The Warwick Agreement on femoroacetabular impingement syndrome (FAI syndrome): an international consensus statement


Correspondence to
Professor DR Griffin, Clinical Sciences Research Institute, University Hospitals Coventry and Warwickshire, Coventry, CV2 2DX, UK; damian.griffin@warwick.ac.uk
Accepted 31 July 2016


ABSTRACT
The 2016 Warwick Agreement on femoroacetabular impingement (FAI) syndrome was convened to build an international, multidisciplinary consensus on the diagnosis and management of patients with FAI syndrome. 22 panel members and 1 patient from 9 countries and 5 different specialties participated in a 1-day consensus meeting on 29 June 2016. Prior to the meeting, 6 questions were agreed on, and recent relevant systematic reviews and seminal literature were circulated. Panel members gave presentations on the topics of the agreed questions at Sports Hip 2016, an open meeting held in the UK on 27–29 June. Presentations were followed by open discussion. At the 1-day consensus meeting, panel members developed statements in response to each question through open discussion; members then scored their level of agreement with each response on a scale of 0–10. Substantial agreement (range 9.5–10) was reached for each of the 6 consensus questions, and the associated terminology was agreed on. The term ‘femoroacetabular impingement syndrome’ was introduced to reflect the central role of patients’ symptoms in the disorder. To reach a diagnosis, patients should have appropriate symptoms, positive clinical signs and imaging findings. Suitable treatments are conservative care, rehabilitation, and arthroscopic or open surgery. Current understanding of prognosis and topics for future research were discussed. The 2016 Warwick Agreement on FAI syndrome is an international multidisciplinary agreement on the diagnosis, treatment principles and key terminology relating to FAI syndrome.

INTRODUCTION
The concept of hip impingement has been appreciated since at least 1936.1 Ganz et al2 discussed femoroacetabular impingement (FAI) in more detail in 2001, reporting a new surgical approach, and then presenting a hypothesis linking FAI with osteoarthritis in 2003.3 This, and the introduction of an arthroscopic approach to surgery in the early 2000s, led to increasing interest in this condition; the number of patients identified with FAI has risen rapidly over the past 10 years.4–6 In parallel, there has been a rapid increase in the number of publications. In 2012, Clohisy and Kim7 organised a meeting of predominantly orthopaedic surgeons to summarise the literature on FAI, develop consensus and consider how best to design future research.8–13

In recent years, the number of patients being treated for FAI has risen sharply in many countries.5–6,14 Clinicians, funders and health systems are concerned about this rise in a previously unrecognised condition, the costs and uncertainties of treatment, the lack of clarity of the epidemiology and the ambiguity of the diagnostic criteria.

To guide patients, clinicians and funders, we convened a consensus meeting. Our aim was to reach an international multidisciplinary agreement on the diagnosis and management of FAI syndrome.

METHODS
Panel selection
We invited representatives from a range of professions and specialties to join a consensus panel. We
Consensus statement

included sport and exercise medicine physicians, physiotherapists, orthopaedic surgeons and radiologists, who are most closely involved in managing these patients. We invited people who were known to have a research interest and clinical practice in FAI syndrome, and asked professional organisations with a known interest to nominate suitable people (International Society for Hip Arthroscopy; International Federation of Sports Physical Therapy and American Medical Society for Sports Medicine). We aimed to have representation from around the world, and deliberately chose people who we knew to hold disparate views, representing as wide a spectrum of opinion as possible. In total, 22 expert clinicians and academics, and 1 patient, from 9 countries and 5 specialties, participated in the process and are the authors of this article.

Preliminary work
We developed a list of topics and questions that we hoped to answer, circulating ideas around the panel until there was agreement. We searched relevant databases (PubMed and Cochrane Library), with review filter (PubMed), using the search term ‘femoroacetabular impingement’ from inception to 18 March 2016 for published articles relevant to these topics. A list of articles consisting of recent systematic reviews and original seminal research relevant to these topics was prepared; panel members suggested additional articles where important research had been omitted. The revised selection of publications was provided to all panel members along with the following final questions:

- What is FAI syndrome?
- How should FAI syndrome be diagnosed?
- What is the appropriate treatment of FAI syndrome?
- What is the prognosis of FAI syndrome?
- How should someone with an asymptomatic hip with cam or pincer morphology be managed?
- Which outcome measures should be used to assess treatment for FAI syndrome?
- What future research needs to be conducted?

