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HIP

Clinical presentation of femoroacetabular impingement

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Abstract The purpose of this study was to identify subjective complaints and objective findings in patients treated for femoroacetabular impingement (FAI). Three hundred and one arthroscopic hip surgeries were performed to treat FAI. The most frequent presenting complaint was pain, with 85% of patients reporting moderate or marked pain. The most common location of pain was the groin (81%). The average modified Harris Hip score was 58.5(range 14–100). The average sports hip outcome score was 44.0 (range 0–100). The anterior impingement test was positive in 99% of the patients. Range of motion was reduced in the injured hip. Patients who had degenerative changes in the hip had a greater reduction in range of motion. The most common symptom reported in patients with FAI was groin pain. Patient showed decreased ability to perform activities of daily living and sports. Significant decreases in hip motion were observed in operative hips compared to non-operative hips.

Keywords Hip arthroscopy · Femoroacetabular impingement · Labral · Symptoms · Groin pain

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Introduction

Early onset of osteoarthritis in the non-dysplastic hip has not been well understood in the past. Recently, femoroacetabular impingement (FAI) has been proposed as a source of soft tissue dysfunction, motion loss, and early osteoarthritis in the hip [3, 7]. The equivocal presentation of FAI constitutes a risk of incorrect diagnoses and even inappropriate surgical interventions. Recognition of FAI is important, as failure to address this underlying pathology may lead to labral re-injury and revision arthroscopy [16].

There are two distinct types of FAI, cam and pincer, which lead to different patterns of labral and/or chondral injury. Cam impingement occurs when an osseous prominence of the proximal femoral neck or decreased head-neck offset causes shearing damage to the acetabular cartilage and labrum. In a report of 251 young males, a ''tilt deformity'', now recognized as a lateral cam-type lesion, was recognized in 24% of highly active athletes [12].

Pincer impingement results from excessive acetabular coverage over the femoral head. Focal anterior over-coverage from acetabular retroversion or global over-coverage from coxa profunda or acetabular protrusio can lead to bony abutment of the rim against the proximal femoral neck. Labral degeneration and tearing, and rim chondrosis may result from this abutment. The prevalence of pincer impingement is unknown and its etiology is not well understood.

The clinical history and physical examination findings in patients with FAI have been presented in a limited number of papers [2, 7, 10, 13–15]. The most commonly reported findings from patient history included groin pain that started after a minor traumatic incident, pain with prolonged sitting and prolonged walking, and pain with athletic activities. On the physical examination, a positive

impingement test [7] (defined as pain with flexion, adduction, and internal rotation) and loss of internal rotation were common.

Although general patterns have been reported, little is known about the history and physical exam findings in patients with FAI. The purpose of this study was to examine a large series of patients treated for FAI to report findings in the history and physical exam. Our hypothesis was that patient treated for FAI would present with similar findings.

Methods

Inclusion criteria

Patients treated for FAI by the senior surgeon between March, 2005 and December, 2006 were included in the study. Patients were excluded from this study if they had a history of previous surgery on the affected hip, incomplete physical exam data, or bilateral hip pathology making comparisons to an unaffected contralateral hip impossible. Pre-operative subjective data, objective data, and radiographic data were prospectively collected. Three hundred and one patients met the criteria and were included in the study. There were 153 males and 148 females. The average age was 39.9 years (range 11–72). The average body mass index was 24 (range 11–56).

Surgical treatment of FAI

All patients underwent osteoplasty for the treatment of FAI. This included either osteoplasty of the femoral neck for cam impingement or a reactive osteophyte, acetabular rim trimming, or both. The technique used has previously been described by Philippon et al. [14, 15].

Subjective examination

All patients completed a subjective questionnaire consisting of the modified Harris hip score [5], the non-arthritic hip score [6], and the hip outcome score [11], Additional questions included pain presence and location, presence of stiffness, weakness, clicking, and ''giving way.'' Sport-specific questions were also included on the forms.

