Return to sport after hip surgery for femoroacetabular impingement: a systematic review

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ABSTRACT

Background We aimed to appraise (1) the rate of return to sport of athletes after hip surgery for femoroacetabular impingement (FAI) and (2) some aspects that may influence the return to sport.

Methods Four databases (EMBASE, PubMed, Web of Science, Cochrane Library) were searched until 21 October 2014. Studies evaluated return to sport of athletes who underwent hip surgery for the treatment of symptomatic FAI. A validated tool was used for quality evaluation of the studies.

Results A total of 18 case series (level of evidence IV) with moderate-to-high methodological quality were included. On average, 87% of athletes returned to sport after hip surgery for FAI and 82% returned to the same sport level as before the occurrence of the symptoms. Professional athletes seem to return to sport at a higher rate compared with recreational and collegiate athletes. Sport participation after hip arthroscopy tends to decrease for professional athletes at short-term and mid-term follow-ups. Diffuse hip osteoarthritis at the time of surgery may not allow athletes to return to sport.

Conclusions Most athletes return to sport after hip surgery for the treatment of symptomatic FAI. The level of competition, time of evaluation after hip surgery and presence of articular cartilage lesions at the time of surgery may influence return to sport. Future studies with higher levels of evidence should describe and evaluate return to sport protocols after hip surgery for FAI.

INTRODUCTION

A large number of athletes at different levels of competition (ie, professional, collegiate, high school, recreational) present with hip pain and functional disability related to femoroacetabular impingement (FAI).1 2 FAI is a pathomechanical process mainly caused by bony deformities at the proximal femur and/or acetabulum, which may induce abnormal contacts between these structures at end ranges of hip motion and chondrolabral lesions within the hip joint.3

FAI is most commonly diagnosed in athletes participating in sports that require (1) repeated changes of direction and cutting causing high rotational loads across the hip joint (eg, soccer), (2) high hip flexion, adduction and internal rotation motions (eg, ice hockey) and (3) supraphysiological hip ranges of motion (eg, dance).1 Hip surgery is an option for the management of symptomatic FAI, but indications remain in debate.4 5 Hip surgery aims to treat the intra-articular pathologies resultant from FAI (ie, labral tears, articular cartilage lesions) that may cause hip pain. While the torn labrum is usually debrided, repaired or reconstructed, chondroplasty and/or microfracture are often used to treat the damaged hip joint cartilage. In addition, osteotomies are implemented to correct the underlying bony deformities at the proximal femur and/or acetabulum.7 The objectives of hip surgery are to (1) reduce hip pain, (2) improve hip function, (3) allow athletes to return to their sport activities and (4) decelerate the degenerative changes within the hip joint.7

Whether or not the athlete can return to sport successfully after hip surgery is of particular concern for patients with symptomatic FAI. The fulfilment of FAI patients’ expectations about return to sport is strongly related to their positive surgery evaluation.9 Therefore, we undertook a systematic review to appraise (1) the rate of return to sport of athletes after hip surgery for the treatment of symptomatic FAI and (2) some of the aspects that may influence the return to sport after hip surgery for FAI.

METHODS

This systematic review was performed according to the guidelines of the PRISMA statement.9

Search strategy

Electronic searches were performed by one reviewer (NCC) in the EMBASE, PubMed, Web of Science and Cochrane Library databases until 21 October 2014 by following the instructions of a medical information specialist (figure 1). Key search terms and synonyms were combined using three main filters: (1) FAI, (2) hip surgery and (3) return to sport. Specifically, the following search code was used: (("femoroacetabular impingement" OR "femoroacacetabular impingement" OR "femoro-acetabular impingement" OR "femoro-acetabulogamentum" OR "femoro-acetabular impingement") OR ((hip OR coxa OR “hip joint” OR “acetabulofoemoral joint”) AND (impingement OR “impingement syndrome”)) AND (surgery OR surgeries OR surgical* OR operative* OR procedure OR arthroscopy OR arthroscopies OR arthroscopic OR osteotomy OR osteotomies OR dislocation*) AND (sport* OR return OR recovery OR athletic*)). Duplicates were removed by one reviewer (NCC).

