POSITION PAPER

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The Italian Consensus Conference on FAI Syndrome in Athletes (Cotignola Agreement)

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SUMMARY
Background. Femoro-acetabular impingement (FAI) is an important topic in literature because of its strong relationship with sport populations.
Methods. Sixty-five experts participated in "this Consensus Conference (CC)". They discussed, voted and approved a consensus document on the FAI syndrome in athletes.
Results. The CC experts approved document provided suggestions concerning: 1) Epidemiology of FAI; 2) Clinical evaluation; 3) Radiological evaluation; 4) Conservative treatment; 5) Surgical criteria; 6) Surgical techniques; 7) Post-surgical rehabilitation; 8) Outcome evaluation; 9) FAI-associated clinical frameworks.
Conclusions. The CC offers a multidisciplinary approach to the diagnosis and treatment of FAI syndrome in athletes taking into account all the different steps needed to approach this pathology in sport populations.

KEY WORDS
Cam-FAI; Pincer-FAI; rehabilitation; surgical treatment; return to play.

INTRODUCTION

Femoroacetabular impingement (FAI) is currently a very common topic in literature because of its strong connection to young and sport populations. Indeed, an abnormal morphology of the head neck junction of the femur (Cam-FAI) and/or acetabulum (Pincer-FAI) may lead to abnormal contact between these two anatomical structures and non-physiological movements. This situation may cause

a progressive damage to cartilage tissue and triggered a subsequent evolution toward early osteoarthritis. Thus, since it has been hypothesized that surgical treatment may improve joint symptoms and interrupt the progression of osteoarthritis (1-4), in recent years there has been a progressive increase in the number of surgical interventions. Therefore, in the last few years there was a wide diffusion of techniques in hip arthroscopy (5-7). FAI morphology, and consequently FAI syndrome, are prevalent in sport populations (8, 9). Indeed, this population is exposed both to a growing risk of FAI morphology (10, 11) and a considerable over-use of the hip with a high risk of developing early osteoarthritis (12) which can compromise both a career in sports and the quality of daily life.

The first symposium (Femoroacetabular Impingement Research Symposium) aimed at developing a consensus about FAI was organized in 2012 in Chicago by the American Academy of Orthopaedic Surgeons/Orthopaedic Research Society (13). In this symposium, importance was given, for the first time, to a multidisciplinary approach for clinically assessing FAI. However, this symposium did not address the specific issue of athletes suffering from FAI. In 2016, the second Consensus Conference on FAI was held in Warwick (3), during which the clinical signs, symptoms and radiographic features of FAI were defined. The concept of "FAI-syndrome" was introduced and differentiated from that of "FAI morphology" during this Consensus Conference for the first time. The Warwick panel of experts outlined guidelines concerning FAI treatment and the Consensus Conference final document now offers a modern approach for treating this widespread pathology. Nonetheless, even in this case, the problem of athletes suffering from FAI syndrome was only marginally addressed. The athlete, especially if he is a high-level professional, represents a patient with very peculiar characteristics. Indeed, the high demand for performance of the professional athlete requires a careful evaluation of the therapeutic choice, which must be the most suitable for his particular needs.

The aim of the Italian Consensus Conference on the FAI syndrome in athletes is to achieve the first multidisciplinary agreement on the diagnosis and management of the FAI-syndrome in athletes.

METHODS

Background

The "Italian Consensus Conference on FAI syndrome in athletes" was held in Cotignola (Ravenna), on 18 January 2019, under the sponsorship of SIA (Italian Society of Arthroscopy), and the participation of SIOT (Italian Society of Orthopedics and Traumatology), SIGASCOT (Italian Society of Knee, Arthroscopy, Cartilage, Orthopedic Technologies) and SIDA (Italian Society of the Hip). Sixty-five experts from different medical backgrounds (45 orthopedic surgeons, 6 sports physicians, 4 rehabilitation physicians, 4 physiotherapists, 4 radiologists, 1 physical trainer and 1 sport physiologist) participated at the Consensus Conference (CC). Selection was based on the experts' Hirsch index, on their publications about FAI and their experience shown in the fields of clinical evaluation, medical treatment and rehabilitation of FAI. The authors of this report were the experts who took part in the CC.

