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Clinical Presentation and Disease Characteristics of Femoroacetabular Impingement Are Sex-Dependent

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Background: Cam-type femoroacetabular impingement (FAI) is generally described as being more common in males, with pincer-type FAI being more common in females. The purpose of this study was to determine the effect of sex on FAI subtype, clinical presentation, radiographic findings, and intraoperative findings in patients with symptomatic FAI.

Methods: We compared cohorts of fifty consecutive male and fifty consecutive female patients who were undergoing surgery for symptomatic FAI. Detailed information regarding clinical presentation, radiographic findings, and intraoperative pathology was recorded prospectively and analyzed. FAI subtype was classified on the basis of clinical diagnosis and radiographic evaluation.

Results: Female patients had significantly greater disability at presentation, as measured with use of the modified Harris hip score (mHHS), the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), the Hip Disability and Osteoarthritis Outcome Score (HOOS), and the SF-12 (12-Item Short Form Health Survey) physical function subscore (all $p \leq 0.02$), despite a significantly lower UCLA (University of California at Los Angeles) activity score ($p = 0.03$). Female patients had greater hip motion (flexion and internal rotation and external rotation in 90° of flexion; all $p \leq 0.003$) and less severe cam-type morphologies (a mean maximum alpha angle of 57.6° compared with 70.8° for males; $p < 0.001$). Males were significantly more likely to have advanced acetabular cartilage lesions (56% of males compared with 24% of females; $p = 0.001$) and larger labral tears with more posterior extension of these abnormalities ($p < 0.02$). Males were more likely than females to have mixed-type FAI and thus a component of pincer-type FAI (combined-type FAI) (62% of males compared with 32% of females; $p = 0.003$).

Conclusions: We found distinct, sex-dependent disease patterns in patients with symptomatic FAI. Females had more profound symptomatology and milder morphologic abnormalities, while males had a higher activity level, larger morphologic abnormalities, more common combined-type FAI morphologies, and more extensive intra-articular disease.

Level of Evidence: Prognostic Level I. See Instructions for Authors for a complete description of levels of evidence.

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Femoroacetabular impingement (FAI) is increasingly recognized as a cause of hip pain in young, active adults[1,2]. FAI results from abnormal, repetitive contact between the femoral head-neck junction and the acetabular rim as a result of abnormal osseous morphology or supraphysiological motion (from participation in activities requiring excessive hip flexion or internal rotation). This can result in damage to the acetabular chondrolabral junction, resulting in labral injury and/or detachment, as well as adjacent articular cartilage damage. The subtypes of FAI can be classified as cam, pincer, or combined (cam and pincer). Cam-type FAI results from deformity of the femoral head-neck junction and results in focal chondrolabral junction damage, including labral detachment and variable components of acetabular rim delamination[3]. Pincer-type FAI

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results from acetabular rim overcoverage as a result of acetabular retroversion, focal anterosuperior overcoverage, or global acetabular overcoverage. Chondrolabral injury in pincer-type FAI can result in labral detachment or ossification from repetitive injury[3]. Acetabular rim damage is generally less destructive with pincer-type FAI, with partial-thickness damage confined to the peripheral acetabular rim.

The sex of a patient has been significantly associated with radiographic differences in FAI deformity, the severity of intra-articular disease, and outcomes[1,2,4-6]. Identifying sex-specific disease patterns is important to improving diagnostic and treatment algorithms. An accurate understanding of differences in FAI disease patterns between males and females may improve sex-dependent diagnostic criteria. Cam-type FAI previously has been described as a problem in young males, while pincer-type FAI has been noted as most common in middle-aged females[1,2,7]. Most authors have described the combined type of FAI as occurring most frequently[1,2,7-9]. The classification of FAI subtype is dependent on both radiographic findings and dynamic intraoperative assessment. Radiographic evaluation is limited by a lack of consensus regarding criteria, which continue to evolve as the radiographic features of FAI are better understood. The authors of several previous studies have reported differences in FAI deformity and intra-articular pathology between males and females[1,2,4-9].

