REVIEW

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A review of outcomes of the surgical management of femoroacetabular impingement

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ABSTRACT

INTRODUCTION Femoroacetabular impingement (FAI) resulting from abnormal contact between the acetabulum and femur has been studied extensively in recent years owing to its association with acetabular labrum tears and possible contribution to the development of osteoarthritis.

METHODS A comprehensive PubMed, MEDLINE® and Embase™ literature search was conducted. Search terms included 'femoroacetabular impingement', 'pathophysiology', 'diagnosis', 'dGEMRIC', 'arthroscopic', 'open', 'mini-open' and 'outcome measure'.

RESULTS A range of radiographic features have been described, and computed tomography and magnetic resonance imaging are both commonly used in the diagnosis of the bony abnormalities in FAI. Treatment of FAI is surgical with methods of treatment ranging from open surgical hip dislocation to arthroscopic osteochondroplasty.

CONCLUSIONS In recent years, a trend towards the use of arthroscopic treatment for FAI has been seen, with promising results from a range of studies. However, only short-term outcome data are available and a range of different outcome measures have been used in studies to date. We present an overview of the outcomes for a range of surgical treatment methods for FAI and discuss the outcome measures used.

KEYWORDS

Femoroacetabular impingement – Osteoarthritis – Hip arthroscopy – Outcome measure

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Femoroacetabular impingement (FAI) is a pathomechanical syndrome resulting from any abnormal contact between the acetabulum and the femoral head. In recent years, FAI has been studied more extensively owing to the emergence of evidence that it is a major cause of acetabular labral tears[1] and it is now recognised as a significant contributing factor in the aetiology of osteoarthritis (OA) affecting the hip joint.[2–4] As a result, there have been an increasing number of clinical studies examining the surgical management of FAI. This review provides a summary of the aetiology, pathology and clinical features of FAI, and discusses the outcomes of the various techniques that have been developed to treat it.

Methods

A comprehensive PubMed, MEDLINE® and Embase™ literature search was conducted online. Search terms used included 'femoroacetabular impingement', 'pathophysiology', 'diagnosis', 'dGEMRIC', 'arthroscopic', 'open', 'mini-open' and 'outcome measure'. All articles in English were given consideration. Articles with only limited relevance to the subject were subsequently disregarded. Those articles of clear relevance to this review concerning the aetiology, pathophysiology, clinical features and surgical management of FAI were included.

Results

FAI is divided into two distinct pathomechanical types: cam and pincer FAI. Both types may be seen (alone or in combination) in patients presenting with the clinical features of FAI.

Cam impingement refers to abnormal contact between the rim of the acetabulum and the femoral head or head–neck junction due to a dysmorphic shape of the femoral head. In the normal femur, the anterior head–neck junction is concave, allowing free rotation of the femoral head in the acetabulum. In cam FAI, the head–neck junction is convex, with the resulting osseous prominence at the head–neck junction therefore creating an effective reduction in head–neck offset.[5,6] During hip flexion, the prominent head–neck junction makes abnormal contact with the anterior rim of the acetabulum, producing shear forces on the articular cartilage during active movements, in extremes of flexion in particular.[2] In turn, this leads to chondral damage in the form of abrasion, delamination or both, seen principally in the anterosuperior aspect of the acetabulum.[3,5]

Common in middle aged athletic women, pincer impingement is due to a relative retroversion of the acetabulum. This may either be as a result of insufficiency of the posterior acetabular rim or anterior overcoverage of the femoral

head. Alternatively, it may be due to a generalised deepening of the acetabulum (ie protrusio).[4] Retroversion of the acetabulum may be seen on anteroposterior radiography as a 'crossover' sign, where the margin of the anterior acetabular rim crosses that of the posterior acetabular rim.[7]

During hip flexion, pincer FAI produces damage to the acetabular labrum, along with bony degeneration of the acetabular rim, as the femoral neck is raised and makes abnormal contact with an abnormally positioned acetabular rim and labrum. Reciprocal damage to the anterior femoral neck occurs, at the site of repeated contact. Furthermore, there may be evidence of damage to the posterior acetabulum due to posterior displacement of the femoral head within the acetabulum at the time of impingement.[8,9]

