

Prioritised Research: Primary Cam Morphology (and FAI syndrome) development, treatment and prognosis; other hip conditions affecting the young person's hip

We will use DelphiManager - a web based system designed to facilitate the building and management of Delphi surveys. The Delphi survey will have 5 domains: (1) definitions (2) terminology (3) taxonomy (4) imaging outcomes (5) **research priorities**.

The aim of this document is to provide more context and information to the 38 "future research" statements (and DelphiManager "help text"). You will be asked to rate these studies (or groups of studies) as "not important", "important but not critical" or "critical" using a 9-point Likert scale using the DelphiManager software. It will take approximately 1 hour to review this document and another 30-60 minutes to complete the research priorities domain of the Delphi study on primary cam morphology (in DelphiManager). "Help text" will provide Delphi Study panellists with additional information relevant to the statement.

Relevant sections from the Warwick Agreement (Griffin et al, 2016) and the 4 consensus papers by the International Hip-related Pain Research Network (IHiPRN) are provided for further context (Reiman et al; Mosler et al; Kemp et al; Impellizzeri et al)

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

Griffin et al (2016)

<http://bjsm.bmj.com/lookup/doi/10.1136/bjsports-2016-096743>

What future research needs to be conducted?

The delegates at Sports Hip 2016 proposed 118 research questions about the diagnosis and management of FAI syndrome. During the consensus exercise, we identified 23 substantially different questions, which were ranked in order of priority by the panel (see online supplementary file B). The panel grouped the questions into four categories: aetiology, diagnosis, prognosis and effect of treatment. Regarding aetiology, there was considerable interest in how cam and pincer morphologies develop, whether sporting activity in childhood may influence this, and why some patients develop symptoms and others do not. For diagnosis, we agreed that diagnostic criteria are imprecise and need to be improved, and that the utility of those we have is unclear. We would benefit considerably from better information on the long-term natural history of FAI syndrome, though the panel recognised that significant resources are needed to perform the necessary long-term prospective studies. Finally, there is an urgent need to compare the effectiveness of conservative, rehabilitation and surgical treatment strategies. Fortunately, several such studies are in progress (see table 2), and results will begin to appear in the next few years.

SUPPLEMENTARY FILE B
Consensus by Question

	MEAN	RANK
● In those with FAI morphology, can we predict who will become symptomatic?	5.6	1
● Is surgery or conservative management more effective for improving short- and long-term outcomes?	6.5	2
● What is the outcome of conservative treatment?	8.8	3
● Is FAI surgery more effective than sham surgery?	9.6	4
● How do we define FAI syndrome?	9.7	5
● What is the natural history of FAI morphology?	9.9	6
● Which patients respond best to conservative management?	10.3	7
● What is the most effective conservative management program?	10.5	8
● Do changes to training in adolescent athletes decrease Cam formation?	10.7	9
● What is the role of hip muscle dysfunction and movement patterns in FAI morphology and symptoms?	10.9	10
● Can rehabilitation prevent FAI pain and if so, how?	11.0	11
● What are the diagnostic criteria for Cam and Pincer morphology?	11.3	12
● What is the source of pain in FAI?	11.8	13
● Does operating on asymptomatic hips lead to long-term benefits in terms of reducing OA?	13.0	14
● What is the incidence and prevalence of FAI syndrome?	13.0	15
● What are the best outcome measures to show change following treatment?	13.1	16
● What is the role of structural features in FAI syndrome eg. Femoral anteversion, capsular tightness?	13.3	17
● What is the optimal post operative rehabilitation program?	14.7	18
● What is the optimal method to treat labral pathology?	15.3	19
● Which factors affect surgical outcomes eg. pre-and post-op alpha angle, fem retroversion, age, sex, OA?	15.6	20
● Does pre-operative rehabilitation improve post-operative outcomes?	16.4	21
● What are the return to sport criteria following FAI surgery?	17.2	22
● Does capsule closure lead to improved patient outcomes?	17.8	23

Question Themes

- Effect of treatment
- Aetiology
- Diagnosis
- Prognosis

2. Consensus recommendations on the classification, definition and diagnostic criteria of hip-related pain in young and middle-aged active adults from the International Hip-related Pain Research Network, Zurich 2018

Reiman et al (2019)

<https://bjsm.bmj.com/content/early/2020/01/20/bjsports-2019-101453>

CR1: Hip-related pain may be further categorised after imaging into: (1) femoroacetabularimpingement (FAI) syndrome, (2) acetabular dysplasia and/or hip instability and (3) other conditions causing hip-related pain. This last category could include soft-tissue conditions without specific bony morphology.

