as the alpha angle and acetabular coverage, complicating interpretation and standardization across clinicians.

A thorough clinical workup for FAI syndrome requires an integrative approach encompassing patient history, physical examination, and targeted imaging studies. Provocative maneuvers such as the FADDIR and FABER tests provide valuable clinical clues but are limited in specificity, necessitating confirmatory imaging. Radiographic evaluation remains central to diagnosis, with parameters like the alpha angle and acetabular coverage serving as key markers of underlying structural abnormalities. When further clarification of intra-articular pathology is required, MRI, offers enhanced visualization of labral and chondral lesions, informing both diagnosis and management strategies. The application of intra-articular anesthetic injections serves as a useful adjunct, aiding differentiation between intra- and extra-articular sources of hip pain. Symptomatic relief following injection supports an intra-articular origin, helping guide therapeutic decisions. The absence of response can spare patients from surgical interventions and their associated risks.

Management of FAI syndrome includes both conservative and surgical options, with each approach offering particular therapeutic value. Conservative care, led by physiotherapists, emphasizes patient education, avoidance of provocative positions, muscle strengthening, and progressive exercise. Such personalized rehabilitation programs have demonstrated efficacy in symptom management for many patients and avoid the risks associated with surgical intervention. Nonetheless, arthroscopic surgery tends to provide more pronounced symptom relief over the short- and medium-term.

Epidemiological findings reveal cam-type deformities to be more prevalent among males and athletic individuals, whereas pincer morphology appears more common in females. Awareness of these patterns can enhance clinical suspicion and guide individualized management. Moreover, the use of validated patient-reported outcome measures like the iHOT-33 and HAGOS facilitates standardized assessment of functional status and treatment impact, which is essential for both clinical practice and research.

In summary, FAI syndrome demands a nuanced diagnostic and therapeutic framework. Careful integration of clinical examination, imaging, and diagnostic injections, combined with tailored treatment strategies can substantially improve patient function, reduce pain, and potentially delay the development of hip osteoarthritis.

Authors' Contributions Statement:
Conceptualization: Michał Ciołkosz
Methodology: Karolina Smolińska, Katarzyna Jania,
Software: Tomasz Antczak, Karolina Smolińska
Check: Weronika Popow, Julia Kulczycka
Formal analysis: Monika Gajda-Bathelt, Katarzyna Jania
Investigation: Monika Dąbek, Paulina Sadkowska
Resources: Weronika Popow, Michał Ciołkosz
Data curation: Monika Dąbek, Zuzanna Perlicka
Writing-rough preparation: Michał Ciołkosz
Writing-review and editing: Michał Ciołkosz, Paulina Sadkowska, Julia Kulczycka
Supervision: Zuzanna Perlicka, Monika Gajda-Bathelt

Project administration: All authors have read and agreed with the published version of the manuscript.
Founding Statement: The study did not receive funding.
Institutional Review Board Statement: Not applicable.
Informed Consent Statement: Not applicable.
Data Availability Statement: Not applicable.
Conflict of Interest Statement: The authors declare no conflicts of interest.
Acknowledgments: Not applicable.

Declaration of the use of generative AI and AI-assisted technologies in the writing process: During the preparation process of this work, the authors used ChatGPT to improve language and readability, text formatting, and fundamental data analysis. After using this tool, the authors reviewed and edited the content as needed, and hence they accept full responsibility for the substantive content of the publication.

Disclosure: Authors do not report any disclosures.