Open meeting
Panel members gave presentations at Sports Hip 2016 (http://www.sportshipurgery.org), an open meeting held in the UK on 27–28 June 2016. One hundred and fifty international delegates from a range of clinical backgrounds (surgeons, radiologists, physiotherapists and sport and exercise medicine doctors) familiar with managing young adult hip pathology attended the conference. Panel members’ presentations explored each topic with an emphasis on the highest levels of evidence, from systematic reviews and randomised controlled trials where available. After each presentation, DRG chaired an open discussion where all delegates and the panel members discussed each topic.

Agreement meeting
On 29 June 2016, the panel met at the University of Warwick to formulate the agreement statement. The meeting was chaired by EJD who did not express opinions during the discussion.

For each topic, the chairman facilitated a structured discussion leading to a proposed wording for consideration. Panel members then voted on each proposal on a Likert scale of 0–10, where 0 reflected complete disagreement, 5 neither agreement nor disagreement and 10 complete agreement. Levels of agreement were summarised with mean scores and 95% CIs. Discussions continued until a mean score of >7.5 was reached, or until the chairman deemed that no further compromise could be found.

A different approach was taken when discussing what future research is needed. Delegates at Sports Hip 2016, including panel members, were invited to suggest their opinions as to the most important research questions that need to be answered in order to improve the management of FAI syndrome. EJD and KB collated responses. We used a web-based prioritisation programme (http://www.1000minds.com) to order these research questions. This software presented panel members with pairs of research questions and asked them to choose the more important of the two. Repeated pairwise comparisons, across all panel members, led to an ordered list of research questions. During the agreement meeting, the panel used this ordered list of research questions as a basis for open discussion and development of research themes.

RESULTS
The results of the consensus process (the Warwick International Agreement) are summarised in online supplementary file A. In the following paragraphs, we present the agreed statements for each topic or question (in shading), followed by a summary of the panel’s consensus discussions.

What is FAI syndrome?

FAI syndrome is a motion-related clinical disorder of the hip with a triad of symptoms, clinical signs and imaging findings. It represents symptomatic premature contact between the proximal femur and the acetabulum.

Level of agreement: mean score 9.8 (95% CI 9.6 to 10).

DISCUSSION
FAI was described by Ganz et al3 as a condition of “abnormal contact that may arise as a result of either abnormal morphological features…or as a result of subjecting the hip to excessive and supraphysiological range of motion”. Sankar et al2 further developed this definition, describing ‘five essential elements’:

- Abnormal morphology of the femur and/or acetabulum;
- Abnormal contact between these two structures;
- Especially vigorous supraphysiological motion that results in such abnormal contact and collision;
- Repetitive motion resulting in the continuous insult;
- The presence of soft-tissue damage.

We felt that these definitions do not sufficiently emphasise patients’ symptoms. Ambiguity as to the role of symptoms in making a diagnosis of FAI has led to the introduction of new terms such as ‘asymptomatic FAI’ or ‘radiological FAI’, apparently to describe hip morphologies rather than a clinical disorder.19 We agreed that this creates confusion when trying to define the clinical disorder.

To make clear the need for symptoms to be present, the panel proposed the new term ‘femoroacetabular impingement syndrome’, or ‘FAI syndrome’.18 We considered other terms, for example, hip impingement syndrome, but preferred FAI syndrome as this did not include extra-articular hip impingement such as ischiofemoral or greater trochanteric impingement. We considered whether ‘syndrome’ might apply a negative label to patients, but the expert patient member of the panel did not feel this would be the case.