Literature review process

Prior to the CC, five senior authors (RZ, GNB, MP, DP and FDP) performed a systematic literature review of the clinical, radiological, surgical and rehabilitative criteria concerning FAI syndrome in the athletes. The systematic review was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) guidelines (14).

The review process was conducted as follows:

1) Research was performed independently by the five senior authors and no language limitation was applied.

2) Databases consulted were MEDLINE, EMBASE, EXCERPTA MEDICA, Cochrane Central Register of Controlled Trials and Cochrane Database of Systematic Review; "grey literature" (*i.e.*, conferences, abstracts, thesis and unpublished reports) was not considered. After a preliminary review of titles and abstracts of selected studies, all studies that did not report relevant information were excluded. The authors obtained the full text of the studies which were most relevant to the FAI syndrome diagnosis and management, and particular emphasis was paid to those studies with the highest level of evidence (systematic reviews and randomized controlled trials where available). Following review, all studies that did not report relevant information were excluded. The inclusion and exclusion criteria, in accordance with PICO criteria (15), are shown in **table I**.

3) Based on the literature review process, the authors provided a comprehensive summary document divided into nine different sections, *i.e.*:

1. FAI syndrome epidemiology in the athletes.
2. Clinical evaluation.
3. Radiological evaluation.
4. Conservative treatment.
5. Surgical selection criteria.
6. Surgical techniques.
7. Post-surgical rehabilitation and return to play.
8. Outcome evaluation.
9. FAI associated clinical frameworks.

The document was delivered to each expert participating at the CC, and was considered as a starting point for discussion.

Consensus conference presentation

The CC experts aimed to approve the nine separate sections.

During the discussion, each section was first presented by a facilitator (RZ, GNB, MP, DP and FDP), after which a plenary discussion followed, guided by the chairman (NS), and voting then took place.

The CC experts voted for each document, using a Likert scale of 0-10 (16), where 0 reflected complete disagreement, 5 neither agreement nor disagreement and 10 complete agreement. The discussions continued until a mean score of > 7.5 was reached, or until the chairman considered that no further agreement could be found (3, 16-18).

During the discussion of each section, the documents were modified according to the indications of the experts and the final version was then voted. The voting results are shown in **table II**.

RESULTS

Section 1. Summary of FAI syndrome epidemiology in the athletes document consensus

Data emerging from literature agree that intensive sport activity during pediatric age, and more precisely before physeal closure, is related to an increased risk of developing Cam-morphology (11, 19, 20).

CC experts, based on these data, suggest that the modulation of the type, duration and frequency of training loads to be applied during the growth period, represents an effective if not the only form of prevention of "Cam-deformity" (10, 21, 22). This prevention strategy involves modifying the training scheme, even if it is not yet completely clear which precise parameters ought to be respected (10, 21).

Table I. Inclusion and Exclusion Criteria following PICO Criteria (15).

Inclusion criteria
Patient and problem RCT, case-series studies, systematic review and consensus statement investigating FAI-syndrome in athletes
Intervention Clinical assessment, radiological assessment, conservative treatment, surgical criteria, surgical techniques, post-surgical rehabilitation, outcomes, associated pathologies
Comparator Comparison between different radiological assessments, conservative treatments, surgical criteria, surgical techniques, post-surgical rehabilitations, outcomes
Outcome Time lost to injury, level of return to play, level of performance, level of satisfaction, complications, and sequelae
Exclusion criteria
Patient and problem RCT, case-series studies, systematic review and consensus statement investigating FAI-syndrome in a non-sports population
Intervention Clinical assessment, radiological assessment, conservative treatment, surgical criteria, surgical techniques, post-surgical rehabilitation, outcomes, associated pathologies in a non-sports population
Comparison Comparison between different radiological assessments, conservative treatments, surgical criteria, surgical techniques, post-surgical rehabilitations, outcomes in a non-sports population
Outcome Unspecified outcome of time lost to injury, level of return to play, level of performance, level of satisfaction, complications and sequelae

Table II. The results of the different voting rounds regarding the 9 different sections of the final document.

