Hip arthroscopy is an effective treatment for high-level female athletes

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ABSTRACT

Objectives: This study aimed to assess the outcomes of hip arthroscopic surgery in high-level female athletes diagnosed with femoroacetabular impingement (FAI) compared to those with lower levels of sports activity. Additionally, we investigated the effectiveness of patient-reported outcomes (PROs) and the potential ceiling effect as a lack of sensitivity in detecting clinically statistically significant changes in high-level female athletes due to high baseline scores.

Methods: We conducted a retrospective analysis of prospectively collected data from female patients who underwent hip arthroscopy for FAI between January 2016 and August 2022 with a minimum 1-year follow-up. Patients were categorised into two groups: high-level athletes (group A) and low sports activity level patients (group B). Various PROs, visual analogue scales for pain, and patient satisfaction were assessed preoperatively and postoperatively. Return to sports (RTS) rates were determined based on the patient's reported ability to return to their previous level of sports activity. The minimally clinically important differences (MCIDs) and the Patient-Acceptable Symptomatic State (PASS) analyses were used to evaluate the clinical impact of the Hip Outcome Score-Sport Subscale (HOS-SSS).

Results: A total of 11 high-level female athletes were included in group A, and 22 were included in the low sports activity level group B. Both groups showed significant improvements in PROs, with no significant differences between them. RTS rates were lower in high-level athletes (63.6%) than in low sports activity patients (85.7%). Visual analogue scales for pain improved significantly in both groups. Patient satisfaction was high in both groups, with a median score of 9. The HOS-SSS showed no ceiling effect, and the MCID and PASS analyses indicated that a high proportion of patients in both groups achieved clinically relevant improvement in HOS-SSS.

Conclusion: Hip arthroscopic surgery is effective for FAI treatment in high-level female athletes, with outcomes similar to those in patients with lower sports activity levels. The absence of a ceiling effect in sports-related outcomes suggests that PROs can detect clinically significant changes in high-level female athletes. Although RTS rates were lower in high-level athletes, this difference was not significant. These findings underscore the value of using PROs to evaluate outcomes in female athletes with different sports-activity levels.

Level of evidence: IV.

What are the new findings?

- Hip arthroscopy is an effective treatment for femoroacetabular impingement in women with high-level sports activity.
- The outcomes of high-level and low-level athletes are similar in terms of patient-reported outcomes and return to sport.
- There is no ceiling effect for sports-related outcomes in the female population with a high level of sports activity.
- Return to sports rates are lower in high-level sports activity than in low-level sports activity.

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INTRODUCTION

Femoroacetabular impingement (FAI) is a common hip condition that significantly affects athletes, often leading to functional limitations and a decline in sports performance. Hip arthroscopic surgery has emerged as an effective treatment for FAI, aiming to alleviate symptoms and improve functional outcomes. The validity of patient-reported outcomes (PROs) for monitoring and assessing the outcomes of arthroscopic surgery in patients with FAI symptoms is well-known; however, the impact of a high level of sports activity and its correlation with PROs in assessing postoperative improvements in athletes, especially in women, remains unclear.

Recent research has highlighted gender-specific differences in hip pathology between male and female athletes, suggesting that women may present unique challenges in FAI management [1–5], with a growing suspicion of potential predisposition to specific hip pathologies [4]. Different studies have examined gender differences in the outcomes of hip arthroscopic surgery in patients with FAI symptoms and the impact of their sports activity level on the functional results obtained. The outcomes in women, particularly in the medium term, are comparable to or even superior to those observed in men. Nevertheless, variations in diagnoses and procedures, characterised by a reduced occurrence of chondral injury and the need for microfractures, may suggest possible divergences in the long term. These distinctions warrant further investigation for validation.

The study included female patients with a confirmed diagnosis of FAI who had undergone arthroscopic surgery by the senior author. Data were prospectively collected and retrospectively reviewed for all women who underwent arthroscopic surgery for FAI treatment.

METHODS

The institutional review board approved the study (code 20235085) as it complied with good clinical practice standards and Spanish Good Clinical Practice (CPMP/ICH/135/95). All ethical standards of maintaining patient confidentiality have been applied, including those in accordance with the ethical principles derived from the Declaration of Helsinki (Fortaleza, Brazil, October 2013). This study used a retrospective analysis of prospectively collected data from female patients who underwent arthroscopic surgery for FAI treatment.