R1: Measures of bony morphology should be reported in detail. We recommend that bony morphology outcome measures (such as the alpha angle or centre-edge angle) should be clearly defined, measured and reported (eg, detailed methodological description, blinding, per hip/per person reporting with statistical correction as appropriate, reliability measures)

R2 Future research recommendations: We recommend large-scale, interdisciplinary research on aetiology and prognosis for each of the listed hip-related pain conditions. (For example: (1) The relationship between bony morphology and other factors related to these conditions or (2) Movement-related factors relative to each hip-related pain condition.)

3. Standardised measurement of physical capacity in young and middle-aged active adults with hip-related pain: recommendations from the first International Hip-related Pain Research Network (IHiPRN) meeting, Zurich, 2018

Mosler et al (2019)

<https://bjsm.bmj.com/content/early/2019/12/24/bjsports-2019-101457>

CLINICAL MEASURES

Research recommendation 1: Further research should investigate, report and improve the measurement properties of tests of range of motion, muscle strength and functional performance.

Discussion among International Hip-related Pain Research Network (IHiPRN) participants raised multiple areas of uncertainty regarding measurement of hip range of motion. These areas included: the use of active versus passive movements, examination of only pain-free range, optimal stabilisation methods, and whether mechanical devices, such as the hip internal rotation examination chair, (50) are required to improve accuracy and reliability. The IHiPRN participants also discussed whether side-to-side comparisons in symptomatic individuals were acceptable for research purposes or comparisons be limited

to asymptomatic individuals, as the clinical interpretation of differences between symptomatic and asymptomatic limbs is currently unclear. High-quality studies that follow the minimal reporting standards for clinical research are required to clarify these areas of uncertainty.⁽⁷⁾ Specifically, clear diagnostic inclusion criteria for the participants of the study should be reported, and a detailed description provided of all measurement methods (including clinometric properties) and instruments used in the study.

The literature review provided clearer guidance for standardised methods of measurement of hip muscle strength in people with hip-related pain.^(19 20) However, reporting of intertester reliability and measurement error is currently lacking. Therefore, high-quality studies are needed to examine and report the clinometric properties of measurement methods for hip muscle strength and investigate the validity of strength testing in symptomatic populations.

There was considerable discussion of methods measuring functional performance to be recommended for clinical and research purposes. Since people with hip-related pain demonstrate reduced squat depth and have impaired performance on single-leg balance tasks and the SEBT, these tests are recommended to be included in clinical research in this area. There is limited and conflicting evidence that hopping performance is impaired in this patient population, and further high-quality studies are required to resolve this uncertainty. ⁽²²⁾ Furthermore, the IHiPRN participants also discussed that the methods of assessment of functional performance should be adapted to the population of interest. For example, the examination of running technique may be important for a football player, but less so for a swimmer.

BIOMECHANICS AND MUSCLE FUNCTION

Research recommendation 2: Future research is needed to investigate the relationship among movement-related parameters (biomechanics, muscle function), symptoms, function, quality of life, and imaging and intra-articular findings. Evidence suggests that hip biomechanics are altered in multiple planes in individuals with hip-related pain when compared with asymptomatic controls. ^(24 51) Individuals with FAI syndrome walk with a lower peak hip extension angle, peak internal rotation angle, and external rotation joint torque, and squat to a lesser depth despite no difference in peak hip flexion angle compared with individuals without hip-related pain. ⁽²⁴⁾ Individuals with developmental hip dysplasia walk with a lower peak hip extension angle than individuals without pain. ⁽⁵¹⁾ However, the relationship between these movement-related parameters and other measures of hip-related pain (symptoms, function, quality of life, imaging and intra-articular findings) is unknown. The evidence is limited, and conflicting, regarding differences in muscle activity between young and middle-aged active adults with hip-related pain and individuals without pain (online supplementary appendix). The evidence is also limited, and inconsistent, regarding differences in muscle size and adiposity of individual muscles in people with hip-related pain compared with those without (online supplementary appendix). To understand how movement-related parameters, including biomechanics and muscle function, may contribute to or result from symptoms, function, quality of life, imaging and intra-articular findings, future research should include measures of each of these parameters to identify the inter-relationships. The method of obtaining and grading imaging and intra-articular findings should be reported in future research on hip-related pain (Reiman et al, 2019).