Eligibility

In the first phase, all studies obtained from the electronic search were screened by one reviewer with expertise in the field of FAI (NCC), and some were excluded based on their titles and abstracts. Afterwards, the full text of potentially eligible studies was obtained and their eligibility was further evaluated by two independent reviewers (NCC and MB), with disagreement resolved by consensus or by a third reviewer (NAM). Studies were eligible if the participants were active in...
sports (i.e., professional, collegiate, high school, recreational athletes), and presented with hip pain and FAI-related bony deformities at the proximal femur and/or acetabulum as diagnosed by one or more imaging features (radiographs and/or MRI and/or CT scans). Participants had hip surgery for the treatment of FAI-related intra-articular pathologies (i.e., labral tears, acetabular and/or femoral cartilage lesions) and bony deformities at the proximal femur and/or acetabulum. The surgical approach for accessing the hip joint could be arthroscopy, open surgery or mini-direct anterior approach. In addition, studies were required to report the rate of return to sport activities after hip surgery or the data that allowed its calculation. Studies were excluded if they were not in English, if they were case reports, reviews or congress abstracts, and if the full text was not available.

Quality evaluation

The methodological quality of the studies included in the review was assessed by two independent reviewers (NCC and MB), with disagreement resolved by consensus or by a third reviewer (NAM). All included studies were case series (level of evidence IV) according to the Centre for Evidence Based Medicine scale. This scale categorises therapeutic studies from level of evidence I to V. Level of evidence I studies correspond to systematic reviews of randomised controlled trials (RCTs) or individual RCTs with narrow CIs, while level of evidence V studies correspond to expert opinions. An instrument specifically developed and validated by Yang et al for evaluating case series was used (see online supplementary file). This instrument investigates 13 methodological criteria subdivided into four dimensions: (1) study aims and design (2 criteria), (2) description of the treatment protocol (3 criteria), (3) description of the methods and therapeutic/side effects (2 criteria) and (4) study conduction (6 criteria). Each criterion is rated either as 1 (if the criterion is met) or 0 (if criterion is not met). The total score is the sum of all satisfied criteria and ranges from 0 to 13 (13=highest methodological quality). According to the data reported in the tool development article, studies with total scores <5 were arbitrarily considered to be of low methodological quality, 5–8 with moderate methodological quality and >8 with high methodological quality.

Data extraction

A single reviewer (NCC) extracted all data, which included the characteristics of the study participants (number of athletes, number of operated hips, gender, age, competition level, sport activity, FAI diagnosis criteria), the description of hip surgery (surgical approach and techniques), the postoperative treatments (rehabilitation protocols) and outcomes (rate of return to sport, rate of return to the same level of sport, sport-related self-reported outcomes). Sport-related self-reported outcomes were extracted to observe the association between rates of return to sport and actual hip pain and function during sport activities reported by patients after hip surgery for FAI. Only self-reported scores that included at least one item asking about sport ability and that were reported by at least three studies were considered. The modified Harris Hip Score (modHHS), the Non-Arthritic Hip Score (NAHS) and the Hip Outcome Score (HOS)—Sport subscore were included. The modHHS and the NAHS (score range: 0–100, 100=best possible score) are used to evaluate hip pain and function during daily and sport activities, while the HOS—Sport subscore (score range: 0–100, 100=best possible score) specifically evaluates hip pain and function during sport activities. In addition, the satisfaction of participants after hip surgery was considered, since it has been shown to be related to sport ability after hip surgery in FAI patients. Satisfaction was reported either as a percentage of satisfied athletes or on a satisfaction scale (score range: 0–10, 10=best possible score).