The purpose of this study was to comprehensively characterize the effect of sex on FAI subtype and on clinical, radiographic, and intraoperative findings in consecutive cohorts of male and female patients with symptomatic FAI. Our hypothesis was that significant differences in the clinical presentation of FAI exist between males and females.

Materials and Methods

Cohorts of fifty consecutive male and fifty consecutive female patients who had symptomatic FAI and were undergoing surgical treatment by the senior author (J.C.C.) were prospectively identified. Approval for the study was obtained from our institutional review board. Inclusion criteria included: primary surgical treatment of FAI, failure of conservative treatment, an age of less than fifty years, and a Tönnis osteoarthritis grade of ≤1. Exclusion criteria included: acetabular dysplasia, osteonecrosis, prior hip surgery, posttraumatic hip disorder, and residual pediatric hip disease (slipped capital femoral epiphysis or Legg-Calvé-Perthes disease). For patients who underwent surgery on both hips during the study period, one hip was randomly selected for inclusion. All patients underwent surgery between July 2010 and November 2011. Surgical treatment included hip arthroscopy (89 patients), surgical hip dislocation (10 patients), and anteversion periacetabular osteotomy combined with hip arthroscopy (one patient). All procedures provided visualization for complete intraoperative disease classification.

The senior surgeon (J.C.C.) prospectively recorded detailed clinical findings and intraoperative pathology[10]. Clinical data included age, FAI subtype, body mass index (BMI), duration of symptoms, location of pain, and history of contralateral surgery. The clinical diagnosis and subtype of FAI were determined by the senior author on the basis of preoperative imaging and intraoperative findings. Preoperative imaging included radiographs and magnetic resonance imaging (MRI) as well as, in some cases, computed tomography (CT). MR arthrograms were obtained in all cases but not included in the current study because of the variability in the protocols used between patients. FAI subtype was classified as cam-type, pincer-type, or combined-type (cam and pincer).

Baseline clinical scores were recorded. Measures included the modified Harris hip score (mHHS), the UCLA (University of California at Los Angeles) activity score, the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), the Hip Disability and Osteoarthritis Outcome Score (HOOS)[11], and the SF-12 (12-Item Short Form Health Survey). Higher WOMAC scores indicate more disability, while higher scores of all other outcome instruments indicate better function/less symptoms. A UCLA score of ≥9 was defined as indicating high-level activity (participation in impact sports)[12]. The total WOMAC score (0 to 96) was calculated by summing subscores for pain (0 to 20), stiffness (0 to 8), and physical function (0 to 68). The total HOOS was calculated as the average of five subscores (each 0 to 100): pain, symptoms, activities of daily living, sports, and quality of life. The SF-12 domains of physical and emotional function were also recorded.

Pain location was characterized as anterior groin, lateral hip, posterior hip, or anterior thigh. Detailed measurements of hip motion were performed as previously described[13] by a single examiner (the senior author) and included hip flexion, internal rotation in 90° of flexion (IRF), external rotation in 90° of flexion (ERF), internal rotation with the hip in extension (IRE), and external rotation with the hip in extension (ERE) (performed with the patient supine and with the position of the patella as reference) as well as hip abduction and hip adduction. The end point for motion testing was determined as the point at which the pelvis began to move.

Radiographic analysis included an evaluation of anteroposterior pelvic, frog-leg lateral, 45° Dunn lateral, and false-profile views. All radiographs were made according to previously published standardized techniques[14]. Radiographs were analyzed with use of computer-assisted radiographic-measurement software (HipMorphometry)[15,16] by two of the authors, who were blinded to clinical findings. One reader (J.J.N.) analyzed the anteroposterior pelvic and false-profile radiographs, and the second reader (J.R.R.) analyzed the frog-leg and 45° Dunn lateral radiographs. The radiographic evaluation included measurements of the lateral center-edge angle, the acetabular inclination, the anterior center-edge angle, the neck-shaft angle, the modified proximal femoral angle, the crossover sign (and crossover sign distance), the posterior wall sign (and distance), the prominent ischial spine sign, the alpha angle (frog-leg, Dunn, and anteroposterior pelvic views), and head-neck offset ratio (frog-leg and Dunn views). Parameters of acetabular version (crossover sign, posterior wall sign, and prominent ischial spine sign) were assessed only for radiographs showing appropriate pelvic tilt (a sacrococcygeal distance of 25 to 50 mm for males and 30 to 65 mm for females)[17]. Similarly, classification of the radiographic FAI subtype was assessed only for radiographs showing appropriate pelvic tilt. Appropriate pelvic tilt was present in 68% of males and 64% of females.