Physical examination

All patients underwent a thorough and systematic physical examination, including range-of-motion and specific tests previously described for diagnosing hip pathology. A goniometer was used to measure flexion, abduction, and adduction in the supine position as well as internal and external rotation in the prone position with the hip in neutral extension. Special tests included the anterior impingement test and FABER test.

Anterior impingement test

To perform the anterior impingement test, the patient is placed supine on the examination table. As previously described by Klaue et al. [9], the examiner passively flexes the hip to 90°, followed by forced adduction and internal rotation (Fig. 1). This position, in which the anterior femoral neck approximates the anterosuperior acetabulum, recreates the impingement that is thought to lead to symptoms in FAI. The presence of hip pain during this manipulation constitutes a positive test. Ganz and colleagues have suggested that this test is nearly always positive in patients with FAI [7].

FABER test

The FABER test has previously been reported to be abnormal in golfers with hip and back pathology [17]. With the patient lying supine, the affected extremity is placed in the figure-four position of flexion, abduction, and external rotation. Gentle downward force is then applied to the

Fig. 1 Impingement test: positive finding of pain with flexion and internal rotation

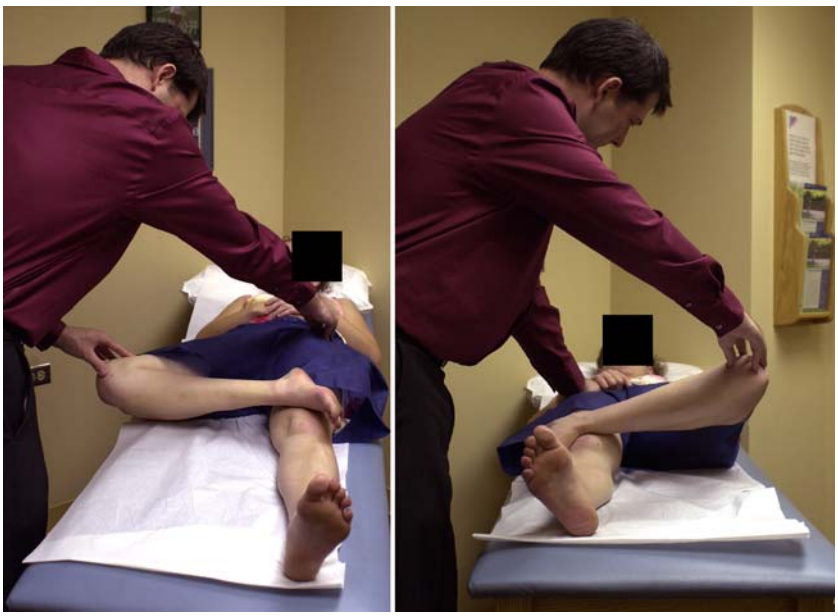

Fig. 2 FABERE's distance: **a** Negative test, **b** Positive test with increased distance measured between the lateral genicular line and the exam table

affected leg while a stabilizing force is applied to the contralateral side of the pelvis (Fig. 2). The vertical distance from the lateral aspect of the knee to the examination table is recorded. A positive test is defined as any loss of distance between the lateral aspect of the knee and the examination table, compared to the unaffected hip.

Radiographic examination

Standard radiographic evaluation consists of both a standard AP plain film of the pelvis as well as a cross-table lateral film of the affected hip [1]. AP films are evaluated for the presence of pincer impingement as well as decreased offset of the superior femoral head-neck junction. Coxa profunda or acetabular protrusion are identified radiographically as overlap of the ilioischial line by either the acetabular floor or the femoral head, respectively. Acetabular retroversion is identified on AP films as an anterior acetabular rim that crosses over the posterior acetabular rim. Attention must be paid to the degree of pelvic tilt when checking for a cross-over sign in order to avoid spurious results. The cross-table lateral view is used to assess the offset of the anterior femoral head-neck junction.