We defined FAI syndrome as a triad of symptoms, clinical signs and imaging findings.3 11 This term and its definition build on the definitions of FAI from Ganz et al and Sankar et al, but emphasise that symptoms, clinical signs and relevant imaging findings must all be present for diagnosis.

To ensure that there is a distinction between patients with FAI syndrome and those with cam or pincer morphology but no
DISCUSSION
In the lateral hip, anterior thigh, buttock, knee, lower back, patients report pain in the groin or hip, but pain is also reported and precipitating factors that characterise this pain. Most there is wide variation in the location, nature, radiation, severity and precipitating factors that characterise this pain. Most clinicians apply and interpret clinical tests differently, with little consistency between professional groups or among peers. Even when tests are well defined, they have often been evaluated in populations with a high likelihood of a positive test, so their performance in a different environment (such as primary care) is not known. The most well-known test, the FADIR impingement test, is sensitive (usually positive when FAI syndrome is present), but not specific (often positive when FAI syndrome is the correct diagnosis). The evidence on hip range of motion (ROM) in FAI syndrome is surprisingly contradictory, but the panel felt that on balance FAI syndrome is associated with a restricted hip ROM.

We also recognised that abnormal movement patterns around the hip and pelvis are present in patients with FAI syndrome. These movement patterns, associated with FAI syndrome, may lead to pain or dysfunction in other regions, such as the spine, pelvis, posterior hip or abdominal wall. Furthermore, muscles around the hip are frequently weak in patients with FAI syndrome.

We discussed the common problem of determining whether pain is really arising from the hip joint or from other structures in the groin and hip region. We agreed that image-guided (X-ray or ultrasound) local anesthetic injections are useful in helping to resolve this situation. Pain relief following a local anaesthetic injection would support a diagnosis of FAI syndrome.

Most patients report pain in the groin or hip, but pain is also reported and precipitating factors that characterise this pain. Most clinicians apply and interpret clinical tests differently, with little consistency between professional groups or among peers. Even when tests are well defined, they have often been evaluated in populations with a high likelihood of a positive test, so their performance in a different environment (such as primary care) is not known. The most well-known test, the FADIR impingement test, is sensitive (usually positive when FAI syndrome is present), but not specific (often positive when FAI syndrome is the correct diagnosis). The evidence on hip range of motion (ROM) in FAI syndrome is surprisingly contradictory, but the panel felt that on balance FAI syndrome is associated with a restricted hip ROM.

We also recognised that abnormal movement patterns around the hip and pelvis are present in patients with FAI syndrome. These movement patterns, associated with FAI syndrome, may lead to pain or dysfunction in other regions, such as the spine, pelvis, posterior hip or abdominal wall. Furthermore, muscles around the hip are frequently weak in patients with FAI syndrome.

We discussed the common problem of determining whether pain is really arising from the hip joint or from other structures in the groin and hip region. We agreed that image-guided (X-ray or ultrasound) local anesthetic injections are useful in helping to resolve this situation. Pain relief following a local anaesthetic injection would support a diagnosis of FAI syndrome, when the other diagnostic criteria are met.

In most patients who seek treatment for FAI syndrome, symptoms are not mild or subtle. They are often severe and limiting in everyday life. The panel felt that this is especially important because patients are usually young, economically active adults. Symptoms of FAI syndrome therefore lead to a significant and lasting cost burden for society as well as being individually debilitating.

**Level of agreement:** mean score 9.9 (95% CI 9.7 to 10).
DISCUSSION

Morphological assessment of the hip is required in order to diagnose FAI syndrome, identifying cam or pincer morphology. Cam morphology refers to a flattening or convexity at the femoral head-neck junction. Pincer morphology refers to either global or focal overcoverage of the femoral head by the acetabulum. The panel emphasised that their presence, in the absence of appropriate symptoms and clinical signs, does not constitute a diagnosis of FAI syndrome. A substantial proportion of people in the general population are thought to have cam or pincer morphology.