Section	Voting score
Epidemiology of FAI Syndrome in Athletes	
Intensive sport activity during pediatric age is it related to an increased risk of developing Cam-morphology?	8.7 ± 1.6
Is there a form of prevention of "Cam-deformity"?	
Clinical evaluation	
What are the commonly used tests in clinical practice?	
What is their specificity and sensitivity?	
Does exists specific symptoms or clinical signs confirming particular differences between athletes and sedentary subjects?	8.8 ± 1.3
Does exists specific symptoms or clinical signs confirming particular differences between professional and non-professional athletes?	
It is necessary to evaluate the range of hip motion and to perform a dynamometric assessment of the hip muscles?	
What is the interest of a local anesthetic injection test in the clinical evaluation?	
Radiological Evaluation	
How the first level of radiological assessment should be structured?	9.0 ± 1.2
Does the presence of Pincer- and/or Cam-morphology, without symptoms and clinical signs, justify the diagnosis of FAI-syndrome in the athlete?	
How the second level of radiological assessment should be structured?	
Conservative treatment	
What are the main points of a conservative treatment for the athletes?	9.0 ± 1.1
What are the main information to give to the athlete adopting a conservative program?	
Surgical selection criteria	
What are inclusion and exclusion criteria for surgery?	
Does ROM evaluation a discriminating factor for surgical treatment?	8.7 ± 1.2
Does the use of PROMPS an useful criteria for indicating surgical treatment?	
Surgical techniques	
What are the main points of the surgical treatment of FAI syndrome?	
There are some differences between arthroscopic, open and mini-open techniques surgery in terms of functional results, biomechanics and return to sport outcome?	9.1 ± 1.1
What is the surgical approach recommended for athletes with high functional demands?	
Post-surgical rehabilitation and return to play	
What are the suggested post-surgical physiotherapy programs?	9.1 ± 1.0
What are the main points of the post-surgical physiotherapy program?	
What are the tests for RTP decision-making process?	
Outcome evaluation	
What are the recommended PROMPS to use in the early and advanced stages of the rehabilitation process?	9.7 ± 0.8
What is the role of the psychological aspect in the decision process of RTP?	
FAI-associated clinical frameworks	
What are the clinical frameworks frequently associated with Cam-FAI?	9.1 ± 0.9
How may these associated clinical frameworks to perturb the hip biomechanics?	
How the CAM-Fai may generate some associated clinical frameworks?	

Section 2. Summary of clinical evaluation document consensus

The CC established that the FAI syndrome represents a "*hip functional-related pathology showing symptoms, clinical signs and radiological imaging of FAI morphology, which becomes pronounced in circumstances of high functional demand, typical of some sport activities requiring repetitive over-physiological movements of the hip, which result in abnormal joint contact*".

CC experts also specify that the FAI-syndrome does not include other hip extra-articular impingement clinical frameworks like sub-spine impingement, ischiofemoral impingement or greater throchanteric impingement.

In a clinical context, the CC agrees that diagnosis of FAI syndrome does not depend on a single on a single clinical sign.

The CC points out that the tests commonly used in clinical practice show very heterogeneous levels of specificity and sensitivity, *i.e.*:

- The Flexion-Adduction-Internal Rotation test (FADDIR), is sensitive (0.78) but not specific (0.10) (23, 24).
- The Dynamic Internal Rotatory Impingement test (DIRIT) shows high specificity (1) but moderate sensitivity (0.59) (25).
- The Posterior Rim Impingement test shows high specificity (1) but low sensitivity (0.21) (25, 26).
- The Flexion-Abduction-External Rotation test (FABER) shows high sensitivity (0.9-1) and high specificity (0.9-1) (25, 27, 28).
- The Log Roll test has high specificity (0.9-1) but low sensitivity (0.3) (26, 29).