Radiographic evidence of cam-type morphology was defined as a maximum alpha angle of >50° or a minimum head-neck offset ratio of ≤0.17 on any view. Radiographic evidence of pincer-type morphology was defined as a positive crossover sign with a crossover sign distance of >10 mm, a lateral center-edge angle of >40°, and/or an acetabular inclination of <0°. Radiographic FAI subtype was additionally classified as isolated cam, isolated pincer, or combined FAI. The interobserver reliability of radiographic analysis of the young adult has been previously reported[18-20], including for the readers in our study (alpha angle, 0.94; head-neck offset ratio, 0.97; crossover sign, 0.86; lateral center-edge angle, 0.99; and anterior center-edge angle, 0.99)[16,21,22].

Intraoperative procedures, including labral debridement, labral repair, femoral head-neck junction osteoplasty, acetabular rim trimming, acetabular microfracture, and psoas tendon lengthening, were recorded. Intraoperative pathology of the acetabular labrum, acetabular cartilage, femoral head cartilage, and ligamentum teres was also recorded. Acetabular chondromalacia was classified as 1 (normal), 2 (malacia), 3 (debonding), 4 (cleavage), or 5 (defect), according to the system of Beck et al.[3]: Labral pathology was also classified according to the system of Beck et al.[3]: 1 (normal), 2 (degeneration), 3 (full-thickness tear), 4 (detachment), or 5 (ossification). The location and the size of lesions were prospectively recorded. The location of acetabular rim chondrolabral pathology was recorded with use of standard clock-face nomenclature (posterior, 9:00; superior, 12:00; and anterior, 3:00 on right and left hip), as were acetabular divisions (posterior, <10:30; superolateral, 10:30 to 1:30; and anterior, >1:30).

TABLE I Preoperative Patient-Reported Outcome and Activity Scores by Sex*

	Female	Male		
Measure	Mean (SD)	Mean (SD)	Mean Difference	P Value
mHHS	54.4 (14.8)	63.7 (16.6)	9.3	0.004
UCLA activity score	6.8 (2.7)	8.1 (2.4)	1.3	0.034
WOMAC	41.2 (21.1)	31.6 (23.2)	9.6	0.020
Pain	9.6 (4.3)	6.2 (3.7)	3.4	<0.001
Stiffness	4.2 (1.7)	2.9 (2.0)	1.3	0.001
Physical function	27.4 (16.1)	22.5 (20.6)	4.9	0.046
HOOS	45.8 (17.4)	55.5 (19.3)	9.7	0.010
Pain	49.3 (19.5)	62.3 (18.0)	13.0	0.001
Symptoms	49.0 (19.1)	61.5 (22.5)	12.5	0.004
Activities of daily living	60.9 (21.6)	71.9 (20.6)	11.0	0.013
Sports	40.5 (24.0)	49.1 (26.1)	8.6	0.087
Quality of life	29.2 (16.9)	32.6 (20.9)	3.4	0.270
SF-12				
Physical function	35.5 (10.7)	41.0 (10.3)	5.5	0.011
Emotional function	54.7 (8.2)	49.3 (11.6)	5.4	0.017

*SD = standard deviation.

Lengths were standardized such that 1 cm was equivalent to one hour on the clock-face.

We performed statistical comparisons of the female and male cohorts with use of the chi-square test or Fisher exact test for categorical variables. The normality of continuous variables was tested with use of the Kolmogorov-Smirnov test and demonstrated lack of normality of the data. The Mann-Whitney U test was utilized for comparisons of continuous variables. P values of <0.05 were considered significant.