Participant recruitment

The study included female patients with a confirmed diagnosis of FAI who had undergone arthroscopic surgery by the senior author. Data were prospectively collected and retrospectively reviewed for all women who underwent primary hip arthroscopy for FAI from January 2016 to August 2022. Inclusion criteria include all patients with a minimum of 1-year follow-up, with a minimum Tegner Activity Scale score of 3 at the time of enrolment, and no data were lost during the review. Exclusion criteria were a body mass index (BMI) of ≥30, age ≥ 40 years, a medical history of ipsilateral hip surgery, and hips with osteoarthritis level greater than grade 1 according to Tönnis, and those unwilling to participate were also excluded.

For the high-level female athletes (group A) patients were considered eligible if they were professional, collegiate, or high school athletes with a confirmed diagnosis of FAI and had reported a baseline activity level, based on Tegner score of 7 or higher. For comparison, high-level female athletes were propensity matched in a 2:1 ratio to a low-sports-activity level group and assigned to this group if they had a Tegner score of 6 or lower (group B), according to a similar BMI and age (same or 15% variation in each matched cases). All eligible patients had been diagnosed with FAI based on history of hip pain, physical examination, and radiographic findings and had failure of conservative treatment.

Outcome measures and follow-up

During the preoperative visit, patients’ level of sports activity (Tegner scale), BMI data, patient age, and other demographic data were collected. Clinical assessment where obtained from the Non-Arthritic Hip Score (NAHS), the International Hip Outcome Tool (iHOT-33), and the Sport Specific Subscale of Hip Outcome Score (HOS-SSS). All scores were collected and translated into Spanish [5,6]. These assessments were routinely scheduled postoperatively at 6 months, as well as at 1, 2, 3, and 5 years. Additionally, patients were questioned about their ability to return to sports (RTS) during the following visits. A new visual analogue scale for pain (VAS pain), ranging from 0 to 10, was administered at each visit, and patient satisfaction was assessed using a visual analogue scale (VAS). We define RTS for high-level athletes as the ability to return to the preoperative competitive level. For the rest of the population, RTS was determined based on the patient’s reported ability to return to their previous recreational activities. To assess the clinical impact of the HOS-SSS variable in the two study groups, we used the minimally clinically important differences (MCID) and the patient acceptable symptomatic state (PASS) for this variable as determined in previous studies [7], establishing a difference of 10.6 points and a cut-off point of 77 points.

For statistical analyses, measurements obtained during the last postoperative visit with a minimum one-year follow-up were considered. The ceiling effect, indicative of an upper limit in measurement sensitivity, was assessed by evaluating whether the PROs demonstrated a clustering of scores at the highest end, limiting the ability to detect further improvements beyond a certain threshold.

Statistical analysis

The statistical analysis will be conducted following the principles specified in the International Conference of Harmonization (ICH) Topic E9 (CPMP/ICH/363/96).

Qualitative variables are presented with their frequency distribution. Quantitative variables are summarised with their mean and standard deviation. Quantitative variables that exhibit an asymmetric distribution are summarised with the median and interquartile range.

To assess the association between categorical variables, the χ² test or Fisher’s exact test, if necessary, was used. For analysing the results of the studied variables, PROs, VAS pain, VAS satisfaction, the Wilcoxon test was used since these variables are asymmetric. The relative preoperative and final differences in the different PROs were calculated to subsequently examine whether there are differences in the evolution between the two study groups. For this purpose, the Mann–Whitney U test was used for asymmetric variables. To investigate the potential correlation between the post-intervention time and the various studied PROs, Spearman’s correlation was applied, considering the asymmetric nature of the variables.

A significance level of 5% was accepted for all tests. Data processing and analysis were conducted using IBM SPSS Statistics v.26 statistical software.

