



# Hip Injuries in Endurance Athletes: The Runner and Cyclist

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Running and cycling have become among the top athletic activities in the United States. While endurance sports can lead to decreased cardiovascular disease and chronic comorbidities, it can lead to musculoskeletal injury. Hip injuries in endurance athletes can be associated with both intra-articular and extra-articular disorders, resulting in prolonged decrease physical function and inability to return to sport. This review provides physicians with a summary of hip injury commonly presented in long distance runners and cyclist, as well as clinical exam recommendations for the source of hip pain in these endurance athletes.

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## Introduction

Arthroscopic treatment of femoroacetabular impingement syndrome (FAIS) with labral repair and osteochondroplasty is widely utilized with excellent success rates, favorable patient satisfaction, and a high rate of return to sport.<sup>1,7,9,25,31</sup> The high rate of return to activity is supported in part by a less invasive surgery with accelerated rehabilitation.<sup>3</sup> In a systematic review, the rate of return to sport in all athletes was 92% in 2011 with a return to previous level of competition of 88%.<sup>1</sup> The rates of return to sport following hip arthroscopy range from 73%-94% for recreational athletes, 84%-88% for elite amateur athletes, and 88%-95% for professional athletes.<sup>8,22,23,31</sup> Additional factors influencing return to sport include the sport type, level of competition, and severity of the intraarticular hip damage.<sup>12</sup> These factors have a significant impact on return to endurance sports.

## Running

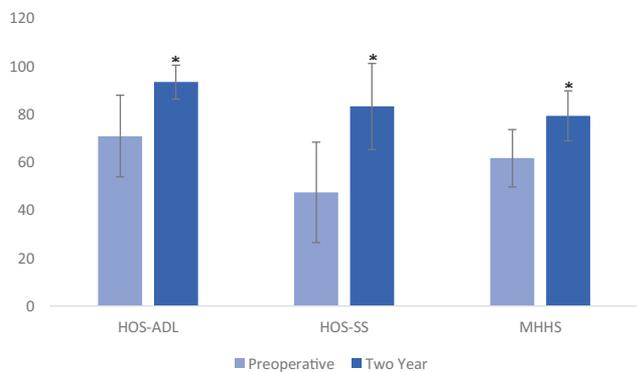
Running, particularly specifically marathon and long distance, is extremely popular in the United States with more than 500,000 marathon finishers annually since 2010.<sup>29</sup>

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Half-marathon finishers have hovered around 2 million annually since 2012.<sup>28</sup> With the growth in popularity, the incidence of symptomatic hip pain is expected to rise. Hip pain in runners can be a disabling and frustrating limitation to activity.<sup>17,19,24</sup> For those with symptomatic hip pain secondary to FAIS, hip arthroscopy has been a successful treatment with a high rate of return to sport.<sup>21</sup>

Runners with the pain will have a typical insidious onset of pain. The pain has been described to begin at the start of the run in progressing with increasing mileage. Some runners are unable to participate in running at all.<sup>17,21</sup> A case series examining elite level runners with hip pain that was refractory to nonoperative treatments, Guanche et al found positive physical exam impingement signs but symmetric range of motion.<sup>17</sup> The runners had Tonnis grade 0 and MRI evidence of labral tear. No readily identifiable cartilage pathology was seen on imaging. At the time of hip arthroscopy in elite long distance runners demonstrated a high rate of labral tears with an increase in chondral wear.<sup>17</sup> Reason for this increased wear pattern is not clear and has been theorized to be related to a degree of microscopic hypermobility. Regardless of the etiology, it is important to consider labral pathology and chondral pathology in runners with refractory hip pain in the differential diagnosis.

A case series that assessed outcomes and return to sport in all runners identified substantially better improvements after FAIS.<sup>21</sup> In the study, 2-year follow-up data was retrospectively reviewed from 52 consecutive patients who self-identified as



**Figure 1** Comparison of preoperative versus 2-year postoperative clinical outcome scores. \*Indicates statistically significant difference in comparison of preoperative versus 2-year postoperative score ( $P$  value > 0.001).

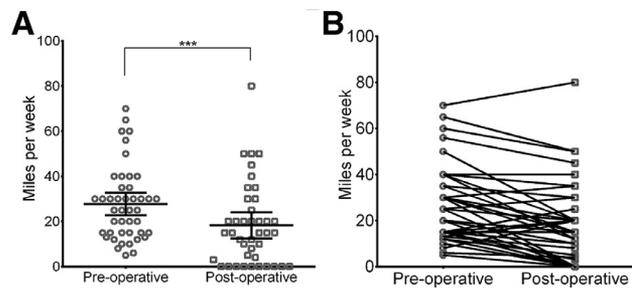
recreational or competitive runners. Forty-nine patients (94%) returned to running at an average of  $8.5 \pm 4.2$  months after surgery. All 2-year outcomes measured (HOS-ADL, HOS-SS, and mHHS) had statistically significant improved outcomes (Fig. 1), with females having a higher change in HOS-ADL scores from baseline when compared to males. This is of particular interest as many previous studies have demonstrated that females have inferior outcome scores after undergoing hip arthroscopy for treatment of FAI syndrome.<sup>18,26</sup> The study also demonstrated that there is a moderate association between increased BMI and lower postoperative improvement, which is consistent with the findings of Westerman et al that BMI is an independent predictor of postoperative pain and hip function.<sup>32</sup> Lastly, the case series demonstrated a moderate decrease in weekly distance ran 2 years after surgery ( $9.5 \pm 6.4$  vs  $6.5 \pm 5.9$  miles/week;  $P < 0.01$ ) (Table 1). On a 10-point scale, patients indicated that prolonged pain and fear of reinjury were higher of a rationale than loss of interest in running.