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Results

Clinical Findings

The mean age of the female cohort was 31.4 years (range, sixteen to forty-nine years), and the mean age of the male cohort was 28.7 years (range, fourteen to forty-nine years) (p = 0.180). Anterior groin pain was present in 86% of the females compared with 94% of the males (p = 0.182). Pain beyond the anterior groin was significantly more common in females (58% compared with 32%; p = 0.009) and included lateral trochanteric pain (in 19% of females compared with 10% of males; p = 0.047). No significant

TABLE II Hip Range of Motion by Sex*

		Female	Male	
Range-of-Motion Measurement	Mean Difference	Mean (SD)	Mean (SD)	P Value
Flexion	3.2°	97.6° (5.6°)	94.4° (4.5°)	0.003
IRF	9.5°	16.4° (9.4°)	6.9° (8.0°)	<0.001
ERF	12.0°	39.1° (15.3°)	27.1° (12.6°)	<0.001
Total range of motion (IRF + ERF)	21.5°	55.5° (17.6°)	34.0° (15.5°)	<0.001
IRE	4.5°	12.6° (6.6°)	8.1° (7.4°)	<0.001
ERE	5.0°	33.1° (16.3°)	28.1° (9.0°)	0.082
Abduction	1.1°	35.7° (9.1°)	34.6° (8.9°)	0.400
Adduction	1.8°	14.4° (4.7°)	12.6° (5.1°)	0.027

*SD = standard deviation.

TABLE III Summary of Radiographic Findings by Sex*

	Female	Male	P Value
Pincer deformity†	47%	56%	0.464
COS >10 mm	28%	47%	0.113
LCEA >40° and/or AI <0°	25%	21%	0.669
Cam deformity‡	88%	100%	0.027
Alpha angle (max.)	57.6°	70.8°	<0.001
<50°	30%	6%	0.002
50°-60°	36%	22%	
60°-70°	18%	22%	
70°-80°	8%	18%	
80°-90°	8%	24%	
>90°	0%	8%	
Anteroposterior pelvic	49.0°	64.9°	<0.001
Dunn	53.1°	65.3°	<0.001
Frog-leg	45.7°	56.9°	<0.001
Head-neck offset ratio (min.)	0.16	0.14	<0.001
>0.17	22%	4%	0.007
0.14-0.17	56%	48%	
<0.14	22%	48%	

*Values are presented as the percentage of the group or as the mean. †COS = crossover sign, LCEA = lateral center-edge angle, and AI = acetabular inclination. As assessed on radiographs with appropriate pelvic tilt. ‡Maximum alpha angle of >50° or minimum head-neck offset ratio of ≤0.17.

differences in terms of duration of symptoms, BMI, or history of contralateral surgery were present between males and females.

Mean baseline clinical scores of the mHHS, WOMAC, HOOS, and SF-12, which are shown in Table I, indicated significantly more substantial symptomatology and functional limitation in females compared with males. The mean preoperative mHHS was significantly lower for females than for males (54.4 compared with 63.7; p = 0.004). An mHHS of <50 was reported for 38% of females compared with 18% of males (p = 0.095). An mHHS of >70 was reported for 38% of males compared with 12% of females (p = 0.003). A UCLA score of ≥9 was reported for 62.5% of males compared with 36% of females (p = 0.009). Physical function as measured with the SF-12 was significantly greater for males (p = 0.011), whereas emotional function was significantly greater for females (p = 0.017).

On physical examination, females demonstrated significantly greater hip motion in terms of flexion, IRF, ERF, IRE, and adduction (Table II). An IRF measurement of <10° was noted for 66% of males compared with 12% of females (p < 0.001) (88% of males compared with 58% of females had an IRF measurement of <20°; p = 0.002). Thirty-eight percent of males and no females had an IRF of ≤0°. An ERF measurement of >45° was seen in 30% of females compared with 6% of males (p = 0.002).