RESULTS

Data were analysed from a single database for all female patients who underwent primary hip arthroscopic surgery performed by the senior surgeon (initials blinded for review) with a diagnosis of FAI during the period between January 2016 and August 2022. A total of 128 primary hip arthroscopic procedures occurred in 115 patients. Of these, 89 patients performed diagnostic procedures in 82 patients met the inclusion criteria with a minimum of 1-year follow-up, a minimum Tegner score of 3, and no missing data.
data. After applying exclusion criteria, a total of 41 patients fulfilled the requirement. In accordance with the predefined high-level athletes (group A), a total of 11 female athletes were included. As planned previously, group A was properly matched in a 2:1 ratio, with a total of 22 females in the low-sports-activity-level group (group B). Overall, a total of 33 patients were included in this study (Fig. 1). The mean follow-up period was 2.7 years (1–7 years). The mean age of the patients included in the study was 32 years ± 6.4 years. The mean BMI of the studied population was 21.7 ± 3.1. The most practiced sport in group A was competitive dance in its various forms, followed by competitive athletics. In group B, the most frequently practiced sport was gymnastics, followed by yoga and swimming. None of the patients included in the study required a reintervention.

Preoperative scores compared to those obtained at the end of follow-up, with a mean follow-up of 33.7 ± 24.1 months, revealed statistically significant improvements for all studied PROs (NAHS, iHOT-33, HOS-DLA and HOS-SSS) in both studied groups (Table 1 and Table 2). In high-level female athletes (group A), NAHS improved statistically significantly from a median score of 67 (range: 45–72.5) to 93.3 (range: 58.7–97.5) (p = 0.003), iHOT-33 improved statistically significantly from a median score of 44.5 (range: 33.5–62) to 80.3 (range: 48–93.3) (p = 0.003), HOS-DLA improved statistically significantly from a median score of 72 (range: 68.4–84.2) to 94.7 (range: 75–100) (p = 0.008), and HOS-SSS improved statistically significantly from a median score of 51.4 (range: 46.7–69.4) to 75 (range: 58.3–91.7) (p = 0.02) (Table 1) (Fig. 2). In female athletes with lower sports activity levels (group B), NAHS showed a statistically significant improvement from a preoperative median score of 57.8 (range: 46–70.5) to 85 (range: 77.5–93) (p < 0.001), iHOT-33 improved significantly from a preoperative median score of 38.2 (range: 32–55) to 73.2 (range: 62.3–89.1) (p < 0.001), HOS-DLA demonstrated a significant improvement from a preoperative median score of 64 (range: 58.2–77.5) to 92 (range: 78.9–97.9) (p = 0.002), and HOS-SSS improved significantly from a

**Table 1**

<table>
<thead>
<tr>
<th>Group</th>
<th>Preoperative</th>
<th>Last visit</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAHS</td>
<td>67 [45–72.5]</td>
<td>93.3 [58.7–97.5]</td>
<td>0.003</td>
</tr>
<tr>
<td>iHOT-33</td>
<td>44.5 [33.5–62]</td>
<td>80.3 [48–93.3]</td>
<td>0.003</td>
</tr>
<tr>
<td>HOS-DLA</td>
<td>72 [68.4–84.2]</td>
<td>94.7 [75–100]</td>
<td>0.008</td>
</tr>
<tr>
<td>HOS-SSS</td>
<td>51.4 [46.7–69.4]</td>
<td>75 [58.3–91.7]</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Abbreviations: PROs, patient-reported outcomes; NAHS, Non-Arthritic Hip Score; iHOT-33, International Hip Outcome Tool; HOS-DLA, Hip Outcome Score-Daily Life Activities; HOS-SSS, Hip Outcome Score-Sport-Specific subscale.

* Values are presented as median (interquartile range).
utilised, with these values considered as 10.6 points and 77 [7], respectively. Both groups of patients showed an MCID of 81.8% (9 high-level female athletes out of a total of 11, and 18 non-high-level female athletes out of a total of 22). In group A, a total of 72.7% of the patients surpassed the PASS threshold, whereas in Group B, 68.2% of the participants exceeded it.

When analysing the ceiling effect in the studied PROs, no significant proportion of patients achieving the maximum score was observed for any of the analysed indices. This percentage consistently remained below 1% in all cases. Therefore, we can conclude that the studied PROs do not exhibit a ceiling effect.

DISCUSSION

The most important finding of this study is the confirmation of the effectiveness of PROs in assessing postoperative improvements in a specific group of female athletes with FAI. The results of this study are consistent with the published literature to date, indicating that hip arthroscopic surgery in properly diagnosed FAI patients provides clinical benefits [8] both for high-level female athletes and females with lower levels of sports activity, as evidenced by the improvement in the results of the PROs obtained. On the other hand, we cannot accept our hypothesis, which was based on the premise that the HOS-SSS might exhibit a ceiling effect, implying that the effectiveness of PROs in detecting significant improvements is similar in high-level female athletes as well as in those with low sports activity levels.