Statistical analysis

Comparison of continuous variable by binary categorical variables was performed using the independent samples *t* test and for multiple (>2) categorical variables was performed using one-way ANOVA. Comparison of two continuous variables was performed using the Pearson correlation coefficient. For comparison of categorical variables the Fisher's exact test for comparisons of proportions was used. Statistical analysis was performed using SPSS (version 11, SPSS Inc., Chicago, IL, USA) software package. All reported *P* values are two-tailed with an alpha level of 0.05 indicating statistical significance.

Results

Operative findings

All patients were treated arthroscopically for FAI. Fifty patients underwent surgical treatment for isolated pincer impingement, 100 patients for isolated cam impingement, and 151 for mixed cam and pincer impingement. The patients with mixed cam and pincer impingement were significantly older than the patients with pincer impingement only (6.2 years difference) and the patients with CAM impingment only (5.6 years difference). Three hundred (99%) patients had associated labral pathology and 249 (82%) had associated chondral pathology. Of the hips with chondral pathology, 117 had chondral lesions that were categorized as either large or diffuse.

Subjective examination

The average time from symptom onset to arthroscopy was 29.6 months (range 0.3–600 months). A traumatic episode leading to the onset of symptoms was reported by 24% of the patients. Insidious onset was reported by 50% of patients. Acute development of symptoms with no history

of a traumatic event was reported by 26% of the patients. Patients who reported onset of symptoms following a traumatic episode were on average 6.5 years younger than those with gradual onset of symptoms ($P = 0.006$). Symptoms developed in relation to sports participation in 60% of the patients.

The most frequent presenting complaint was pain, with 85% of patients reporting moderate or marked pain. The most common location of pain was the groin, with 81% of patients reporting pain there. However, there was significant overlap with other regions; with 61% reporting pain over the greater trochanter, 52% reporting deep posterior buttock pain, and 23% reporting sacroiliac joint pain.

Stiffness that greatly limited activity was reported by 33% of patients. Weakness was reported to greatly limit activity in 34% of patients. Clicking or snapping that was greatly limiting was reported by 25% of patients. Feelings of instability or giving way were reported by 26% of patients. Many patients suffered moderate to severe limitation with activities of daily living (Table 1). Overall hip function was rated as abnormal or severely abnormal in 74% of patients. Heavy work was difficult for 90% of patients, walking for >15 min was difficult for 78%, and getting in and out of a car was difficult for 65%. Sport activities were significantly limited for the majority of patients (Table 2). Ninety-two percent of patients reported moderate difficulty or inability to participate in their sport for as long as they desired. High demand sports such as aerobics, football, basketball, and tennis caused difficulty in 91% of patients. Running was limited in 84% and jogging in 86%. In order to continue their sports, 71% had to modify their technique.

The average modified Harris hip score was 58.5 (range 14–100). The average non-arthritic hip score (NAHS) was 63.3 (range 9–100). The average ADL hip outcome score was 69.6 (range 16–100). The average sports hip outcome score was 44.0 (range 0–100). All scores were normally distributed except for the HOS ADL, which had substantial right skew. In this group of patients, the HOS ADL, HOS Sport, and the NAHS were significantly correlated with age ($P < 0.05$). Body mass index did not correlate with preoperative outcome scores. Neither did time from onset of symptoms.

Physical examination

Average hip flexion on the injured hip was 111 ± 18°. This was 9° (95%CI: 6.7–10) less than the contralateral limb ($P < 0.001$). Mean abduction was 39 ± 13° on the injured hip, 4° (95%CI: 2.9–5.3) less than the unaffected side ($P < 0.001$). Mean adduction was 18 ± 8°, 3° (95%CI: 2.0–3.6) less than the unaffected side ($P < 0.001$). Internal rotation measured in the prone position was an average of 31 ± 14° on the injured hip and was 4° (95%CI: 2.7–5.4) less than the unaffected side ($P < 0.001$). Mean external rotation was 38 ± 11°, 3° [95%CI:2.3 to 4.6] less than the unaffected side ($P < 0.001$). The anterior impingement test as evaluated by the treating physician was positive in 99% of the patients. The physician obtained a positive FABER test in 97% of the patients.