Radiographic Findings

Radiographic evidence of cam-type morphology (a maximum alpha angle of >50° or a minimum head-neck offset ratio of ≤0.17) was present for all of the males and 88% of the females (p = 0.027). Radiographic evidence of pincer-type morphology (a crossover-sign distance of >10 mm, a lateral center-edge angle of >40°, and/or an acetabular inclination of <0°) was present for a similar proportion of females and males (47% of females compared with 56% of males; p = 0.464) (Table III). The maximum alpha angle was significantly greater in males (mean, 70.8°) than in females (mean, 57.6°) (p < 0.001) (Table III). A maximum alpha angle of >70° was evident in 50% of males compared with 16% of females (p < 0.001). Mean alpha angles were significantly greater for males for the anteroposterior pelvic, Dunn, and frog-leg lateral views (all p < 0.001, Table III). The largest difference between males and females (15.9°) was seen on the anteroposterior pelvic radiograph, with an alpha angle of >50° present on this view for 72% of males compared with 28% of females (p < 0.001). Males had a significantly lower femoral neck-shaft angle and modified proximal femoral angle and were more likely to have a positive posterior wall sign (Table IV). No significant differences were seen in terms of the presence of borderline acetabular dysplasia (a lateral center-edge angle of 20° to 25° or an anterior center-edge angle of 20° to 25°).

Intraoperative Findings

Labral pathology was present in all hips, and the characteristics of labral pathology were similar between male and females (Table V). Labral repair/refixation was performed in 76% of both males and females, and selective labral debridement was performed in the remaining 24%. Among hips with labral

TABLE IV Other Radiographic Findings by Sex*

	Female	Male	P Value
LCEA	28.9°	30°	0.335
ACEA	30.6°	32.1°	0.251
AI	3.5°	4.5°	0.374
Neck-shaft angle	134.1°	131.2°	0.012
MPFA	93.4°	88.2°	0.003
SC vertical distance† *(mm)*	39.8	29.1	0.001
Appropriate pelvic tilt‡	64%	68%	0.216
Posterior wall distance§ *(mm)*	−0.2	−3.3	<0.001
Posterior wall sign (<0 mm)	56%	85%	0.009
Prominent ischial spine sign	47%	50%	0.800

*Values are presented as the mean or as the percentage of the group. LCEA = lateral center-edge angle, ACEA= anterior center-edge angle, AI = acetabular inclination, MPFA = modified proximal femoral angle, and SC = sacrococcygeal joint. †Relative to the superior pubic symphysis. ‡Defined as an SC distance of 30 to 65 mm for females and 25 to 50 mm for males. §Posterior wall medial (−) and lateral (+) to femoral head center.

TABLE V Intraoperative Findings by Sex*

	Female	Male	P Value
Beck Acetabular Cartilage Classification			
1 (normal)	6%	0%	0.242
2 (malacia)	10%	18%	0.249
3 (debonding)	60%	26%	0.001
4 (cleavage)	20%	42%	0.017
5 (defect)	4%	14%	0.160
Advanced acetabular cartilage disease (grade 4-5)	24%	56%	0.001
Size of chondral lesion, any grade *(mm^2)*	208	280	0.014
Posterior extension (to 10:30, grade 4-5)	0%	14%	0.012†
Beck Labral Classification			
1 (normal)	0%	0%	NA
2 (degeneration)	10%	12%	0.741
3 (full-thickness tear)	0%	0%	NA
4 (detachment)	82%	82%	1.0
5 (ossification)	8%	6%	1.0
Detachment length *(mm)*	22.1	28.4	0.013
Posterior extension of detachment (to 10:30)	5%	24%	0.012

*Values are presented as the percentage of the group or as the mean. NA = not applicable. †Fisher exact test.