In this study, we wanted to report on a very specific and homogeneous population of patients, namely high-level female athletes. Our study aimed to assess whether within the female population there are differences in the results obtained in the different variables studied. In order to maintain the study as homogeneous as possible, strict exclusion criteria were used, such as an age over 40 years, as this has been associated with worse outcomes [9,10] and a higher conversion rate to THA [11,12], and a BMI higher than 30, as a lower BMIs have been related to better patient-reported outcomes [13]. This was done to control confounding variables and improve comparability between the groups.

To contextualise our findings, we explored previous research on gender-specific differences in hip pathology between male and female athletes [4–14]. It has been reported that females present a higher prevalence of intra-articular and extra-articular hip injuries, including labral and ligamentum teres pathology, psoas impingement, proximal hamstring and gluteal tendinopathy, ischiofemoral impingement, stress fractures, and nerve entrapment syndromes [15]. These differences in injury patterns may contribute to the varying postoperative outcomes observed in female athletes.

Furthermore, the type of sport engaged in by female athletes appears to influence the pathophysiology and prognosis of hip injuries [14]. Athletes participating in flexibility sports demonstrated higher rates of cartilage lesions and tears of the round ligament after FAI surgery than do athletes in other sports [14]. The impact of the type of sport on postoperative outcomes warrants consideration in the evaluation and management of hip injuries in female athletes.

PROs are an essential measure to assess the effectiveness of FAI surgery. In several studies, both men and women have been found to experience significant improvements in PRO scores after hip arthroscopic surgery for FAI, with no significant gender-based differences [2,15–18]. It is important to note that, despite potential initial differences in clinical presentation, as described by Owens et al. [1], both the RAS rate, which ranges between 54% [2,19] and 93.9% [7,20], and the final PRO results are comparable in both cohorts.

However, the sensitivity of PROs to detect meaningful clinical changes in high-level female athletes remained a point of interest. As Meghpara et al. [21] point out, despite not finding significant differences when analysing the outcomes between a group of athletes versus non-athletes, the first group had a higher tendency towards superior PROs. In our study, we observed a similar pattern across all functional assessment scales, with one exception: the Hip Outcome Score-Sport Subscale (HOS-SSS). In this particular subscale, we noted lower results when than in the group of individuals with low sport activity levels. While no statistically significant differences were detected, this trend might be related to higher expectations among high-level female athletes.
or potentially more severe joint conditions at the time of surgery. It is important to note that this does not align with our initial hypothesis of a potential ceiling effect as the average and range of final outcomes values remain comparable between both groups.

It is worth mentioning that high-level athletes often receive financial compensation, which may lead them to delay surgery until their joint conditions worsen [15]. As observed by Liedman et al. [22], a delayed intervention with more severe joint damage could explain the lower RTS rate observed in athletes with high Tegner Activity scores (63%) than in those with lower scores (85%), although this difference lacks statistical significance. These findings emphasise the significance of utilising validated PROs to assess outcomes among athletes with varying levels of sports activity [23]. New studies to analyse intraoperative findings in both groups could help to elucidate this statement.

The primary limitation of this study stems from the relatively small number of patients within our study group comprising females engaged in high-level sports activities. This limitation may account for our inability to detect any differences when comparing RTS rates. However, it’s worth noting that this subset of patients is quite unique. Their economic and sporting interests make managing their expectations a complex task that cannot rely solely on standardised measurements. Instead, each case should be assessed individually.

We are not considering different technical issues in this study, just the results; however, cartilage damage can certainly be related to the lower results in sports related outcomes of high level of sport activity group and worst RTS. However, results in all the other PROs are similar in both groups with a significant improvement.

Finally, including patients with less than two years after surgery is an important limitation, but we did it to achieve maximum sample size of the high-level-sport-activity group.

CONCLUSIONS

FAI arthroscopic surgery is associated with good results according to the different PROs used in high-level and low-level athletes in the women population, without the ceiling effect of sports-related outcomes.

Rate of return to sports is lower in high level of sports activity than in low level of sports activity.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References