Presence of osteoarthritis, as defined by large or diffuse cartilage lesions had a significant impact upon several variables. Patients with osteoarthritis were, on average,

Table 1 Limitations of activities of daily living

Subjective complaints	Percent reporting moderate difficulty to inability to perform (%)
Heavy work, including push/pulling, climbing, carrying	68
Twisting	61.5
Squatting	60.8
Heavy-duty housework, including lifting firewood and moving furniture	58
Walking for 15 min or more	54.8
Rise from a sitting position	44.8
Walking up steep hills	44.2
Light to moderate work, including standing, walking	34.5
Getting into and out of an average car	33.6
Putting on shoes and socks	29.3
Low-duty housework, including cooking, dusting, vacuuming, and laundry	27
Standing for 15 min	25.6
Sitting for 15 min	25.5
Getting into and out of a bathtub	21
Going down one flight of stairs	20.2
Walking down steep hills	19.9

Table 2 Sporting limitations

Subjective complaints	Percent reporting moderate difficulty to inability to perform (%)
Sport as long as desired	91
Difficulty with high demand sports involving sprinting or cutting, including football, basketball, tennis, aerobics	88
Recreational activity	79
Jogging	78
Running	77.4
Ability to perform sport with normal technique	71.5
Cutting	66
Jumping	64.1
Starting/stopping quickly	56.4
Difficulty with low demand sports, including golfing and bowling	55
Low impact activities like fast walking	53
Landing	50.2
Swinging objects like a golf club	39.6

10 years older (36 vs. 46 years old) ($P = 0.001$) The mean time from symptomatic onset to arthroscopy was 23 months ± 40 in patients without osteoarthritis and 40 months ± 72 in patients with OA ($P = 0.024$). The mean flexion in osteoarthritic patients was 5° less (95%CI: 1–9.5) than that of non-arthritic patients ($P < 0.024$). Abduction was 5.5° [95%CI: 2.5–8.6] less ($P < 0.001$), while adduction did not significantly differ. Internal rotation was 8° [95%CI: 5–11.8] less in patients with arthritis ($P < 0.001$), while external rotation showed only a 3° reduction [95%CI: 0.5–6]. Stratifying the data between groups with and without arthritis showed there was still a significant side-to-side difference for all ROM variables ($P < 0.05$).

Discussion

In this study we found that pain was the most common symptom and patients had difficulties performing activities of daily living and sports. Hip range of motion was decreased and this was worse in the presence of osteoarthritis. Femoroacetabular impingement is beginning to be recognized as a potential cause of hip pain, labral pathology, chondral damage, and eventually osteoarthritis. We feel that it is very important to recognize and address these bony abnormalities during the evaluation and treatment of pain in the hip, as well as pain in other surrounding areas.

Onset of symptoms is most often insidious, as demonstrated by the fact that the development of symptoms was not preceded by a traumatic episode in approximately three-quarters of our patient population. On average, our patients underwent surgery 29.6 months after the onset of symptoms. Many of these patients had significant chondral and labral damage at the time of surgery. Because of the insidious nature of FAI, a high index of suspicion is necessary if intervention is to happen early in the course of disease so that progression of pathology may hopefully be prevented.