TABLE VI Summary of Radiographic and Clinical Classification of FAI Subtype by Sex

	Radiographic*		Clinical	
FAI Subtype	Female†	Male	Female	Male
Isolated cam (femoral based)	47%	44%	68%	38%
Combined cam-pincer	41%	56%	32%	62%
Isolated pincer (acetabular based)	6%	0%	0%	0%

*As assessed on radiographs with appropriate pelvic tilt. †6% had no radiographic deformity.

detachment, detachment length was significantly greater for males than for females (mean, 28.4 mm compared with 22.1 mm; p = 0.013). Posterior extension of the labral detachment (to 10:30) was more common in males than in females (24% compared with 5%; p = 0.012).

Acetabular cartilage pathology was noted in all males and in all but three females. Males were more likely than females to have acetabular cartilage cleavage lesions (42% compared with 20%; p = 0.017), while females were more likely than males to have debonding lesions (60% compared with 26%; p = 0.001) (Table V). Females were significantly more likely to have early cartilage changes (malacia or debonding) compared with males (70% compared with 44%; p = 0.009), while males were significantly more likely to have advanced cartilage changes (cleavage or defect) compared with females (56% compared with 24%; p = 0.001). The total area of abnormal cartilage and the posterior extension on the acetabular rim (to 10:30) were greater in males (Table V).

FAI Subtype

The clinical and radiographic diagnosis of FAI subtype by sex is summarized in Table VI. Clinical evidence of isolated cam-type or combined-type FAI was seen among all patients (no cases of isolated pincer-type FAI). A component of pincer-type FAI (combined-type FAI) was present in 32% of females compared with 62% of males (p = 0.003). By radiographic diagnosis alone, all males had a component of cam-type FAI, with 56% also having a component of pincer-type FAI. Among females, 47% had isolated cam-type, 41% combined-type, and 6% isolated pincer-type FAI (6% with normal morphology/“functional” FAI). A component of pincer-type radiographic FAI was present in 56% of males and 41% of females (p = 0.464).

Discussion

The diagnosis of FAI can be challenging because of the diversity of the affected patient population and the wide spectrum of disease patterns encountered. Previous studies have suggested that certain disease patterns may be sex-specific[1,2,4,10,23], yet there is a paucity of comprehensive data comparing FAI disease characteristics in males and females. Understanding differences between the sexes in the presentation of FAI is important for establishing accurate diagnostic algorithms and for treatment decision-making. We demonstrated significant differences between males and females in terms of FAI subtype, clinical presentation, radiographic findings, and intraoperative pathology. The clinician should recognize that female patients with FAI present with significantly more disability, despite generally having less severe deformities and less intra-articular disease. Also, female patients with symptomatic FAI demonstrated milder femoral head-neck offset deformities, with only 34% (compared with 72% of males) having a maximum alpha angle of >60°. Additionally, internal rotation in flexion was greater in females, with only 12% (compared with 66% of males) showing <10°. These data indicate that diagnostic criteria for males and females are different.

Several previous studies have suggested that females with FAI have lower clinical scores than males at presentation[4,23]. Hetsroni et al.[4] reported a lower mHHS for females at presentation (63.8 compared with 72.5 for males). Impellizzeri et al.[23] found that females had a significantly higher WOMAC score (39.4 compared with 25.0), indicating more disability at presentation. In the current study, we demonstrated significant differences between sexes in terms of mHHS (a mean of 54.4 for females compared with 63.7 for males) and WOMAC score (a mean of

41.2 for females compared with 31.6 for males). The magnitude of these differences is greater than the minimal clinically important difference (MCID) previously reported for these scores (HHS, 7 to 9 points; WOMAC, 4 to 5 points/12% of baseline)[24]. Additionally, we found significantly lower levels of activity among females (a mean UCLA score of 6.8 for females compared with 8.1 for males). Significantly lower WOMAC subscores (pain, stiffness, and physical function), higher HOOS subscores (pain, symptoms, and activities of daily living), and higher scores for the SF-12 physical function component were also noted for males.