In our data, patients who ran marathons prior to undergoing hip arthroscopy were evaluated at greater than 2 years follow-up. These patients underwent labral repair with femoral osteoplasty and standard rehabilitation.<sup>20</sup> A total of 36 patients (82%) returned to running following hip arthroscopy for FAIS. Eleven of these patients (25%) returned to long-distance

**Table 1** Comparison of Preoperative and Postoperative Running Metrics

	Mean ± Standard Dev.
<b>Distance and time</b>	
Pre-op miles per week	9.7 ± 6.4
Post-op miles per week	6.5 ± 5.9*
Pre-op hours running per week	4.7 ± 3.1
Post-op hours running per week	3.0 ± 2.4*
<b>Reasons for discontinued running</b>	
Postoperative pain	5.1 ± 3.5
Fear of reinjury	4.9 ± 3.7
Loss of interest in running	3.1 ± 2.9
No longer participating at given institution	2.5 ± 2.8

\*Indicate statistical significance in comparison of preoperative versus postoperative metrics.

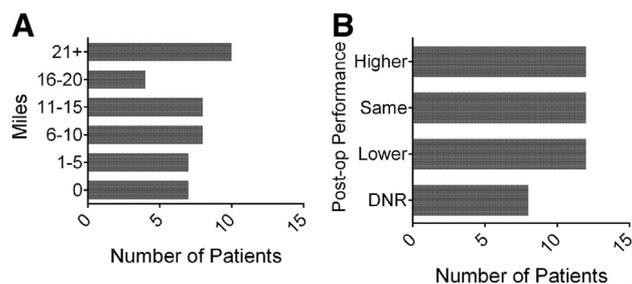


**Figure 2** Pre- and postoperative weekly mileage for the marathon cohort. (A) Mean mileage. Each point represents a runner with the line as the mean mileage and error bars representing the 95% confidence interval. (B) Individual runners demonstrating the change from pre- to postoperative weekly mileage. Each point may represent more than 1 patient if weekly mileage was reported as the same number. (Color version of figure is available online.)

running with completion of a marathon. The furthest distance run in a single episode during the 2-year minimum postoperative period is shown in Figure 3A. Seven patients did not return to running at all and 1 attempted but was unable to continue. The weekly mileage run decreased from  $27.7 \pm 16.3$  miles to  $17.8 \pm 18.2$  miles, which was a significant reduction of  $9.90 \pm 11.5$  miles (95% CI: 6.32-13.5,  $P < 0.001$ ; Fig. 2). The mean time to return to running without pain for those that returned was  $7.9 \pm 6.2$  months. The level of self-reported postoperative performance was evenly distributed among those who returned to running (Fig. 3B). For those who did not return to marathon running, the reasons for not returning are outlined in Table 2. Fourteen patients reported both pain and fear of reinjury as the reasons for decreasing or stopping running. Six patients who reported pain as a reason for decreasing running also cited pain other than the operative hip. All patients demonstrated significant improvement from pre- to postoperative patient reported outcomes measures (Table 3).

## Cycling

Cycling continues to grow in popularity as a recreational and competitive sport. The number of Americans riding 100 days



**Figure 3** Self-reported postoperative return to running. (A) Furthest distance run in a single episode following surgery. (B) Self-reported postoperative performance running performance. Responses to the question “compared to before surgery, what level are you currently running at?” DNR: did not return. (Color version of figure is available online.)

**Table 2** Reasons for Not Returning to Running or Decreasing Running Intensity/Frequency Following Hip Arthroscopy

Reason	Number of Patients
Fear of reinjury	20
Pain	19
Loss of interest	5
Physical limitation other than hip	13

**Table 3** Pre-and Postoperative Patient Reported Outcome Measures Following Hip Arthroscopy for Femoroacetabular Impingement Syndrome

	Preoperative (95% CI)	Postoperative (95% CI)	P value
HOS-ADL	68.92 (58.9-76.61)	92.65 (88.95-96.20)	<0.001
HOS-SS	45.74 (37.64-55.15)	79.11 (75.22-88.84)	<0.001
mHHS	62.35 (57.94-70.61)	83.79 (80.28-91.48)	<0.001
VAS-Pain	58.32 (51.85-69.4)	17.69 (8.06-23.99)	<0.001

ADL, activities of daily living; HOS, hip outcome score; HOS-SS, hip outcome score-sport specific; mHHS, modified Harris Hip Score; VAS, Visual Analog Score (Pain).

or more in the United States increased by 12% from 2000-2010.<sup>14</sup> USA Cycling reported steady increases in competitive cycling licenses with a 78% increase between 2002 and 2013.<sup>11</sup> While tendonitides and bursitis about the hip and the knee are attributed to abnormal repetitive motion, poor positioning, or inadequate recovery time,<sup>30</sup> intraarticular hip pain in cyclists remains an enigma.