A number of aetiologies are recognised in the formation of the anatomical abnormalities responsible for FAI. Slipped upper femoral epiphysis (SUFE) has been known for some time to predispose to cam FAI as a result of alterations in the shape of the femoral head following epiphyseal movement.[10–12] Prior treatment of developmental dysplasia of the hip (DDH) has also been noted in adolescent patients with FAI, suggesting DDH as a further developmental cause, most likely due to acetabular retroversion.[13] Moreover, acetabular retroversion has been shown in approximately a sixth of patients with DDH.[14] In addition, Legg–Calvé–Perthes disease has also been implicated as a cause of FAI owing to the alteration in femoral morphology as the disease progresses.[15] Malunion following femoral neck fracture and septic arthritis of the hip have also been suggested as causative factors.[16,17]

Clinically, FAI typically presents in young adulthood with pain and stiffness. Pain is usually felt in the groin, with gradual onset, and may be precipitated by an initiating traumatic event, often minor.[18,19] Groin pain is the presenting feature of FAI in 83% of patients, with 65% describing a slow and insidious clinical course, and 35% describing rapid onset after a particular initiating event.[19] Although pain is most frequently felt in the groin, pain commonly radiates elsewhere and may be felt exclusively in the gluteal, sacroiliac or trochanteric areas.

Examination reveals pain and stiffness of motion at the extremes of flexion and internal rotation. Performing the impingement test, in which the hip is flexed and adducted to produce abutment of the femoral neck on the acetabular rim, with subsequent internal rotation to apply shearing forces to the labrum and acetabular chondral surfaces, will often produce pain in the presence of a labral lesion or chondral delamination.[1,20] The flexion, abduction and external rotation test is also commonly positive. Patients may cup their hand around the groin and trochanteric region displaying the 'C' sign relating to the site of the pain. In addition to pain, patients complain frequently of stiffness being a limit to activity. The restriction of internal rotation worsens with increasing flexion and adduction, and an improvement in hip motion has been demonstrated after arthroscopic osteoplasty.[21]

Radiographic studies of the hips are often used in conjunction with history and clinical examination in the initial diagnosis of FAI.[22] On anteroposterior radiography, cam impingement can be observed as asphericity of the femoral head and a decreased femoral head–neck offset.[22–24] In the past, this deformity has been referred to as a 'pistol grip deformity' and has long been associated with a predisposition to OA of the hip.[15] Commonly described radiological indices include the head–neck offset,[22] alpha angle[25] and triangular index.[26]

Characterised by acetabular retroversion, pincer FAI may be evident on anteroposterior radiography in the presence of a crossover sign. The crossover sign was described originally by Reynolds *et al*.[7] It refers to the lateral margin of the anterior acetabular rim appearing lateral to the equivalent point on the posterior rim, at the most proximal part of the acetabulum, in addition to the appearance of these two lines crossing one another as they progress medially and caudally. Furthermore, a 'posterior wall' sign may be present where the line corresponding to the lateral margin of the posterior rim of the acetabulum is seen to cross the femoral head medially to its centre point.[7] (In the normal, anteverted acetabulum this line crosses at or lateral to the midpoint.)

Despite characteristic appearances, the reliability of conventional radiography in the diagnosis of FAI has been questioned. Clohisy *et al* demonstrated that there was only moderate interobserver agreement for the diagnostic ability of conventional radiography for hip disorders.[27]

A number of studies have evaluated the use of computed tomography (CT) in assessing the morphological abnormalities in FAI.[28–30] Whereas previously, conventional two-dimensional CT provided only limited information on subtle abnormalities at the head–neck junction, recent advances in (and the more widespread use of) three-dimensional CT for imaging the proximal femur has allowed more detailed characterisation of acetabular and femoral head–neck morphology.