We agreed that radiological assessment is best achieved initially with plain radiographs. A pelvic radiograph allows an overall assessment of the pelvis and hips, and exclusion of other painful conditions such as fracture, acetabular dysplasia and osteoarthritis. Ideally, this radiograph should be centred on the pubic symphysis, without rotation, and with neutral pelvic tilt. The shape of the acetabulum can be interpreted from this radiograph, but visualising the shape of the proximal femur requires an orthogonal view of the femoral neck. A number of such views have been described such as the cross-table lateral, Dunn and frog laterals.

There are some difficulties in interpreting three-dimensional (3D) shapes from plain radiographs. For example, the spatial orientation of the acetabulum may be affected by the position of the pelvis. Posterior tilt increases in standing position and the orientation of the acetabulum may be affected by the position (3D) shapes from plain radiographs. For example, the spatial orientation of the acetabulum can be interpreted from this radiograph, but visualising the shape of the proximal femur requires an orthogonal view of the femoral neck. A number of such views have been described such as the cross-table lateral, Dunn and frog laterals.

We agreed that morphology can be better characterised through cross-sectional imaging, either CT or MRI. This is particularly important if surgery is being considered. MRI arthrography is usually more accurate than plain MRI to assess the labrum and articular cartilage. MRI may also identify other soft tissue lesions that may result in hip or groin pain. When performing cross-sectional imaging of the hip in FAI syndrome, limited images of the distal femoral condyles allow assessment of femoral torsion, while 3D reformattting of CT or radial MRI allows assessment of local morphological abnormalities, particularly of the proximal femur.

Many radiographic measures of cam and pincer morphology have been described including the α angle (cam), cross-over sign and centre-edge angle (pincer). Some clinical trials (e.g. UK FASHIoN) of treatments for FAI syndrome have included patients with an α angle >55° at any position on the head neck junction for cam morphology and a positive cross-over sign or a centre edge angle >39° for pincer morphology. However α angles cannot accurately discriminate between patients with cam type FAI syndrome and asymptomatic volunteers, despite changes to the threshold value.

The panel was unable to recommend precise diagnostic values for any of the common measures to define cam or pincer morphology in routine clinical practice. This is because we recognised that impingement is the result of a complex interaction, during motion, between the acetabulum and femoral neck. We agreed that the depth, orientation and rim of the acetabulum, and the head–neck profile, neck angle and torsion of the proximal femur all vary in the general population. It is when a particularly unfavourable combination of these characteristics occur together, along with provocative movement or position, that a patient may present with FAI syndrome. It has not been possible to capture all of this in a single measurement or even a simple set of shape criteria.

What is the appropriate treatment of FAI syndrome?

FAI syndrome can be treated by conservative care, rehabilitation or surgery. Conservative care may involve education, watchful waiting, lifestyle and activity modification. Physiotherapy-led rehabilitation aims to improve hip stability, neuromuscular control, strength, range of motion and movement patterns. Surgery, either open or arthroscopic, aims to improve the hip morphology and repair damaged tissue. The good management of the variety of patients with FAI syndrome requires the availability of all of these approaches. Level of agreement: mean score 9.5 (95% CI 9.0 to 10).

DISCUSSION

Treatment strategies for FAI syndrome have included conservative care, rehabilitation and surgery. The panel agreed that each of these may have a role in different patients, but that there is little evidence to compare their effectiveness. Figure 1 is a suggested pathway for the management of FAI syndrome.

There is currently no high-level evidence to support the choice of a definitive treatment for FAI syndrome. For any one patient, the panel agreed that it is appropriate to consider the different treatment options. This is best done in a shared decision-making process, supporting the individual patient to make an informed preference decision on the best treatment option for them. We agreed that those treating FAI syndrome, particularly in secondary and tertiary care, should be part of a multidisciplinary group with knowledge of, and access to, all the treatment options.

Conservative care of patients with FAI syndrome is poorly described but could include patient education, activity and lifestyle modification, oral analgesia including non-steroidal anti-inflammatory drugs, intra-articular steroid injection and watchful waiting. There are no reports of what effect such an approach, in isolation, has on the symptoms of FAI syndrome. Similar conservative strategies are recommended in other musculoskeletal disorders such as hip osteoarthritis.