Hence, the CC suggests evaluating, carefully and accurately, the specificity and sensitivity of the tests employed during the clinical assessment.

CC experts acknowledged that no specific symptoms nor clinical signs confirmed particular differences between athletes and sedentary subjects; furthermore, no differences in clinical signs and symptoms exist between professional and non-professional athletes (23).

The CC suggests evaluating the range of hip motion and performing a dynamometric assessment of the hip muscles. When it is difficult to establish whether the pain experienced stems from the hip joint or from other anatomical structures, the CC experts suggest performing a local anesthetic injection test (30, 31).

Section 3. Summary of the radiological evaluation document consensus

The first level of radiological evaluation consists in RX examination performed on:

1. Antero posterior view of the orthostatic position (AP) (26, 32, 33).
2. 45° Dunn view (32, 34).

The CC suggests that the evaluation of Pincer-morphology should be extrapolated by the AP view with the calculation of Central Edge Angle (CEA) and the presence of cross sign (35-37). Concerning the CEA cut-off value, the CC agrees that a value ≥ 40° indicates a "Pincher morphology", while a value ≤ 20° indicates an acetabular under-coverage and consequently, possible joint instability (38-40).

Furthermore, the CC suggests that the evaluation of Cam-morphology should be extrapolated by the 45° Dunn view with calculation of the alpha angle (41, 42). Concerning the alpha angle cut-off value, the CC agrees that a value > 55° indicates "Cam morphology" (41, 42).

The CC experts underline that the presence of Pincer- and/or Cam-morphology, in a subject that does not show specific symptoms and clinical signs, does not justify the diagnosis of FAI-syndrome (3, 43, 44).

Moreover, the CC experts underline the fact that hip impingement is a motion-related situation resulting from a complex interaction between the acetabulum and the femoral neck whereas the RX examination is a static evaluation. For this reason, the CC suggests careful evaluation of RX images in the context of the movements usually performed by the athlete during sporting activity.

The second level radiological examination consists in MRI examination performed on both the hip and the pelvis. MRI assessment should be performed with no less than a 1.5 or 3 Tesla device (45, 46). Finally, the experts suggest the use of arthro-MRI examination for chondral and labral damage assessment (47, 48).

Section 4. Summary of conservative treatment document consensus

CC recommendations include FAI-syndrome conservative programs focused on controlling and modifying the articular mechanical loads so as to limit the progression of the FAI syndrome. This CC recommends that the patient be made aware of the fact that a FAI conservative program is based on the modification of technical movements and the limitation of functional request (17, 49-51). This strategy must be based on the following four main points (52-57):

1. Strengthening of hip muscles and improvement of neuromotor control.
2. Optimal control of core muscles.
3. Reduced request for extreme range of motion (ROM) movements.
4. The patient must be aware of the functional limitations imposed by this clinical condition. The CC particularly recommends that the patient avoid or, at the very least,

limit extreme rotation of the hip especially when carried out together with a movement of flexion or extension.

Section 5. Summary of surgical selection criteria document consensus

Studies available in literature have brought the CC experts to propose the following inclusion and exclusion criteria for surgery:

1. Age (58, 59).
2. Clinical presentation (27, 60).
3. Severity of chondral damage (61, 62).
4. Degree of osteoarthritis (63).
5. Associated inguinal pathologies (17, 22).
6. Body mass index (59, 64).

Furthermore, the CC considers age as a relative contra-indication.

The CC suggests to consider the duration of pre-operative symptoms for the outcome prediction (27, 60, 65-67).

The CC propose that a severe degree of chondropathy (IV° degree following the Outerbridge classification) should be considered as an important exclusion criteria for determining FAI surgery. Therefore, the CC experts suggest that surgery should be indicated only in certain cases for professional athletes, with severe chondropathy.