Return to sport after hip surgery was further investigated considering the following aspects, arbitrarily chosen a priori by the authors, that could potentially influence the return to sport after hip surgery for FAI: (1) level of competition of athletes with FAI, (2) time of follow-up evaluation, (3) associated sport-related outcomes reported by athletes and (4) amount of articular cartilage lesions at the time of hip surgery.

Statistical analysis

Percentage agreement and Cohen k statistics (mean and 95% CI) were calculated to provide absolute agreement and an estimate of the level of agreement between raters, respectively, when scoring the methodological quality of the included studies. Weighted means and ranges were calculated for age, rate of return to sport, rate of return to the same level of sport, time of follow-up, sport-related self-reported outcomes (modHHS, NAHS, HOS-Sport subscore) and satisfaction scores.

RESULTS

A total of 685 studies were identified (figure 1). From these, 39 studies were potentially eligible, but after full-text evaluation only 18 studies were included. Return to sport outcomes were not reported in five of the excluded studies, five were case reports, four were reviews, three were current concept reports, one study also included participants without an isolated FAI diagnosis, one was not in English, one had no available full-text and one reported the return to sport outcomes in another study, which was already included in the review. The methodological quality of the single studies is reported in table 1. A total of 3 studies showed moderate methodological quality, and 15 studies showed high methodological quality. The inter-rater agreement for methodological quality of the studies was good (absolute agreement=87%, k=0.66 (95% CI 0.54 to 0.77)).

A total of 977 participants (1076 hips) were included and 745 of them (76%) were men (see online supplementary table S1). A total of 99 participants (10%) had bilateral hip surgery. The

![Figure 1](-flow_chart_of_the_study_selection_process.png)

**Figure 1** Flow chart of the study selection process.
mean age of participants was 28 years (range 15–41). A total of 372 participants were professional athletes (38%), 351 recreational athletes (36%), 106 collegiate athletes (11%), 55 high school athletes (6%), while for 93 the level of competition was not specifically reported (9%). The top 10 most performed sport activities were reported for each study. For one study, the number of athletes participating in the reported sport activities was not shown, since it could not be read with accuracy from the chart that was used for reporting the results.10 The criteria for the diagnosis of symptomatic FAI included—besides hip pain and functional limitations—physical examination, radiographs, MRI and CT scans.

A total of 782 hips were operated on by hip arthroscopy (73%), 228 using open surgery (21%) and 66 using a minimi-
direct anterior approach (6%; table 2). Femoral osteoplasty and acetabular rim trimming were used to correct the respective bony deformities in 974 (90%) and 552 (51%) hips, respectively. Labrum tears were repaired in 414 hips (38%), debrided in 374 hips (35%) and partially resected in 65 hips (6%) in an attempt to preserve as much healthy labrum as possible, or reconstructed with iliotibial band autografts in 25 hips (2%).

Rehabilitation protocols include three main phases: (1) partial weight-bearing with focus on the recovery of passive hip ranges of motion, (2) improvement of the neuromuscular function of the trunk, pelvis and lower limbs and (3) training of sport-specific tasks until return to sport (see online supplementary table S2). On average, the rate of return to sport of participants was 87% (range 56–100), while the rate of return to the same level of sport as before the occurrence of symptoms was 82% (range 55–100). Participants were evaluated at a mean of 2.3 years (range 0.5–5.0) after hip surgery. The mean mHHS score was 71 (range 61–86) and 92 (range 84–98) preoperatively and postoperatively, respectively, with an average increase of 1 points. The mean NAHS score was 70 (range 54–85) and 91 (range 86–99) preoperatively and postoperatively, respectively, with an average increase of 21 points. The mean HOS-Sport subscore was 82% (range 75–100), two studies reported a mean satisfaction of 8.5 (range 8.2–9.0) and one study a median satisfaction of 10. Complications related to hip surgery were only examined in eight studies (44%). Four of these studies (22%) reported that players did not show any complications, contrary to the four other studies (22%). In these four studies, players were operated on by hip arthroscopy and capsulolabral adhesions occurred with an incidence of 8%, transient lateral femoral cutaneous nerve neuropathy with an incidence of 4%, transient sciatic and femoral nerve neuropathy with an incidence of 1%, and transient pudendal nerve neuropathy and heterotopic ossification with an incidence of 0.5%.