Magnetic resonance imaging is used widely for the detection of cartilage changes and labral tears, and magnetic resonance arthrography has become the gold standard for diagnosis as cam lesions and associated pathology are seen well.[31–33] The role of delayed gadolinium enhanced magnetic resonance imaging of cartilage has been studied increasingly in the last few years, with several authors demonstrating chondral damage in early FAI and other hip morphological abnormalities, with the extent of damage correlating to the magnitude of the abnormality.[34–36] The principle features of the pathology, presentation and diagnosis are summarised in Table 1.

Open surgical treatment

Although the concept of FAI is relatively new, as long ago as in 1936 Smith-Petersen described open procedures such as acetabular trimming and proximal femoral osteotomy for the correction of deformities associated with acetabular protrusio, previous SUFE and coxa plana.[37] Coinciding with the recognition of FAI as a pathological entity, in the late 1990s Ganz *et al* reported the use of surgical dislocation of the hip, with a transtrochanteric approach and direct debridement of the proximal femur and acetabulum, for the treatment of FAI.[38] Using this open method, giving full visualisation of the acetabulum and labrum, various

Table 1 Summary of the features of femoroacetabular impingement

Pathology

> Pathomechanical disorder of the young adult hip
> Results from abnormal abutment of acetabular rim and femoral head neck junction
> Two distinct anatomical causes include femoral head asphericity (cam type) and acetabular overcoverage of femur (pincer type)
> Leads to labral injury, chondral delamination and progression towards osteoarthritis of hip joint

Clinical features

> Presents with groin, thigh or gluteal pain
> More common in athletic individuals, symptomatic after exercise, worse with rotatory and cutting movements of the hip
> Stiffness, impingement signs, FABER test positive and 'C' sign are common at presentation

Diagnosis

> Radiographic signs include cam lesions, acetabular retroversion ('crossover' sign), protrusio and head–neck junction abnormalities
> Three-dimensional computed tomography demonstrates cam lesions and pitting of head–neck junction
> Magnetic resonance arthrography demonstrates chondral delamination, labral damage, site and size of cam lesions
> dGEMRIC accurately visualises pattern and extent of joint damage

Treatment

> Open, arthroscopic and combined treatment options have been explored
> Promising clinical outcomes from several studies

FABER = flexion, abduction and external rotation; dGEMRIC = delayed gadolinium enhanced magnetic resonance imaging of cartilage

studies have assessed its use in the management of FAI with successful results (Table 2).[8,39–43]

Beaulé *et al* treated 37 hips in 34 cam FAI patients with open dislocation and osteochondroplasty of the femoral neck.[39] Using the WOMAC® (Western Ontario and McMaster Universities) score, functional outcome scores increased from 61.2 points preoperatively to 81.4 points postoperatively, at a mean of 3.1 years of follow-up ($p<0.001$). Activity and psychological impact of treatment was assessed using the University of California at Los Angeles (UCLA) activity score and the mental component of the 12-item Short Form questionnaire (SF-12®) respectively. The authors reported an increase in the UCLA score from 4.8 to 7.5 points ($p<0.001$) and an increase in the SF-12® mental component score from 46.4 to 51.2 ($p=0.031$). However, despite favourable functional results, they reported a number of complications with this approach. Trochanteric non-union was seen in 3% of patients, trochanteric bursitis necessitating screw removal in 26%, and patient dissatisfaction with the procedure in 18%.

Murphy *et al* reported a series of 23 hips in 23 patients treated with surgical dislocation and debridement, with a follow-up period ranging from 2 to 12 years.[40] No outcome measure was used in this study but 15 patients required no further intervention while 7 required conversion to total hip arthroplasty (THA) and 1 patient underwent arthroscopic labral debridement of a recurrent tear.