CC experts agree that clinical and accurate radiographic examination represent fundamental points for surgical selection (12, 68).

A Tonnis value ≥ 1 and a joint space < 2 mm should be considered the lim.it beyond which arthroscopy is no longer indicated.

The CC experts agree that ROM evaluation is not a discriminating factor for indicating surgical treatment (except for an osteoarthritic clinical framework).

The CC considers the use of patient reported outcomes (PROMPS), evaluation of hip-muscle strength and ROM to be equally useful criteria for indicating surgical treatment (60).

Section 6. Summary of surgical techniques document consensus

The CC established the main points of FAI-syndrome surgical treatment in athletes to be:

1. Articular decompression.
2. Interruption or slowing down of the degenerative processes of cartilage tissue.
3. Obtaining an outcome which allows athletes to return to sporting activity.

From data present in literature today, the CC experts have concluded that arthroscopic surgery, open surgery and mini-open techniques surgery are equivalent in terms of functional results, biomechanics and return to sport outcome. Nevertheless, since arthroscopic techniques display lower complication and morbidity risks (70), and rapid recovery (2, 71, 72), the CC recommend an arthroscopy approach both in athletes and in subjects performing sports with high functional requests.

Section 7. Summary of post-surgical rehabilitation and return to play document consensus

This CC suggests a post-surgical program of physiotherapy based on 4 phases which respect the following points:

First phase

The duration of the first phase depends on the surgical procedure performed (73, 74).

The objectives of this first phase are:

1. Biological protection of repaired tissues.
2. Reduction of pain and inflammation.
3. Prevention of muscle inhibition.
4. ROM recovery.

The load on the affected limb must be limited to 9-10 kg (*i.e.*, 20 lbs) for an average of 2 weeks. After this period, the patient proceeds with body weight according to tolerance.

The ROM passive exercises have the following limitations:

1. Flexion: 90° (to progress up to 110° by the end of first phase).
2. Extension: 0° (to progress up to 10° by the end of first phase).
3. Abduction: from 25° to 30°.
4. Adduction: initially limited to neutral and then carefully increased.
5. Internal rotation (with 90° hip flexion): 0° and then careful increase to 30° by the end of the first phase.
6. Internal rotation in prone position: limited by patient comfort.
7. External rotation (with 90° hip flexion): 15°.
8. External rotation in prone position: limited by patient comfort.

Second phase

The objectives of the second phase are:

1. The biological protection of repaired tissues.
2. The total ROM recovery.
3. The recovery of a normal gait cycle with total body weight.
4. The strengthening of hip muscles.

Furthermore, the use of hip braces and CPM devices, if adopted, is suspended (in absence of complications).

Third phase

The third phase generally lasts from the ninth week to the twelfth or thirteenth week.

The objectives of the third phase are:
1. Recovery of muscle strength. The strength, measured by dynamometric tests, must reach 80-85% of the contralateral limb or of the basal values.
2. Achievement of total proprioceptive control.
3. Achieving satisfactory aerobic conditions (if required by the sporting activity practiced).

Fourth phase

Duration of the third phase is generally from the twelfth or thirteenth week to the sixteenth or eighteenth week.
During this phase, patients gradually meet the performance model of the sporting activity practiced. This phase corresponds to the return to play (RTP).
The CC recommends the following test for RTP decision-making process:
1. Y Balance Test or in alternative the Y balance test (75).
2. Single Hop for Distance Tests,"Triple Hop for Distance Test" and the "Triple Crossover Hop for Distance Test (75).
3. Drop Jump Test (75).
4. Vail Hip Sport Test (75-77).
5. T agility (78).
6. Tuck Jump Exercise test (79).

Furthermore, the biomechanics of running at constant speed and sprinting must be correct and pain-free (75).