Research recommendation 3: Established minimum reporting standards for movement-related parameters (eg, biomechanics, muscle function) should be followed, or determined as appropriate.

The optimal methods for biomechanical and muscle function measurements are currently not established for individuals with hip-related pain, but this aim was beyond the scope of the current consensus meeting. We instead focused on the reporting of these measurements in the literature and found that the lack of consistent reporting limited the ability to critically appraise and reproduce previous studies, which also impeded their inclusion in meta-analyses (online supplementary appendix). Currently, there are no reporting standards for biomechanical measures, although there are recommendations for methods of data collection. (52) Despite established reporting standards for electromyographic data, (53–55) reporting across studies remains poor (online supplementary appendix). For measurement of muscle size and adiposity, there are no reporting standards and the methods of measurement are inconsistent (online supplementary appendix). Thus, it is important that reporting standards should be followed (when available) and should be developed (when not available).

MEASURES OF PHYSICAL ACTIVITY AND RTS

Research recommendation 4: The patient's goals, expectations, physical activity and occupational requirements should be measured using quantitative and qualitative methods.

As discussed previously (clinical recommendation 5), quantifying patient expectations, and their fulfilment, regarding RTS, physical activity and occupational requirements is important to accurately interpret the efficacy of management of hip-related pain. It is equally important that these measures, in addition to patient satisfaction, be included in studies of interventions for hip-related pain. The IHiPRN participants also recommended in clinical recommendation 4 that physical activity be quantified using objective methods of measurement in people with hip-related pain. This recommendation is equally relevant for hip-related pain research as it is for clinical practice.

Research recommendation 5: The Return to Sport (RTS) continuum recommended by the 2016 RTS consensus paper should be used in future research.

Definitions used in studies examining RTS following management of hip-related pain often consider RTS as a dichotomous variable (yes/no) and fail to distinguish between the differing levels of RTS or consider whether the athlete has successfully returned to their preinjury sporting performance. (56) Two recent studies have applied this graded definition, providing a more nuanced picture of RTS expectations for patients following hip arthroscopy. (33 35) The 2016 consensus statement on RTS introduced the concept of RTS being considered a continuum through which an athlete progresses during the rehabilitation process. (34)

Three key elements of the RTS continuum were operationally defined as: 1. Return to participation: patient is able to participate in physical activity, even their preferred sport, but perhaps at a lower level, reduced workload or lower sporting performance. 2. RTS: the patient is able to return to their preferred sport but is not performing at their desired level. 3. Return to performance: the patient has returned to their preferred sport and is at or above their preinjury

level with respect to performance and/or physical ability. These principles of the RTS continuum are equally applicable for a patient with hip-related pain returning to any form of physical activity (including sport and occupational demands). By quantifying the patient's outcomes with respect to RTS, physical activity and/or occupational demands according to these three defined elements, the clinician and researcher can better determine whether management was successful at meeting the patient's expectations and goals. Accurate and detailed reporting of RTS using the continuum outlined in the 2016 RTS consensus paper (34) is therefore recommended for all future hip-related pain research. Specifically, reporting should include information regarding the patient's expectations and goals with respect to returning to physical activity (including sport and occupational demands), and their reasons for either returning to that physical activity or not.

Research recommendation 6: Future research is required to quantify, and report return to physical activity (including sport and occupation) following management of hip-related pain. Six recent systematic reviews have examined RTS levels following surgical management of hip-related pain. The synthesis of these pooled findings determined that between 86% and 93% of athletes return to sport participation. (49 56–60) However, the actual level of RTS of these athletes is mostly unreported, with only one-third of included studies clearly distinguishing RTS (any level) from RTS at preinjury level. (56) Furthermore, there is limited to moderate evidence that one in four athletes did not return to their previous level of sport participation after surgery for FAI syndrome. (56) Data from recent cross-sectional surveys of athletes after hip arthroscopy suggest that the percentage of athletes returning to their preinjury level of sport with optimal performance could actually be as low as 17%. (33 35) In general, poor outcome reporting on athletic performance after surgery makes it difficult to determine the actual sporting performance these athletes return to. (56) Additionally, RTS following non-surgical management of hip-related pain has only been reported in one study of eight football players, all of whom returned to playing at the same competitive level. (61) The IHiPRN participants recommended that the return to physical activity (including sport and occupational demands) following hip-related pain management be quantified to improve the quality of reporting, and better understand patient outcomes.