Pain was the most frequent complaint in our patients, especially pain in the groin. Complaints of groin pain, pain over the greater trochanter, or buttock pain are extremely nonspecific. The differential diagnoses for these complaints are numerous and certainly not limited to pathology of the hip. Failure to identify FAI as the cause of symptoms may lead to unnecessary tests and even inappropriate interventions. Ganz et al. [7] reported patients with FAI being subjected to unnecessary laparoscopy, laparotomy, knee arthroscopy, lumbar spine decompression, and inguinal hernia repair. In a series of 66 hips with labral tears, Burnett et al. [4] reported inappropriate treatment recommendations that included lumbar discectomy, ovarian cyst laparoscopy, Iliotibial band or trochanteric bursitis procedure, hernia exploration, and psoas or musculotendinous release. Furthermore, four of these patients had undergone surgery that failed to relieve their symptoms. These procedures included one inguinal herniorrhaphy, one psoas release, and two diagnostic laparoscopies. These inappropriate interventions underscore the importance of correctly identifying FAI when it is the cause of pain.

Other complaints included snapping or clicking that was severely limiting in 25% of the patients. Complaints of snapping of the hip are often due to snapping of the iliotibial band across the greater trochanter or snapping of the iliopsoas across the iliopectineal eminence, not intra-articular pathology. Yet it has been proposed that labral tears can also cause hip snapping [18]. While we can only

speculate on the cause of the relatively high number of patients complaining of snapping, the large number of concomitant labral tears may contribute. Similarly, in a series of patients with labral tears, Burnett et al. [4] reported that 53% had complaints of snapping, popping, or locking.

Physical exam findings were alike in almost all of the patients in this series. The anterior impingement test was positive in 99% of patients evaluated by the treating physician. Ganz et al. have similarly reported that this test is almost always positive in patients with FAI(2). Abnormalities on the FABER exam were found in 97% of patients assessed by the treating physician. This loss of motion is felt to be due to apprehension. Intraoperatively, we have not observed any direct mechanical impingement upon FABER testing. Yet, FABER distance has been observed to improve after arthroscopic decompression of FAI. Further research is needed to elucidate the exact cause of this loss of motion and to assess the validity of the FABER exam for FAI.

Differences in range of motion between the affected and unaffected hips were all statistically significant; although perhaps not all can be considered clinically significant. Flexion was the most severely limited in this study, with a 9° side-to-side difference. Differences in other motions were much smaller. At first, these differences may seem clinically irrelevant. However, if the 95% CI's are examined, some differences may appear to be more clinically relevant. This becomes especially apparent when it is considered that the upper ends of some of the CI's may constitute as much as a 20% loss in range of motion. It is surprising that the side-to-side difference for internal rotation was only 5°. In our clinical experience and that reported by other authors, there is a significant reduction of internal rotation with the hip flexed at 90° that is disproportionate to the loss of motion in the other planes in many FAI patients [2, 7, 8, 13]. It is likely that the internal rotation measurements we obtained with the patient in the prone position with the hip in neutral extension are different from those that would have been measured with the hip flexed to 90°. In the flexed position, abutment of anterior cam lesions or anterior acetabular over-coverage may impede internal rotation that may be otherwise unhindered in neutral extension.

This study is limited by the fact that all patients were seen at a major referral center for arthroscopic treatment of hip pathologies. Radiographs of patients' hips are screened before offering them an appointment at this institution. Patients with FAI would not have been seen unless their symptoms were severe enough to prompt them to seek medical evaluation. And patients were not included in this study unless their symptoms were severe enough for them to consent to surgical treatment. So it is likely that patients with FAI presented late in the course of the pathology. Consequently, this study is not capable of making inferences about the frequencies of these findings in other patient populations. All patients seen at this institution are approached with a high index of suspicion of the diagnosis of FAI. Other limitations of this study are its retrospective design and the lack of a control group without FAI.

In conclusion, FAI most commonly presents with pain and functional limitations. Pain was most frequently reported in the anterior groin, followed by the lateral trochanteric area and posterior buttock. Significant limitations in sports and activities of daily living were usually present in patients with FAI. Limitations of hip range of motion, particularly flexion and internal rotation, were common. A positive anterior impingement test was seen almost universally, as was a positive FABER test. Future research is needed to delineate the frequency of these findings in general populations and better define the progression of these findings throughout the history of pathology.

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