Section 8. Summary of outcomes evaluation document consensus

Based on current literature, the CC recommends use of the Hip Outcome score (HOS) (80-82) both in early and advanced stages of rehabilitation processes, even if the questionnaire suffers from a lack of validation in the Italian language. However, the CC experts point out that during phase III of the rehabilitation process, the results of the HOS sub-scales, relating to sports, could still be unsatisfactory (75).
Furthermore, this CC agrees on the utility of recording the RTP level (same, higher, lower), the level of athlete performance when returning to the same sports level (same, higher, lower) and the satisfaction level of the athlete (0-10) in the period following surgery.
Finally, the CC experts agree on the importance of the psychological aspect in the RTP decision making process (83-85).

Section 9. Summary of FAI overload associated syndromes document consensus

The CC recommends, in patients with Cam-FAI, a careful evaluation of the following clinical frameworks that are frequently associated with Cam-FAI (17, 22):

1. Inguinal hernia.
2. Posterior inguinal wall weakness.
3. Conjoint tendon lesion.
4. Inguinal ligament lesion.
5. Rectus abdominis distal insertion lesions.
6. External obliquus, internal obliquus and pyramidalis lesions.
7. Rectus abdominis-adductor longus common aponeurosis lesions.
8. Pre-aponeurotic capsule lesions.

DISCUSSION

The Italian Consensus Conference on FAI-syndrome in athletes is, to the best of our knowledge, the first CC specifically aimed at sports patients. Indeed, sporting populations require both a particular clinical-diagnostic evaluation and a specific therapeutic and rehabilitative approach. Furthermore, sport populations, particularly those involved in sports which command high functional requests of the hip joint, show significantly higher incidences of FAI-morphology, compared to non-sporting populations (10, 11). Data emerging from literature agree that intensive sport activity during pediatric age, and more precisely before physeal closure, is related to an increased risk of developing Cam morphology (8, 86, 87). The Cam-morphology becomes stable after growth plate closure (11, 19, 20). This risk is higher for males than for females but further studies are needed to confirm this data (11, 20). To date, there are insufficient data in literature concerning ethnic differences in both acetabular morphology and femoral bone response to athletic loads. Furthermore, it seems that Middle-Eastern athletes have a lower risk of developing CAM morphology compared to other sport populations (88). For these reasons, the modulation of training load during the growth period represents an effective form of prevention of "Cam-deformity" (21).
The most important symptom that FAI-syndrome presents is the pain experienced mainly in the hip and groin area but also in the lower back region, buttock or in the lateral and posterior regions of the thigh. The pain is usually movement-related although it may sometimes be associated with static-positions such as long periods of sitting (26, 89). Furthermore, clicking, loss of range of articular motion (especially in intra-rotation) stiffness, sensitivity or giving-way may be referred with a FAI syndrome clinical framework (3, 90-92). Since internal rotation of the hip is usually limited in the FAI-syndrome (3, 22) the muscles around the hip joint are frequently weak (93). The diagnosis of FAI syndrome does not depend on a single clinical sign and the use of several diagnostic tests in clinical practice is recommended. It is also important to note that no differences in symptoms or clinical signs exist between

athletes and sedentary subjects or between professional and non-professional athletes (23).

The radiological evaluation is an important aspect of FAI diagnosis and is based both on RX and MRI. Given that the sensibility and specificity of MRI for labral and cartilage damage are respectively 30% and 36% (94), whereas arthro-MRI yields sensibility and specificity values of 91% and 86% respectively (95) the use of arthro-MRI examination for chondral and labral damage assessment is recommended (47, 48).

To our knowledge, no scientific evidence found in literature points to a preferential program for the conservative treatment of FAI-syndrome (49). Indeed, all existing conservative programs are based on expert advice and clinical experience (level of evidence IV, grade of recommendation D): the conservative treatment for FAI-syndrome is based substantially on the same conservative strategy recommended for osteoarthritis (50 57).

Since hip flexion and hip extension (51-53) may increase the mechanical load at the femur head-knee junction, limiting hip flexion, extension internal rotation and abduction is a fundamental aspect of FAI conservative programs (17, 51, 53-56).