Research recommendation 7: Research is recommended to determine the best criteria for rehabilitation progression and RTS following management of hip-related pain. Several studies have reported RTS criteria following hip arthroscopy (online supplementary appendix). (40–42 44–46 48) However, there have been no reports of RTS criteria following non-surgical management of hip-related pain. There is also evidence that clinicians vary considerably in how they weight the importance of various outcome measures that may influence the RTS decision. (62) Readiness to RTS should take into account the individual patient and the physical and psychological demands of the sport. (34) Psychological readiness has rarely been considered in published data on RTS following hip surgery. Clearly, a significant gap exists in the literature with respect to standardised RTS criteria following management of hip-related pain, and this was identified as a future research priority by the IHiPRN participants.

4. Patient-reported outcome measures for hip-related pain: a review of the available evidence and a consensus statement from the International Hip-related Pain Research Network, Zurich 2018

Impellizzeri et al (2020)

<https://bjsm.bmj.com/content/early/2020/02/17/bjsports-2019-101456>

Recommendation 1: The Hip and Groin Outcome Score (HAGOS) and International Hip Outcome Tool (iHOT) instruments (long and reduced versions) are the most appropriate Patient-reported outcome measures (PROMs) to use in young and middle-aged active adults with hip-related pain.

Recommendation 2: HAGOS and iHOT were developed mainly in surgical context. More research is needed into their utility in a non-surgical treatment context.

The HAGOS and iHOT have only been investigated in a surgical context (patients assessed before and after surgical interventions) or in mixed populations (undergoing both surgical and non-surgical treatments) (see details on population and context in online supplementary appendix 1). The magnitude of the effects following surgical interventions is not necessarily comparable with non-surgical treatment, which can impact the acceptability of measurement error and instrument responsiveness. Since the acceptability of the reproducibility level (instrument noise) depends on the context and the magnitude of changes determined by the interventions (signal), we recommended the HAGOS and iHOT-33 primarily as outcome measures in a surgical setting (which is the main context in which they were investigated), while in non-surgical treatment the aforementioned limitations should be taken into consideration.

Recommendation 3: EQ-5D and SF-36 are generic quality of life measures that can supplement the hip-related measures, HAGOS and iHOT.

Recommendation 4: Future research should include further analysis of content and structural validity, and the relationship between individual measurement error and the minimal clinically important change for the recommended PROMs.

The examination of study quality and measurement properties highlighted inadequate structural validity, meaning that the structural validity of PROMs could not be determined despite us recommending their use. The structure of HAGOS (55) was developed using the HOOS as a template,⁵⁶ and not with a confirmatory analysis, but the HOOS structure was also not examined, but based on the structure of the Knee Injury and Osteoarthritis Outcome Score (KOOS). (57) Since the KOOS structure was not examined, an SR on the KOOS psychometric properties scored the structural validity as 'poor' (according to the COSMIN). (58) Similarly, the structure of the iHOT was not properly examined or confirmed. Lack of structural validity examination is an important weakness, especially for instruments providing a single score such as the iHOT, as this limits interpretation of the total score. The operational definitions and theoretical framework of the construct reflected by the subscales were also not specified for the HAGOS and iHOT. These limitations are reflected in the content validity score. Despite being rated as sufficient by the reviewers, the content validity was mostly deemed to be inconsistent or indeterminate due to the lack of methodological information. Therefore, future studies should examine the structural validity, clarify the constructs measured and analyse the

content validity of the HAGOS and iHOT. Finally, the measurement error was higher than the minimal clinically important change, thus questioning the use of these PROMs at the individual level (eg, in clinical practice), particularly for the iHOT. While the measurement error may be sufficient to detect change over time at a group level (eg, research studies), further studies are needed to examine the minimal clinical change and its relationship with measurement error at the individual level, especially for the iHOT.

5. Physiotherapist-led treatment for young to middle-aged active adults with hip-related pain: consensus recommendations from the International Hip-related Pain Research Network, Zurich 2018

Kemp et al (2019)

<http://bjsm.bmj.com/lookup/doi/10.1136/bjsports-2019-101458>

R1. Reporting of exercise programmes. Exercise descriptors such as load magnitude, number of repetitions and sets, duration of whole programme, duration of contractile element of exercise, duration of one repetition, time under tension, rest between repetitions, range of motion through which the exercise is performed and rest between exercise sessions should be considered and reported.