Cycling is generally considered a favorable form of exercise because of its low-impact and aerobic benefits; however, cycling places the hip in a position that may predispose the hip to impingement. Lajam et al found that the mean maximum hip flexion angle in the forward flexed position during cycling is  $133.7^\circ \pm 9.7^\circ$ , and the mean flexion angle at which impingement occurs during intraoperative assessment is  $52.8^\circ \pm 11.4^\circ$ .<sup>10</sup> The high flexion angle may predispose cyclists to impingement with chondral and labral injuries from repetitive trauma. This theory is consistent with findings that persistent intra-articular hip pain in cyclists is associated with significant chondro-labral disease. In a matched case control study, Stone et al found that cyclists demonstrated significantly greater: femoral head chondromalacia grade, femoral head chondromalacia area, and femoral head chondromalacia index (severity of the disease) at the time of hip arthroscopy.<sup>27</sup> Hip pain in cyclists positively correlated with an increased acetabular center edge angle and an increased Tonnis grade. At the time of hip arthroscopy, all cyclists were found to have at least partial tearing of the labral cartilage from the acetabular bony rim at the time of arthroscopy and several demonstrated complete disruption of the chondrolabral interface. The labral tears occurred in the anterosuperior portion of the acetabulum (10 to 12-o'clock position in the right hip). This finding was suggestive of repetitive trauma that may be related to the position of the hip in the cyclist is flexed in a low riding position that further insults a portion of the labrum predisposed to tearing.<sup>13,17</sup>

Despite the potential for increased chondral damage at the time of presentation and subsequent hip arthroscopy, cyclists have a high rate of return to sport after hip arthroscopy for femoral acetabular impingement syndrome. Following hip arthroscopy for FAIS in cyclists, Frank et al reported a high rate of return to cycling activities with 97% of patients able to return the same (41%) or higher (59%) level of cycling compared with preoperative levels.<sup>16</sup> Cyclists were able to return at a mean  $4.5 \pm 2.5$  months after hip arthroscopy. Significantly improved patient reported outcomes were seen at 2-year minimum follow-up with continued cycling activity at final follow-up.<sup>16</sup> The authors found that only 2 of 58 patients were unable to return, with 1 of not returning to cycling secondary to persistent hip pain. Patient age, sex, and BMI were not independently associated with either patient reported outcomes or return to cycling rates.<sup>16</sup>

The data in aggregate, supports that the cyclists are at a risk for femoroacetabular impingement and may present with more advanced disease. This finding may be the result of improved tolerance secondary to the non-weightbearing nature of the sport. While cyclists may have greater chondromalacia at the time of arthroscopy, labral repair, and osteoplasty to address the underlying pathology produces significant improvements in patient reported outcomes and return to cycling.

## Exam Considerations

Cyclists and elite runners demonstrate many similar symptoms and physical exam findings.<sup>17,27</sup> Guanche et al. reported that elite runners in their series had very insidious onset of pain with increasing pain with activity, which was similar to our reported symptoms. Both studies identified similar rates of mechanical symptoms in the athletes (43% of cyclists and 50% of runners<sup>17</sup>). Runners and cyclists demonstrated normal and symmetrical terminal hip flexion on physical examination, although the FABER test was asymmetric between legs. Symmetric terminal flexion is expected, since both running and cycling demand equal leg strength and contributions. Sports with differential leg contributions from a lead or kicking leg, such as soccer or throwing, may more commonly demonstrate asymmetric range of motion. One potential reason for similar symptoms between the runners and cyclists is the prevalence of labral pathology and associated chondral lesions. Labral tears were identified in all cyclists and runners.<sup>17,27</sup>

## Conclusions

As the participation of both long-distance running and cycling continues to grow, so will the number of patients presenting to orthopedic clinicians with cases of FAIS. Arthroscopy for athletes and labral pathology at large is highly successful,<sup>2,4,6,15,25</sup> however, the presence of chondral damage portends a worse prognosis for all patients regardless of sporting activity.<sup>2,5,6</sup> Since the patients in our cycling group demonstrated a greater degree of chondromalacia in both the femoral head and acetabulum, it is important to

counsel patients on expectations peri-operatively. Postoperative rehabilitation may be focused on preventing exacerbation of chondral symptoms. Clinicians should consider the results from the studies presented in this review, and counsel patients involved in long-distance running and cycling on recovery expectations and return to sport.

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