One of the most challenging aspects of treating athletes with FAI syndrome is the correct choice of inclusion and exclusion criteria for determining surgical intervention (64). Concerning the clinical presentation, some studies show that optimal cutoff value of "pain duration before surgery" as a predictor of negative outcome was 9.5 months. Indeed, a greater duration of preoperatively pain symptoms predicts a lower Harris Hip Score and an increased failure rate (65, 66). The degenerative condition of cartilage tissue represents an important limit to treatment with surgery (96, 97). However, some studies show that the post-surgical outcome and the return to sports activity seem encouraging even in the presence of chondropathy (6, 98). On the contrary, others studies show that an alpha angle > 78° may predict Outerbridge IV° cartilage damage and therefore negatively affect the post-surgical outcome (11, 98, 99). The caution in advocating surgery in cases of severe chondropathy is justified by the fact that the follow-up studies for these interventions are still too few to be able to yield objective conclusions (100). Adopting a surgical approach in athletes suffering from a progressive osteoarthritic clinical framework remains controversial, as can be seen in current literature. Furthermore, a cut-off limit for cartilaginous damage, caused by osteoarthritic degeneration, to be used as exclusion or inclusion surgical criteria, does not emerge from current literature. Current studies show that a Tonnis value ≥ 1 and a joint space < 2 mm, are correlated to an inferior clinical outcome and to a greater tendency towards hip arthroplasty (12, 67). The CC considers these data to be the limit beyond which arthroscopy is no longer indicated. Furthermore, the CC underline that for deciding upon surgical treatment within an osteoarthritic clinical framework, joint stiffness is an important aspect to consider. Indeed, a 10° reduction in intra-rotation greatly increases the risk of the condition evolving towards osteoarthritis (23). Concerning the athlete another important point to consider is the ROM. Since athletes present very different ranges of motion depending on their sporting activity (101-103), the CC experts agree that ROM evaluation is not a discriminating factor for indicating surgical treatment (except for an osteoarthritic clinical framework as mentioned above).

Although surgical treatment of FAI has become more common, the clinical evidence supporting which kind of technique should be used is open to debate (104-106). This lack of consensus in literature results mainly from the limited number of studies published, the heterogeneous study methods and the relative great number of surgical techniques described in the different studies (105). The surgical techniques are arthroscopy, open surgery and mini-open techniques. There are no statistically significant results in favor of one particular technique nor for a combination of techniques (107-109). To date, consensus in literature shows an increasing improvement in the results obtained with arthroscopic surgery; this positive trend is justified by the improvement of both technology and surgical techniques (110).

Few studies exist in literature that focus on guidelines for post-surgery physiotherapy programs for acetabular labrum lesions and/or femoral osteochondroplasty (74, 111-116). As for conservative treatments, post-surgical rehabilitation treatments are based on expert advice (Level of evidence IV): consequently, there is a lack of data regarding the outcomes of the rehabilitation protocols proposed (75). Nonetheless, the majority of the programs proposed are typically divided into 3, sometimes 4 or even 5 different phases (73, 116). The CC propose to adopt a rehabilitation program divided in 4 phases. Data emerging from literature show that most athletes can return to sport after hip arthroscopy (5-7, 117-119): the range of RTP is between 73% and 93% (5, 117). Data from literature also show that there is a difference in outcome between professional and non-professional athletes, with a better outcome witnessed for professionals compared to non-professionals (6, 7, 118, 119). However, the CC points out that it is challenging to define when, and if, RTP is at the same pre-injury level because of the lack of relevant data: several authors report that, 82% of athletes RTP at the same pre-injury level (119). The time needed to return to sports activity, has been reported to vary and range from 4 to 14 months (5, 7, 117, 119, 120). Most of the papers published have short follow-ups. Papers with a follow-up period of 2 years do not report any deterioration

in performance (121) but report a 5% reduction in sports participation at high levels of activity (6) and a 6% reduction of games played (7).
Another important point is the use of PROMPS. To date, in literature many PROMPS are used to evaluate clinical outcomes following hip arthroscopy. The CC experts underline the following points for adopting PROMPS:

1. Specific PROMPS are necessary to reveal, in a specific and sensitive manner, the level of hip functionality without incurring in the "ceiling effect" (122).
2. The Western Ontario and McMaster University Arthritis Index (WOMAC), the Hip disability and Osteoarthritis Outcome Score (HOOS) and the Lower Extremity Functional Scale (LEFS) do not show sufficient evidence to justify their use in verifying the outcome of arthroscopic hip surgery (75).
3. The Modified Harris Hip Score (MHHS) and the Non-arthritic Hip Score (NHS) are not sensitive enough to be able to record changes in high levels of functionality (75).
4. The Copenaghen Hip and Groin Outcome Score (HAGOS) was validated for the conservative treatment of non-osteoarthritic pain (75).
5. The International Hip Outcome Tool (iHOT-33) is reliable and exhibits validity and responsiveness towards functional changes. However, its clinical use involves excessive periods of time (123), whereas the iHOT-12 (124) is not sufficiently complete (75).
6. In literature, there is a certain consensus for the use of the Hip Outcome score (HOS), justified by the fact that the HOS contains both a sub-scale for the ADL and for sports activities. Furthermore, the HOS shows a particular specificity and sensitivity in the evaluation of high levels of physical ability (80-82).

Based on current literature, the CC recommends use of HOS both during the rehabilitation processes (80-82).
Many studies report the association between Cam morphology and inguinal pathologies in literature (20, 22, 125, 126). The term "inguinal pathologies", in accordance with the "*Groin Pain Syndrome Italian Consensus Conference on Terminology, Clinical Evaluation and Imaging Assessment in Groin Pain in Athletes*" (17) includes a vast range of conditions, *i.e.*:

1. Inguinal hernia.
2. Posterior inguinal wall weakness.
3. Conjoint tendon lesion.
4. Inguinal ligament lesion.
5. Rectus abdominis distal insertion lesions.
6. External obliquus, internal obliquus and pyramidalis lesions.
7. Rectus abdominis-adductor longus common aponeurosis lesions.
8. Pre-aponeurotic capsule lesions.

The association between Cam morphology and inguinal pathologies can be explained by the reduction in normal hip intra-rotation observed in Cam-FAI. This ROM limitation is due to the impingement between the ball-shaped head of the femur and the articular rim (127). This condition may cause an increase in the stiffness of the hip joint capsule (128, 129), which is often compensated for by exaggerated mobilization of the symphyseal joint which, in turn, may cause the onset of inguinal pathologies as well as pubic osteopathy and adductor tendinopathy (18, 22, 128, 130-133). For these reasons, the CC recommends, in patients with Cam-FAI, a careful evaluation of the above mentioned clinical frameworks that are frequently associated with Cam-FAI.
Finally, we acknowledge that our consensus, despite engaging a large number of experts, provides 'level 4' evidence. The authors both anticipate, and welcome, constructive discussion on areas where others may have data we have missed, opinions that diverge from ours, and suggestions for new investigations. We appreciate that the overarching goal of sports and exercise medicine research is to improve the return to sports activities for all sportsmen and women.

Limitations of the study

The most important limitation of this study is that a CC only provides only a "level 4" evidence. This limitation is directly related to the nature of a CC, whose purpose is also to stimulate intellectual reflection for further studies. For this reason, further studies with to confirm the suggestion formulated by this CC are grounds for future research.

CONCLUSIONS

This CC was specifically focused on the problematic of FAI-syndrome in athletes. At the best of our knowledge was the first CC concerning this topic. The CC furnishes suggestions concerning clinical evaluation, radiological evaluation, conservative treatment, surgical selection criteria, surgical techniques, post-surgical rehabilitation, outcome evaluation and FAI-associated clinical frameworks.

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DATA AVAILABILITY

Data are available under reasonable request to the corresponding author.

CONTRIBUTIONS

All authors contributed equally to this work.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interests.

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