REFERENCES

1. Griffin DR, Dickenson EJ, O'Donnell J, et al. The Warwick Agreement on femoroacetabular impingement syndrome (FAI syndrome): An international consensus statement. *British Journal of Sports Medicine*. 2016;50(19):1169-1176. doi:10.1136/BJSPORTS-2016-096743,
2. Ganz R, Parvizi J, Beck M, Leunig M, Nötzli H, Siebenrock KA. Femoroacetabular Impingement: A Cause for Osteoarthritis of the Hip. *Clinical Orthopaedics and Related Research*. 2003;417(417):112-120. doi:10.1097/01.BLO.0000096804.78689.C2,
3. Agricola R, Heijboer MP, Bierma-Zeinstra SMA, Verhaar JAN, Weinans H, Waarsing JH. Cam impingement causes osteoarthritis of the hip: A nationwide prospective cohort study (CHECK). *Annals of the Rheumatic Diseases*. 2013;72(6):918-923. doi:10.1136/ANNRHEUMDIS-2012-201643,
4. Pun S, Kumar D, Lane NE. Femoroacetabular Impingement. *Arthritis & rheumatology (Hoboken, NJ)*. 2015;67(1):17. doi:10.1002/ART.38887,
5. Trigg SD, Schroeder JD, Hulsopple C. Femoroacetabular Impingement Syndrome. *Current Sports Medicine Reports*. 2020;19(9):360-366. doi:10.1249/JSR.0000000000000748,
6. Mascarenhas V v., Castro MO, Rego PA, et al. The Lisbon Agreement on Femoroacetabular Impingement Imaging—part 1: overview. *European Radiology*. 2020;30(10):5281-5297. doi:10.1007/S00330-020-06822-9,
7. Hunter DJ, Eyles J, Murphy NJ, et al. Multi-centre randomised controlled trial comparing arthroscopic hip surgery to physiotherapist-led care for femoroacetabular impingement (FAI) syndrome on hip cartilage metabolism: the Australian FASHIoN trial. *BMC Musculoskeletal Disorders*. 2021;22(1). doi:10.1186/S12891-021-04576-Z,
8. Griffin DR, Dickenson EJ, Achana F, et al. Arthroscopic hip surgery compared with personalised hip therapy in people over 16 years old with femoroacetabular impingement syndrome: UK FASHIoN RCT. *Health Technology Assessment*. 2022;26(16). doi:10.3310/FXII0508,
9. Palmer A, Fernquest S, Rombach I, et al. Medium-term results of arthroscopic hip surgery compared with physiotherapy and activity modification for the treatment of femoroacetabular impingement syndrome: a multi-centre randomised controlled trial. *British journal of sports medicine*. 2025;59(2):109-117. doi:10.1136/BJSPORTS-2023-107712,
10. Rankin AT, Bleakley CM, Cullen M. Hip joint pathology as a leading cause of groin pain in the sporting population: A 6-year review of 894 cases. *American Journal of Sports Medicine*. 2015;43(7):1698-1703. doi:10.1177/0363546515582031,
11. Clohisy JC, Baca G, Beaulé PE, et al. Descriptive epidemiology of femoroacetabular impingement: A North American Cohort of patients undergoing surgery. *American Journal of Sports Medicine*. 2013;41(6):1348-1356. doi:10.1177/0363546513488861,
12. Frank JM, Harris JD, Erickson BJ, et al. Prevalence of femoroacetabular impingement imaging findings in asymptomatic volunteers: A systematic review. *Arthroscopy - Journal of Arthroscopic and Related Surgery*. 2015;31(6):1199-1204. doi:10.1016/j.arthro.2014.11.042,
13. Gosvig KK, Jacobsen S, Sonne-Holm S, Palm H, Troelsen A. Prevalence of malformations of the hip joint and their relationship to sex, groin pain, and risk of osteoarthritis: A population-based survey. *Journal of Bone and Joint Surgery*. 2010;92(5):1162-1169. doi:10.2106/JBJS.H.01674,
14. Clohisy JC, Knaus ER, Hunt DM, Lesher JM, Harris-Hayes M, Prather H. Clinical Presentation of Patients with Symptomatic Anterior Hip Impingement. *Clinical Orthopaedics and Related Research*. 2009;467(3):638. doi:10.1007/S11999-008-0680-Y,
15. Pazzinatto MF, Rio EK, Crossley KM, et al. The relationship between kinesiophobia and self-reported outcomes and physical function differs between women and men with femoroacetabular impingement syndrome. *Brazilian Journal of Physical Therapy*. 2022;26(2). doi:10.1016/J.BJPT.2022.100396,
16. Mohtadi NGH, Griffin DR, Pedersen ME, et al. The development and validation of a self-administered quality-of-life outcome measure for young, active patients with symptomatic hip disease: The International Hip Outcome Tool (iHOT-33). *Arthroscopy - Journal of Arthroscopic and Related Surgery*. 2012;28(5):595-610.e1. doi:10.1016/J.ARTHRO.2012.03.013,
17. Thorborg K, Hölmich P, Christensen R, Petersen J, Roos EM. The Copenhagen Hip and Groin Outcome Score (HAGOS): development and validation according to the COSMIN checklist. *British Journal of Sports Medicine*. 2011;45(6):478-491. doi:10.1136/BJSM.2010.080937,