**Level of competition**

One study reported a tendency for a higher rate of return to sport in professional rather than in recreational athletes at 6 months (78% vs 65%, respectively) and 1 year after hip arthroscopy (88% vs 73%, respectively).25 Similarly, a second study demonstrated a higher rate of return to sport in professional than in collegiate athletes at a mean of 1.6 years after hip arthroscopy (95% vs 85%, respectively).19 Another study showed a higher rate of return to sport in professional than in collegiate athletes (83% vs 59%, respectively), while the highest rate was observed in high school athletes (90%).21

**Time of follow-up**

One study showed that in a series of 45 professional athletes, 93% returned to sport after hip arthroscopy, but only 78% remained active at professional level at 1.5-year follow-up.14 Similarly, another study reported that 78% and 73% of their 33 athletes were playing at 1 and 2 years after hip arthroscopy,
and 81% returning to the same sport level as before the surgery. In addition, one study showed that 81% of their 120 professional athletes returned to play during the same season or the season after hip arthroscopy, while only 62% were still playing at a mean follow-up of 3 years (range 2–12 years). In contrast, one study reported that 4 years after open hip surgery, and this result was supported by another study which reported a mean satisfaction score of 8.2, ranging, however, between 5 and 10, and a mean HOS-Sport subscore of 77 in 21 professional athletes returned to play during the same season or the season after hip arthroscopy.

Associated self-reported outcomes

One study reported a mean satisfaction score of 8.2, ranging between 3 and 10, and a mean HOS-Sport subscore of 77 in 21 professional athletes at 3.5 years after hip arthroscopy. These results actually reflect the rates of return to sport reported by these professional athletes, with 86% of them returning to sport and 81% returning to the same sport level as before the occurrence of symptoms. Similarly, another study reported a mean HOS-Sport subscore of 89 in 22 professional athletes at 4 years after open hip surgery, and this result was supported by a rate of return to sport of 95% and by a rate of return to the same sport level of 86%. In contrast, one study reported that 75% of 153 recreational athletes were satisfied with their surgery outcome at 5 years postoperatively, but 85% had returned to sport. This suggests that, despite returning to sport, some athletes were not satisfied with their hip surgery outcome.

Table 2  Hip surgery description

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<tr>
<th>Study</th>
<th>Hip surgical approach</th>
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<td>Open surgery</td>
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<td>Philippon et al</td>
<td>Arthroscopy</td>
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*Hip surgical techniques used for the management of bony deformities, labrum tears and articular cartilage lesions are indicated for each study in the first, second and eventually in the third lines, respectively.*
hockey players at 2 years after hip arthroscopy. Despite incomplete satisfaction and not excellent sport ability, all athletes returned to the same sport level after hip surgery as before the occurrence of symptoms. In contrast, one study reported that 96% of 53 recreational athletes were satisfied with their surgery outcomes at 2.4 years after hip arthroscopy; however, only 82% returned to sport and 69% returned to the same level.

Articular cartilage lesions
One study observed that in a series of 24 professional Australian football players, the only athlete who could not return to sport had >40% cartilage loss at the time of hip surgery. Similarly, another study showed that in a series of 45 professional ice hockey players, only 3 athletes who could not return to sport presented with diffuse hip osteoarthritis at the time of hip arthroscopy. On the contrary, one study reported a 77% rate of return to sport early after hip arthroscopy in a group of professional athletes with Outerbridge grade IV (ie, full thickness) cartilage lesions treated using microfracture and a 70% rate of return to sport at a mean of 3 years of follow-up. In contrast, the same study reported a rate of return to sport of 84% early after hip arthroscopy in professional athletes with Outerbridge grade I–III cartilage lesions treated using chondroplasty, but only a 54% rate of return to sport at a mean of 3 years of follow-up.