Recent investigations have suggested a link between athletic activity during adolescence and the development of the cam morphology[25-27]. Several previous studies have suggested that females with FAI have more subtle abnormalities than males[4,8,28-31]. Hetsroni et al.[4] found that females had significantly smaller alpha angles (a mean of 47.8° compared with 63.6°) on reformatted axial oblique CT images. However, isolated measurement of the alpha angle at the anterior head-neck junction on axial images underestimates the cam-type deformity, which is generally maximal at the anterosuperior head-neck junction[15,32-34]. The study also noted significantly greater acetabular and femoral anteversion in females. Similarly, Beaulé et al.[28], analyzing a group of thirty symptomatic patients with FAI, found smaller alpha angles in females (a mean of 58.7° compared with 73.3°). A similar difference in femoral and acetabular anatomy between males and females has been reported in asymptomatic populations[35-39]. In the current study, on the basis of multiple radiographic views, we found a mean maximum alpha angle of 57.6° in females and 70.8° in males. Additionally, the mean minimum head-neck offset ratio was significantly greater for females (0.16) than for males (0.14). Males were significantly more likely to have large cam morphologies. The largest difference (15.9°) between the alpha angle for males and that for females was noted in the lateral extension of the cam lesion visualized on the anteroposterior pelvic view. This indicates that cam deformities in males may extend more lateral/posterolateral and can be less accessible to surgical correction, specifically with arthroscopic techniques.

Previous studies have generally described cam-type FAI to be more common in males and pincer-type FAI more common in females[1,2,7]. The presence of coxa profunda (acetabular fossa touching or medial to the ilioischial line) was previously reported to be indicative of pincer-type FAI, but this association has recently fallen out of favor because of the high prevalence of coxa profunda in asymptomatic patients and hips with acetabular dysplasia[22,40,41]. When considered in isolation as an indicator of pincer-type FAI, coxa profunda results in over-classification of the pincer-type or combined-type FAI subtype. The current study found cam-type morphology to be present in the majority (88% to 100%) of both males and females, on the basis of both radiographic and clinical assessments (Table VI). A component of pincer-type FAI was more common in males than in females by clinical or radiographic diagnosis. This may be due to the exclusion of coxa profunda as a parameter of FAI (or the exclusion of radiographs with abnormal pelvic tilt in radiographic diagnosis). Similar to our findings, Hetsroni et al.[4] found that males were more likely to undergo pincer resection for pincer-type deformity (89% compared with 64%). They also reported smaller alpha angles and increased acetabular and femoral anteversion in females with FAI compared with males. The current study demonstrated significantly higher rates of advanced acetabular cartilage disease (cleavage lesions or defects) and larger labral lesions in males. These findings are consistent with a previous investigation demonstrating more severe intra-articular disease findings in males, independent of the severity of cam lesion measured by the alpha angle[6].

There were several limitations of the current study. The patient population in the study was heavily reliant on the patient population of the practice of the senior author and the clinical diagnosis of FAI. The senior author has substantial experience in the treatment of pre-arthritic hip disease, including FAI, hip dysplasia, and residual pediatric deformities, and we believe that the study cohort was representative of the spectrum of symptomatic FAI patients. Criteria for radiographic diagnosis of cam and pincer morphologies are somewhat controversial, with various recommended diagnostic thresholds. Much of the controversy results from the fact that these deformities are not uncommon in asymptomatic individuals that may never experience hip symptoms. On the other hand, borderline or very mild morphologic abnormalities may be symptomatic due to extreme activity profiles. In addition to presenting data based on threshold values utilized in our study, we also present detailed data on associated continuous variables to allow appropriate interpretation. Finally, while radiographic analysis in our study was thorough, it did not include data on acetabular and femoral version based on three-dimensional imaging, as these studies were not routinely obtained in the study cohort. However, increased acetabular and femoral anteversion has previously been demonstrated in females compared with males[4].

In summary, we demonstrated distinct differences in the overall FAI disease presentation between males and females that may aid clinicians in identifying typical and atypical FAI presentations by sex and in making diagnostic and treatment decisions. Treatment decisions regarding pincer-type morphologies should be based on clear radiographic evidence, as the presence of pincer-type FAI may not follow previously reported patterns by sex. Milder FAI deformities in females should be assessed carefully, as they may still contribute to FAI associated with activities requiring increased amounts of hip flexion and rotation. ■

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