In cases associated with labral tears, refixation of the labrum may be associated with a more favourable functional outcome. In a retrospective case analysis by Espinosa *et al*, the authors demonstrated reduced evidence of progression of degenerative disease at follow-up visits in patients undergoing labral refixation at the time of open osteoplasty.[41] In this comparative study, 60 hips in 52 patients underwent open arthrotomy, dislocation and debridement with either labral resection (25 hips; group 1) or labral refixation

Table 2 Outcomes of open treatment of femoroacetabular impingement

Study	Number of patients	FAI type	Mean follow-up duration	Improvement in outcomes
Siebenrock, 2003[8]	26 hips	Combined	2.5 years	Merle d'Aubigné: 14.0 to 16.9, $p<0.001$; 26/29 good or excellent
Beaulé, 2007[39]	34 (37 hips)	Cam	3.1 years	WOMAC®: 61.2 to 81.4, $p<0.001$ UCLA: 4.8 to 7.5, $p<0.001$ SF-12® (M): 46.4 to 51.2, $p=0.031$
Murphy, 2004[40]	23 (23 hips)	Cam	5.2 years	Merle d'Aubigné: 13.2 to 16.9, $p<0.0001$
Espinosa, 2006[41]	52 (60 hips)	Cam and pincer	2 years	Merle d'Aubigné: 12 to 15 (labrum left) or 17 (labrum fixed), $p<0.001$ both groups
Beck, 2004[42]	19	Cam	4.7 years	Merle d'Aubigné: 13/19 good to excellent
Peters, 2006[43]	29 patients (30 hips)	Cam (14), pincer (1), combined (15)	2 years (minimum)	HHS: 70 to 87, $p<0.001$

FAI = femoroacetabular impingement; WOMAC® = Western Ontario and McMaster Universities; UCLA = University of California at Los Angeles; SF-12® (M) = Short Form 12 mental component; HHS = Harris hip score

(35 hips; group 2). The follow-up duration was 2 years, with clinical and radiographic evaluation at 12 and 24 months using Merle d'Aubigné scores and the Tönnis classification for degenerative changes.

At 12 months, both groups showed a significant improvement in clinical outcome (p=0.0003 and p<0.0001 in groups 1 and 2 respectively).[41] At 24 months, 28% of hips in the labral resection group had an excellent result, 48% a good result, 20% a moderate result and 4% a poor result. By contrast, results for the group with labral refixation were more favourable, with 80% demonstrating an excellent result, 14% a good result and 6% a moderate result. Radiographic evidence showed that degenerative changes were significantly more prevalent and advanced in the resection than in the refixation group at one year (p=0.02) and at two years (p=0.009).

Beck *et al* treated 19 cam FAI patients with open dislocation and osteoplasty, following patients up for a mean of 4.7 years.[42] Using Merle d'Aubigné scores, 13/19 patients were rated excellent or good at the final follow-up appointment, with a pain score improvement from 2.9 to 5.1 points. Five patients with OA subsequently required THA. The authors recommended open treatment of FAI in patients without degenerative changes. Peters and Erickson used a similar approach in their study of 30 patients with cam (14 hips), pincer (1 hip) and combined FAI (15 hips), using open dislocation with trochanteric osteotomy and osteochondroplasty.[43] The mean Harris hip score (HHS) improved from 70 preoperatively to 87 at the final follow-up visit (p<0.0001). Follow-up duration was for a minimum of two years. Eight patients displayed progressive degenerative changes to the articular surface, with four eventually requiring THA.

Other open techniques have been used in patients with isolated pincer impingement requiring surgical dislocation for full exposure. In a study of 29 hips in 22 patients with acetabular retroversion, Siebenrock *et al* performed an open periacetabular osteotomy in order to treat the causative lesion.[8] An additional arthrotomy was performed in 26 hips to visualise and treat intra-articular lesions. The mean length of follow-up was 30 months (range: 24-49 months). Using Merle d'Aubigné scores, the authors demonstrated a functional improvement with an increase from 14.0 points preoperatively to 16.9 points postoperatively (p<0.001). Good or excellent results were seen in 26/29 hips. Range of motion improved significantly with internal rotation increasing by 10°, flexion by 7° and adduction by 8°. Radiographically, there was an improvement at the final follow-up appointment in anterior centre–edge angle from a preoperative mean of 36° to a postoperative mean of 28° (p=0.002).