DISCUSSION
A total of 18 studies with a low level of evidence (level IV, case series) were included in this systematic review to investigate the rate of return to sport of athletes after hip surgery for the treatment of symptomatic FAI. The methodological quality of the studies was moderate to high. On average, athletes demonstrate a high rate of return to sport (87%), and a high rate of return to the same level of sport as before the occurrence of symptoms (82%). Professional athletes seem to return to sport at a higher rate compared with recreational and collegiate athletes. Sport participation after hip arthroscopy tends to decrease for professional athletes at short-term and mid-term follow-ups. Diffuse hip osteoarthritis at the time of surgery may not allow athletes to return to sport. In addition, the rate of return to sport is not always positively associated with the actual satisfaction and sport ability of athletes.

The strengths of this systematic review are the use of (1) a reproducible search strategy, (2) the PRISMA guidelines, and (3) a validated tool for the methodological quality evaluation of case series. In addition, this systematic review includes nine new articles with respect to the systematic review by Altradwan et al about return to sport after hip surgery for FAI. Moreover, we discussed some aspects that may potentially influence the rate of return to sport of athletes. On the other side, a limitation of this review is that only one reviewer screened titles and abstracts of the studies obtained from the electronic search during the first phase of the eligibility process, thereby increasing the possibility of rejecting relevant reports. The reviewer had, however, a significant expertise with the scientific literature in the field of FAI. Another limitation is that only studies in English were included and most of them were conducted by world-renowned surgeons and facilities. Therefore, the high rates of return to sport observed in this systematic review are probably not generalisable to all hip surgeons and facilities. In addition, return to sport was not always defined by all studies as the same time point of the rehabilitation process. Some authors referred to return to sport as the return to sport-specific tasks (eg, skating/hockey drills), while others considered it to be the return to play or competition. Future studies should better report the different rehabilitation time points or at least specify which time of the rehabilitation process is meant as return to sport.

More professional than recreational or collegiate athletes returned to sport after hip surgery for FAI. Professional athletes are mainly interested in eliminating the symptoms that impair their sport performance in order to return to their sport activity as soon as possible after surgery. Indeed, they usually experience significant socioeconomic pressures from trainers, teams, managers and sponsors for an early return to competition. However, return to sport, especially the return to high-impact sport activities, is not always recommended for the health of the hip joint when degenerative changes are already present (ie, acetabular and/or femoral chondral lesions). Indeed, high-impact sport activities might potentially accelerate the degenerative process of the hip joint. In contrast, recreational athletes are usually more willing to reduce or change their sport activity habits, or even to discontinue sport if it is recommended by the hip surgeon. Indeed, Naal et al reported that even if recreational athletes practice several high-impact sport activities before hip surgery (eg, downhill skiing, jogging, soccer), they tend to change their sport habits after hip surgery towards low-impact activities (eg, cycling, fitness, biking).

To the best of our knowledge, no study has systematically compared the return to sport outcomes between athletes who underwent hip arthroscopy and open hip surgery. Based on the data summarised in this systematic review, nowadays, there is limited evidence supporting the superiority of hip arthroscopy over open hip surgery. On average, the rate of return to sport was 86% after hip arthroscopy and 87% after open hip surgery, and the rate of return to the same sport level as before the occurrence of symptoms was 84% and 81%, respectively. The surgical approach should be primarily dictated by the specific bony deformity and intra-articular pathologies presented by the symptomatic athletes. While the arthroscopic approach has mainly been used for the treatment of traditional cam and/or pincer bony deformities, open hip surgery is increasingly adopted for the correction of more complex bony abnormalities.