The level of evidence supporting this statement was moderate, where in the systematic review, one high quality RCT, 5 one moderate quality RCT and two high quality pilot RCTs (12-14) did not report these descriptors adequately. The median (IQR) score was 9 (0) out of a possible 9 points, indicating almost no variability within the opinions of expert group. The primary goal of studies examining physiotherapist-led exercise therapies for hip-related pain is to develop and then test the most effective exercises for the condition. When developing effective and tailored treatment programmes, the mechanistic effect of particular elements of the exercises on the target muscles and surrounding tissues is considered. Toigo and Boutellier (33) described principles to be considered in the development and reporting of exercise programmes. These included load magnitude, number of repetitions and sets, duration of whole programme, duration of contractile element of exercise (ie, how long the concentric, eccentric or isometric component of the repetition should take), duration of one repetition, time under tension (ie, the overall time the muscle is under tension during the set), rest duration between repetitions, ROM through which the exercise is performed and rest duration between exercise sessions. (24-33) When reporting (and developing) exercise-based interventions, we also recommended using the Consensus on Exercise Reporting Template (CERT) (34) and Template for Intervention Description and Replication (TIDieR) checklist. (35) Improved reporting of programmes is critical to move forward in the quality of physiotherapist-led treatments provided to patients with hip-related pain.

R2. Development of high-quality exercise programmes. Research should investigate the optimal frequency, intensity, time, type, volume and progression of exercise therapy

The level of evidence supporting this statement was moderate. One high quality Randomised Controlled Trial (RCT) (5) and one moderate quality RCT (4) did not describe the physiotherapist-led exercise programme adequately. The median (IQR) score was 9 (2) out of a possible 9 points, indicating some variability

within the opinions of expert group. Exercise-based programmes used in clinical research should include patient input in their design and be appropriately constructed to gain maximal improvements in outcomes. In strength-based treatments, exercise programme require adequate load to gain a strength effect. The frequency, intensity, time, type, volume and progression of exercise therapy may need to be manipulated to gain the desired effect. The expert group recommended that guidelines, such as those developed by the American College of Sports Medicine (ACSM), should be used with the development of strength-based treatments. (17) The group also indicated that fidelity and adherence of exercise programmes were often not suitable to gain the desired effect. (36) Studies evaluating the effectiveness of physiotherapist-led exercise programmes should ensure that treatments are developed and reported using these principles.

R3. Research should examine the effect of patient education in people with hip-related pain

The level of evidence supporting this statement was insufficient and based solely on the opinion of the expert group and the median (IQR) score was 8 (2) out of a possible 9 points, indicating some variability within the opinions of the expert group. To our knowledge, no studies have investigated patient education in people with hip-related pain. We recommended that future studies assess the specific effect of patient education for hip-related pain including content, modes of delivery and the use of innovative technologies to enhance education benefits.

R4. Research should investigate the effect of other treatments used in people with hip-related pain

There was no evidence to our knowledge supporting this statement and so was based solely on the opinion of the expert group, with the median (IQR) score was 8 (1) out of a possible 9 points, indicating small variability within the opinions of the expert group. Hip joint intra-articular injections, (37) analgesic and anti-inflammatory medications, manual therapy adjunctive techniques such as taping, bracing and orthotics might be used by clinicians; however, their rate of use and clinical effectiveness is unknown. Although the group acknowledged that clinical treatment of hip-related pain is generally multimodal, these adjunct therapies should not replace exercise-based treatment. Further research is required to determine the frequency of use and the effectiveness of adjunct therapies used for hip-related pain.

R5. Research should examine the impact of comorbidities and social determinants on treatment effectiveness in people with hip-related pain.

The level of evidence supporting this statement was insufficient and based solely on the opinion of the expert group; however, the median (IQR) score was 9 (0) out of a possible 9 points, indicating almost no variability within the opinions of the expert group. The expert group indicated that comorbidities and social determinants (eg, socioeconomic status, education level) can influence the patient's prognosis as well as the effectiveness of treatment. Comorbidities including chronic pain, insomnia and anxiety increased following hip arthroscopy surgery, although causation was not implied. (38) To date, no studies examining physiotherapist-led treatment for hip-related pain have determined whether comorbidities influence the outcome of treatment or whether they change with treatment. These factors should be examined in future studies exploring physiotherapist-led treatment for hip-related pain.