Open surgical management of FAI may be associated with a significant improvement in early functional outcome (Table 1). However, various complications have been reported with this approach such as trochanteric non-union,[39] trochanteric bursitis necessitating screw removal,[39] patient dissatisfaction[39] and recurrent tear[40] as well as progression of degenerative disease and subsequent conversion to THA.[40,42] As a result, many surgeons have moved to less invasive methods of treatment.

Combined open and arthroscopic management

A combined management approach has been advocated by some authors, with promising functional and clinical results (Table 3).[44–46] In these cases, a mini-open anterior approach to the hip is combined with arthroscopic assistance. Proposed advantages have been a low complication rate and the ability to provide direct visualisation of the femoral head–neck junction, without the need for surgical dislocation.[44] However, some authors have noted complications such as injury to the lateral femoral cutaneous nerve and transient femoral nerve palsy.[46] Additionally, following improvements in technical ability with arthroscopic instruments, some surgeons using the combined approach have subsequently progressed to a full arthroscopic technique.[44]

Laude *et al* reported a retrospective series of 100 hips in 97 patients in which they used a mini-open method of access to the labrum with arthroscopic assistance.[44] Patients were followed up for a mean period of 28 months and assessed for functional outcome using the non-arthritic hip score (NAHS). At the most recent follow-up visit, the authors reported a mean increase in NAHS of 29.1 points (from 54.8 preoperatively to 83.9).

Lincoln *et al* conducted a similar retrospective review of a combined approach in their series of 16 hips in 14 patients, followed up for a minimum of 2 years.[45] They reported an increase in mean HHS from 63.8 to 76.1 (p=0.01). Significant improvements in alpha angle and head–neck offset, with no significant radiographic deterioration, were reported.

More recently, Hartmann and Günther reported a retrospective analysis of 33 patients, demonstrating a mean HHS improvement from a preoperative value of 64 to 85 (p<0.001) at 15 months.[46] Patient satisfaction using a visual analogue scale assessed patient response, with a mean postoperative satisfaction score of 7/10 (range: 2–10).

Table 3 Outcomes of combined arthroscopic and open treatment of femoroacetabular impingement

Study	Number of patients	FAI type	Mean follow-up duration	Outcomes
Laude, 2009[44]	97 (100 hips)	Combined	2.3 years	NAHS: 54.8 to 83.9, p<0.01
Lincoln, 2009[45]	33	Combined	2.0 years	HHS: 63.8 to 76.1, p<0.01
Hartmann, 2009[46]	33	Combined	1.3 years	VAS; HHS: 64 to 85, p<0.001

FAI = femoroacetabular impingement; NAHS = non-arthritic hip score; HHS = Harris hip score; VAS = visual analogue scale

Arthroscopic management

Arthroscopic treatment of FAI is gaining popularity. A range of studies have shown promising results in both cam and pincer FAI.[47–58] Only a limited number, however, have produced robust prospective data demonstrating a significant improvement in surgical outcome at two or more years (Table 4). Improvements in pain scores and range of movement postoperatively have also been demonstrated by several authors. Furthermore, various factors associated with improved outcome after arthroscopic management have been identified such as lower HHS preoperatively,[47] joint space narrowing of 2mm or more[47] and labral repair rather than debridement.[47,50,58]

Philippon *et al* studied 112 patients prospectively, with a mean follow-up duration of 2.3 years (range: 2.0–2.9 years).[47] Of the 112 patients, 23 underwent osteoplasty for isolated cam lesions, 3 underwent acetabular trimming for isolated pincer FAI, and the remaining 89 cases had mixed cam and pincer FAI. They reported significant improvements in mean HHS from 58 to 84, with a median patient satisfaction score of 9/10. Similarly promising results were reported at 2 years by Byrd and Jones in a prospective analysis of 207 hips in 200 patients with cam (163 hips) or combined cam-pincer (44 hips) FAI.[48] The authors used a modified version of the HHS, which included pain and function sections only. The mean HHS improved by 20 points, with 83% of patients demonstrating improvement. Of those patients followed up for 2 years, all HHS scores were maintained from the 12-month values.