However, hip arthroscopy is very attractive for both hip surgeons and athletes since it offers a less invasive surgical approach, less muscle dissection, faster rehabilitation and, potentially, an earlier return to sport than open hip surgery. Hip arthroscopy is, however, technically demanding and presents considerable risks of iatrogenic chondral injury, particularly for inexperienced hip surgeons. In addition, incomplete corrections of bony deformities, which are difficult to address with hip arthroscopy, may lead to the persistence of symptoms and eventually require revision surgery. According to the rates of return to sport reported by some of the studies included in this review, there is a tendency for a reduction in sport participation over time for professional athletes at both short-term and mid-term follow-ups after hip arthroscopy. This may be explained not only by the persistence or even exacerbation of hip pain and dysfunction following hip arthroscopy but also by other factors such as retirement in professional athletes. Few studies reported on the duration of return to sport after hip surgery, which varies considerably within and between studies. In one study, the professional ice hockey players who returned to sport (100% of 28) played on average 94 games (range 3–252) after hip arthroscopy, where the regular season consists of 82 games. In another study, the professional players who returned to sport (81% of 120) played on average three seasons (range 1–12) after hip arthroscopy.
Given that some athletes may present with hip joint cartilage lesions resulting from FAI at the time of hip surgery, and that advanced articular cartilage lesions as well as hip osteoarthritis seem to be associated with negative clinical outcomes after hip preservation surgery, it is important to consider the negative influence of articular cartilage lesions on the return to sport of athletes. It seems, however, that discrete full-thickness chondral lesions can be successfully managed, at least in the short-term, using microfracture, which may lead to relatively high rates of return to sports in professional athletes.

In addition to return to sport outcomes, several studies have reported the satisfaction of athletes and some sport-specific outcomes after hip surgery. Overall, return to sport was not always positively associated with the satisfaction and the recovery of sport ability in FAI athletes. It seems that return to sport outcomes could overestimate the actual satisfaction and sport ability of athletes after hip surgery. While sometimes a high satisfaction is not necessarily associated with a high rate of return to sport, at least in recreational athletes.

Return to sport should not be used as a single outcome for evaluating the success of hip surgery, since it is a subjective outcome influenced by the treating surgeons and physiotherapists. Performance-based outcomes should be implemented so as to better characterise the ability of athletes to properly satisfy the sport-specific functional demands and the progress in rehabilitation. Nevertheless, even if it is well recognised that rehabilitation plays an important role in the management of athletes after hip surgery, nowadays, there is still limited evidence supporting the proposed rehabilitation protocols. Future studies should include RCTs that evaluate return to sport of athletes with FAI by comparing hip surgery approaches and rehabilitation protocols, and using self-reported and performance-based outcomes. In addition, return to sport should be prospectively reported at different follow-ups so as to observe for how long athletes get back to sport after hip surgery for FAI.

CONCLUSION

On average, from 18 studies analysed, 87% of the athletes with symptomatic FAI returned to sport after hip surgery and 82% could return to the same level of sport as before the occurrence of symptoms. The level of competition, the time of evaluation after hip surgery and the amount of articular cartilage lesions at the time of hip surgery may all influence the return to sport. In addition, the rate of return to sport is not always positively associated with the actual satisfaction and sport ability of athletes.

What are the new findings?

- A total of 18 studies with level of evidence IV (case series with moderate-to-high methodological quality) were included into the review.
- On average, 87% of athletes return to sport after hip surgery for femoroacetabular impingement (FAI), while only 82% returned to the same level of sport as before the occurrence of symptoms.
- Professional athletes present higher rates of return to sport compared with recreational or collegiate athletes.
- Return to sport does not always correspond to high satisfaction and excellent sport ability after hip surgery for FAI, at least in professional athletes.

There is a need for prospective studies with high levels of evidence that describe and evaluate the rehabilitation protocols performed by athletes and their return to sport at short-term and long-term follow-ups after hip surgery for FAI.

Contributors

NCC, ML, NAM and MB conceived the idea for the study. NCC performed the literature search. NCC and MB evaluated the eligibility of the studies. NCC and MB evaluated the methodological quality of the studies. NCC wrote the first draft of the manuscript. NCC, ML, NAM and MB approved the final version of the manuscript.

Competing interests

None.

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REFERENCES


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