Physiotherapist-led rehabilitation aims to reduce patients’ symptoms by improving hip stability, neuromuscular control and movement patterns. The treatment targets for rehabilitation are wide-ranging and include improving sagittal and frontal plane hip range of motion, hip muscle strengthening and lumbo-pelvic dissociation. However, details of what should be incorporated in such a programme has not been well tested and it would appear that different physiotherapists are delivering different treatments. Surgery aims to correct hip morphology to achieve impingement-free motion. Cam morphology can be reshaped and femoral torsion or neck angle adjusted; the acetabulum can be reorientated or its rim trimmed. Where there is damage to the labrum or articular cartilage, this can be resected, repaired or reconstructed. Often, these procedures can be done by either arthroscopic or open surgery. An arthroscopic approach may be preferable in many patients to allow rapid recovery, but some of these procedures will require an open approach. Postoperative physiotherapy protocols have been described but their value is uncertain.
What is the prognosis of FAI syndrome?

In patients who are treated for FAI syndrome, symptoms frequently improve, and they return to full activity, including sports. Without treatment, symptoms of FAI syndrome will probably worsen over time. The long-term outlook for patients with FAI syndrome is unknown. However, it is likely that cam morphology is associated with hip osteoarthritis. It is currently unknown whether treatment for FAI syndrome prevents hip osteoarthritis.

Level of agreement: mean score 9.6 (95% CI 9.3 to 9.8).

DISCUSSION

The panel agreed that patients with FAI syndrome who are not treated probably experience a gradual deterioration of symptoms. We do not know of any reports of the outcomes of conservative care. Physiotherapy-led rehabilitation seems to be associated with an improvement in symptoms for at least 2 years. However, the studies supporting this are only a few observational studies with small sample sizes and important methodological weaknesses. Reports of the results of surgery are more numerous and describe significant improvement in symptoms up to 5 years, but they suffer similar issues of poor design and therefore high risk of bias. Longer term results have been reported for open surgery, including improved symptoms persisting in most patients for at least 10 years. All prospective cohort studies available demonstrate an association between cam morphology and osteoarthritis of the hip. These studies have not found a similar association between pincer morphology and osteoarthritis. We are unable to say whether FAI syndrome is associated with a higher risk of osteoarthritis than isolated cam morphology, but the panel thought it was likely. There is no evidence that treatment for FAI syndrome alters the risk of subsequent osteoarthritis.

How should someone with an asymptomatic hip with cam or pincer morphology be managed?

It is not known which individuals with cam or pincer morphologies will develop symptoms and, therefore, FAI syndrome. Preventive measures may have a role in higher risk populations, but it is rarely indicated to offer surgery to these individuals.

Level of agreement: mean score 9.6 (95% CI 9.4 to 9.8).

DISCUSSION

There is no evidence that treating people who do not have pain, but who do have cam or pincer morphology, will alter the risk of them developing FAI syndrome or osteoarthritis, and so it is rarely indicated to offer surgery to these people. Preventative physiotherapy-led rehabilitation and conditioning strategies may be appropriate in professional athletes where the prevalence of cam morphology is high, such as...
professional football teams. In exceptional circumstances, and in a shared decision-making process with a patient, surgery may occasionally be appropriate for high-risk patients. An example of such a patient could be an active young adult who has had surgery for FAI syndrome in one hip and in whom chondroablation is seen to be developing in the other (painless) hip. In such cases, careful consideration must be given to the risks of surgery and its unknown long-term outcome as well as to the uncertain risks of worsening degeneration and the onset of symptoms.