In one of the few prospective comparative studies of treatment modalities, Domb *et al* observed outcomes at 2 years in 10 patients undergoing surgical dislocation compared with 20 patients treated arthroscopically.[49] Both groups improved significantly postoperatively and better results were seen in the arthroscopic group than in the dislocation group. However, this study was not powered sufficiently to provide a robust answer as to which is the better treatment method.

These results are similar to those of a retrospective comparative study by Larson and Giveans, who reviewed 75 hips with pincer or combined cam and pincer FAI with associated labral defects treated by either arthroscopic debridement

Table 4 Outcomes of arthroscopic treatment of femoroacetabular impingement

Study	Number of patients	FAI type	Mean follow-up duration	Outcomes
Philippon, 2009[47]	112	Cam (23), pincer (3), combined (89)	2.3 years	HHS: 23 to 84, $p<0.001$
Byrd, 2009[48]	200 (207 hips)	Cam (163), combined (44)	1.3 years	Modified HHS: 83% showed significantly improved outcome at 2 years
Domb, 2013[49]	20 (arthroscopic) vs 10 (open treatment)	Cam or combined	2 years	HOS and NAHS significantly improved at 2 years
Larson, 2009[50]	75	Labral debridement (36), repair (39)	1 year	Labral repair group showed improved radiological outcome and HHS good or excellent in 89.7% vs 66.7%
Sampson, 2005[51]	183 (194 hips)	Combined	2.5 years (maximum)	94% pain free on flexion and rotation at 2.5 years
Ilizaliturri, 2007[52]	13	Combined	2.5 years	WOMAC®: 4 to 14, $p<0.01$
Ilizaliturri, 2008[53]	19	Cam	2 years	82% pain free at 2 years
Philippon, 2008[54]	16	Cam (2), pincer (5), combined (6)	1.4 years	HHS; HOS; significantly improved clinical outcomes for all patients
Bardakos, 2008[55]	24	Cam	1 year	HHS: good or excellent in 83% compared with 60% in control group
Stähelin, 2008[56]	22	Cam	0.5 years	VAS; NAHS; significantly improved outcomes in all patients at 6 months
Schilders, 2011[57]	96 (101 hips)	Combined	2.44 years (median)	Improved HHS; greater effect with labral refixation
Larson, 2012[58]	94 hips (50 with labral refixation, 44 without)	Pincer or combined	3.5 years	Improved HHS, SF-12® and VAS for both groups, significantly greater improvement with labral refixation

FAI = femoroacetabular impingement; HHS = Harris hip score; HOS = hip outcome score; NAHS = non-arthritic hip score; WOMAC® = Western Ontario and McMaster Universities; VAS = visual analogue scale; SF-12® = Short Form 12

(36 hips) or repair (39 hips).[50] They demonstrated a better clinical and radiological outcome in the labral repair group with a superior mean HHS (p=0.029) and good to excellent results in 89.7% of patients undergoing labral refixation compared with 66.7% of patients having labral debridement (p<0.01) at the 12-month follow-up visit. Various other retrospective studies have also shown promising data (Table 4)[51,53–56] but many are small case series and a range of different outcome measures have been used, making data interpretation difficult.

Arthroscopy has also been shown to be both safe and effective in treating FAI secondary to paediatric hip disorders. In a study of 13 adult patients undergoing arthroscopic osteoplasty for FAI secondary to previous paediatric hip disorders (eg SUFE), Ilizaliturri *et al* demonstrated significant improvements in functional scores using the WOMAC® index, from a mean of 4 to 14 at the final follow-up appointment at 2.5 years.[52]

There remains debate as to whether labral refixation or simple debridement/excision improves outcome in arthroscopic treatment for FAI. In a cohort study of 94 hips, Larson *et al* reported that labral refixation in 50 of the hips resulted in significantly improved HHS, SF-12® and visual analogue scale scores compared with the 44 hips undergoing labral debridement alone.[58] It should be noted that both groups demonstrated significantly improved outcomes compared with pretreatment scores at a mean of 3.5 years. These results are echoed by Schilders *et al*, who reported improved outcomes for labral refixation compared with debridement/resection in a retrospective comparative study of 96 patients (101 hips).[54] Further prospective work is required with randomisation of labral fixation to elucidate more reliably the benefits of this aspect of treatment.