18. Wong SE, Cogan CJ, Zhang AL. Physical Examination of the Hip: Assessment of Femoroacetabular Impingement, Labral Pathology, and Microinstability. *Current Reviews in Musculoskeletal Medicine*. 2022;15(2):38. doi:10.1007/S12178-022-09745-8,
19. Pålsson A, Kostogiannis I, Ageberg E. Combining results from hip impingement and range of motion tests can increase diagnostic accuracy in patients with FAI syndrome. *Knee Surgery, Sports Traumatology, Arthroscopy*. 2020;28(10):3382. doi:10.1007/S00167-020-06005-5,
20. Wichman D, Rasio JP, Looney A, Nho SJ. Physical Examination of the Hip. *Sports Health*. 2020;13(2):149. doi:10.1177/1941738120953418,
21. Castro MO, Mascarenhas V v., Afonso PD, et al. The Lisbon Agreement on Femoroacetabular Impingement Imaging—part 3: imaging techniques. *European Radiology*. 2021;31(7):4652-4668. doi:10.1007/S00330-020-07501-5,
22. Mascarenhas V v., Castro MO, Afonso PD, et al. The Lisbon Agreement on femoroacetabular impingement imaging—part 2: general issues, parameters, and reporting. *European Radiology*. 2021;31(7):4634-4651. doi:10.1007/S00330-020-07432-1,
23. Ekhtiari S, Fairhurst O, Mainwaring L, Khanduja V. The Alpha Angle. *The Journal of Bone and Joint Surgery American Volume*. 2024;106(20):1910. doi:10.2106/JBJS.23.01089,
24. Sutter R, Dietrich TJ, Zingg PO, Pfirrmann CWA. How useful is the alpha angle for discriminating between symptomatic patients with cam-type femoroacetabular impingement and asymptomatic volunteers? *Radiology*. 2012;264(2):514-521. doi:10.1148/RADIOL.12112479,
25. Lerch S, Kasperczyk A, Berndt T, Rühmann O. Ultrasound is as reliable as plain radiographs in the diagnosis of cam-type femoroacetabular impingement. *Archives of Orthopaedic and Trauma Surgery*. 2016;136(10):1437-1443. doi:10.1007/S00402-016-2509-6,
26. Tannast M, Siebenrock KA, Anderson SE. Femoroacetabular impingement: Radiographic diagnosis - What the radiologist should know. *American Journal of Roentgenology*. 2007;188(6):1540-1552. doi:10.2214/AJR.06.0921,
27. Reynolds D, Lucas J, Klaue K. Retroversion of the acetabulum. *The Journal of Bone and Joint Surgery British volume*. 1999;81-B(2):281-288. doi:10.1302/0301-620X.81B2.0810281,
28. Bardakos N v., Villar RN. Predictors of progression of osteoarthritis in femoroacetabular impingement: A radiological study with a minimum of ten years follow-up. *Journal of Bone and Joint Surgery - Series B*. 2009;91(2):162-169. doi:10.1302/0301-620X.91B2.21137,
29. El-Hajj G, Abdel-Nour H, Ayoubi R, et al. The Ischial Spine in Developmental Hip Dysplasia: Unraveling the Role of Acetabular Retroversion in Periacetabular Osteotomy. *Advances in Orthopedics*. 2020;2020:1826952. doi:10.1155/2020/1826952,
30. Kakaty DK, Fischer AF, Hosalkar HS, Siebenrock KA, Tannast M. The Ischial Spine Sign: Does Pelvic Tilt and Rotation Matter? *Clinical Orthopaedics and Related Research*. 2009;468(3):769. doi:10.1007/S11999-009-1021-5,
31. Hanson JA, Kapron AL, Swenson KM, Maak TG, Peters CL, Aoki SK. Discrepancies in measuring acetabular coverage: revisiting the anterior and lateral center edge angles. *Journal of Hip Preservation Surgery*. 2015;2(3):280. doi:10.1093/JHPS/HNV041,
32. Welton KL, Jesse MK, Kraeutler MJ, Garabekyan T, Mei-Dan O. The anteroposterior pelvic radiograph: Acetabular and femoral measurements and relation to hip pathologies. *Journal of Bone and Joint Surgery - American Volume*. 2018;100(1):76-85. doi:10.2106/JBJS.17.00500,
33. Clohisy JC, Carlisle JC, Beaulé PE, et al. A Systematic Approach to the Plain Radiographic Evaluation of the Young Adult Hip. *The Journal of Bone and Joint Surgery American volume*. 2008;90(Suppl 4):47. doi:10.2106/JBJS.H.00756,
34. Kivlan BR, Martin RL, Sekiya JK. Response to diagnostic injection in patients with femoroacetabular impingement, labral tears, chondral lesions, and extra-articular pathology. *Arthroscopy - Journal of Arthroscopic and Related Surgery*. 2011;27(5):619-627. doi:10.1016/j.arthro.2010.12.009,
35. Byrd JWT, Jones KS. Diagnostic Accuracy of Clinical Assessment, Magnetic Resonance Imaging, Magnetic Resonance Arthrography, and Intra-Articular Injection in Hip Arthroscopy Patients. *The American Journal of Sports Medicine*. 2004;32(7):1668-1674. doi:10.1177/0363546504266480,
36. Bray EDR, Sherafati M, Cutts CL, Stafford GH. The young adult hip: extra-articular causes of hip pain and how to pick the winners. *Journal of Hip Preservation Surgery*. 2015;2(1):51-55. doi:10.1093/JHPS/HNV012