**Table 2** Randomised clinical trials comparing arthroscopic surgery with non-operative care or sham surgery for femoroacetabular impingement syndrome

<table>
<thead>
<tr>
<th>Trial</th>
<th>Trial ID</th>
<th>Country</th>
<th>Sample Size</th>
<th>Interventions</th>
<th>Reporting Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK FASHIoN</td>
<td>ISRCTN64081839</td>
<td>UK</td>
<td>344</td>
<td>Arthroscopic surgery vs physiotherapy</td>
<td>2017</td>
</tr>
<tr>
<td>Aus FASHIoN</td>
<td>ACTRN12615001177549</td>
<td>Australia</td>
<td>120</td>
<td>Arthroscopic surgery vs physiotherapy</td>
<td>2018</td>
</tr>
<tr>
<td>FAIT</td>
<td>NCT01929304</td>
<td>UK</td>
<td>120</td>
<td>Arthroscopic surgery vs physiotherapy</td>
<td>2017</td>
</tr>
<tr>
<td>FIRST</td>
<td>NCT01623843</td>
<td>Canada and Finland</td>
<td>220</td>
<td>Arthroscopic surgery vs arthroscopic washout</td>
<td>2017</td>
</tr>
<tr>
<td>HIPARTI</td>
<td>NCT02692807</td>
<td>Norway and Australia</td>
<td>140</td>
<td>Arthroscopic surgery vs diagnostic arthroscopy</td>
<td>2020</td>
</tr>
<tr>
<td>US MHS</td>
<td>NCT01993615</td>
<td>USA</td>
<td>60</td>
<td>Arthroscopic surgery vs physiotherapy</td>
<td>2017</td>
</tr>
</tbody>
</table>

**Author affiliations**

1Warwick Medical School, University of Warwick, Coventry, UK
2University Hospitals of Coventry and Warwickshire NHS Trust, Coventry, UK
3Hip Arthroscopy Australia, Melbourne, Victoria, Australia
4St Vincents Private Hospital, East Melbourne, Victoria, Australia
5Department of Orthopaedics, Erasmus University Medical Centre, Rotterdam, The Netherlands
6Medsport, Department of Orthopaedic Surgery, University of Michigan, Ann Arbor, Michigan, USA
7Department of Clinic of Orthopaedic and Trauma Surgery, Luzern Kantons spitale, Luzern, Switzerland
8Department of Orthopaedic Surgery, Washington University School of Medicine St. Louis, St. Louis, Missouri, USA
9Aspetar, Qatar Orthopaedic and Sports Medicine Hospital, Doha, Qatar
10Sports Surgery Clinic, Dublin, Ireland
11Department of Medicine, University College Cork, Cork, Ireland
12Southampton Football Club, UK
13Department of Physiotherapy, The University of Melbourne, Melbourne, Victoria, Australia
14Department of Orthopaedic Surgery, Sports Orthopaedic Research Center (SORC-C), Copenhagen University Hospital, Ama ger-Hvidovre, Denmark
15Cranes, LLC, Brookline, Massachusetts, USA
16Medical Service, Madrid Open Tennis, Madrid, Spain
17Hip Preservation Center, Baylor University Medical Center at Dallas, Dallas, Texas, USA
18Rangos School of Health Sciences, Physical Therapy, Duquesne University, Pittsburgh, Pennsylvania, USA
Consensus statement


REFERENCES


82 Walters SJ, Brazier JE. Comparison of the minimally important difference for two health state utility measures: EQ-5D and SF-6D. *Qual Life Res* 2005;14:1523–32.


The Warwick Agreement on femoroacetabular impingement syndrome (FAI syndrome): an international consensus statement


doi: 10.1136/bjsports-2016-096743

Updated information and services can be found at:
http://bjsm.bmj.com/content/50/19/1169

These include:

References
This article cites 82 articles, 15 of which you can access for free at:
http://bjsm.bmj.com/content/50/19/1169#BIBL

Email alerting service
Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

Topic Collections
Articles on similar topics can be found in the following collections

Editor's choice (343)
Physiotherapy (188)
Physiotherapy (245)
Orthopaedic and trauma surgery (54)

Notes

To request permissions go to:
http://group.bmj.com/group/rights-licensing/permissions

To order reprints go to:
http://journals.bmj.com/cgi/reprintform

To subscribe to BMJ go to:
http://group.bmj.com/subscribe/