It is worth noting that only a small number of studies are prospective in their design.[47–49] Most other studies relating to both open and arthroscopic treatment outcomes are small retrospective case series, which do not provide data that are as reliable as the larger prospective studies. In addition, there are so far no comparative data either by prospective comparative case series or randomised controlled trials examining the relative efficacy of the different treatment modalities.

The data presented above appear to demonstrate a trend towards arthroscopic treatment or combined approaches, with promising functional and clinical outcomes, particularly in the larger prospective case series reported by Philippon *et al*[47] and Byrd and Jones.[48] However, more work is needed in the form of a prospective, randomised, multicentre trial with standardised outcome measures and a follow-up period of five years or more. This approach will be more likely to enable clinicians to ascertain which is the more efficacious treatment option with the more favourable complication rate. In addition, we may be a step closer to establishing if any method of treatment is of benefit in altering the natural history of FAI and either delaying or preventing the onset of OA.

The results of arthroscopic treatment of FAI are promising but owing to the relatively short follow-up times in the literature presently, an alteration in the natural progression to OA and sustained relief of pain remains to be seen. Furthermore, the association between the degree of correction of femoral morphology and functional outcome has yet to be demonstrated.

Discussion

Despite significant advances in our understanding of the pathophysiology of FAI, and the development of open and arthroscopic treatment modalities, further advances seem necessary for diagnosis, treatment and postoperative follow-up of these patients. Imaging modalities must be improved for more accurate diagnosis and follow-up of soft tissue (labral and chondral) and bony pathology.

As surgical technique improves in both arthroscopic and combined approaches, and more long-term data become available, reliable measures of treatment outcomes are likely to be required, to aid surgeons in decision making about the appropriate mode of treatment. Despite the increasing numbers of studies evaluating the open, arthroscopic and combined treatment of FAI, the data remain inconclusive as to the optimum method. As FAI remains a relatively new concept, the vast majority of case series have limited follow-up times, with very few reporting data beyond two years. Furthermore, few prospective data are available.

There has been a recent trend towards arthroscopic management of FAI, particularly for symptomatic cam lesions, with positive results from a number of studies. Nevertheless, a wide range of outcome measures have been used and numbers in the majority of series are small.

The use of some functional outcome scores designed primarily for the evaluation of older patients with degenerative hips is likely to be of limited value. The Merle d'Aubigné score and HHS in particular were designed for arthritic hips, and have traditionally been used for the evaluation of outcome following hip arthroplasty. They do not, however, allow for smaller variations in functional abilities seen in younger individuals with activity reduction attributed to FAI.[59]

A number of studies have addressed this issue and provided evidence for the validity of other functional outcome measures for the hip in patients with FAI. In particular, the NAHS[59] and WOMAC® score[60] have been shown to produce valid functional results. There has also been recent evidence that the hip outcome score is valid and reliable in younger patients undergoing hip arthroscopy.[61–63] In this younger, more physically demanding group of patients, it is likely that these outcome measures provide the more robust data.

In the coming years, it is likely that a range of studies are to be produced with treatment outcomes at five or more years of follow-up. A consensus should therefore be reached on a standardised outcome measure for patients receiving surgical treatment of FAI. This will help to ensure that more robust, comparable data are available, allowing clinicians to better evaluate the efficacy of treatment in the medium to long term.

Conclusions

Although still a relatively recently established phenomenon, the investigation, diagnosis and surgical management of FAI are developing. There is, however, no clear

evidence for one treatment modality over another. Arthroscopic treatment appears to be gaining popularity, with some authors reporting promising treatment outcomes at two or more years. Despite this, longer-term prospective data are required to allow clinicians to draw more reliable conclusions regarding the best treatment modality. Moreover, prospective comparative data are scarce, and a randomised controlled trial over five or more years, with a standardised outcome measure, will help to ascertain the most appropriate treatment method and provide prognostic information relating to the subsequent development of OA.

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