Femoroacetabular Impingement in Professional Basketball Players

Return to Play, Career Length, and Performance After Hip Arthroscopy

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Background: Previous studies have demonstrated that hip arthroscopy is an effective treatment for symptomatic femoroacetabular impingement (FAI) in professional athletes across a variety of sports. However, the return-to-play rates and postoperative performance of elite basketball players after hip arthroscopy are currently unknown.

Purpose: To determine return-to-play rates and postoperative performance among professional basketball athletes after hip arthroscopy.

Study Design: Case series; Level of evidence, 3.

Methods: Eighteen professional basketball players underwent hip arthroscopy (24 hips) for symptomatic FAI between 2001 and 2016 by a single surgeon. Return to play was defined as competing in a single professional game of equal level after surgery. Data were retrospectively obtained for each player from basketball-reference.com, ESPN.com, eurobasket.com, and individual team websites. Matched controls were selected from the websites to compare performances.

Results: The mean age at the time of surgery was 25.6 years, and the mean body mass index was 24.4 kg/m^2. All players returned to their previous levels of competition, with a mean number of 4 seasons played after surgery (median, 3; range, 1-12). The mean ± SD time between the date of surgery and return to a professional game was 7.1 ± 4.4 months. There was no change in player efficiency rating when pre- and postinjury performance were compared. When compared with controls, players undergoing surgery also had no significant decline in player efficiency rating.

Conclusion: Elite basketball athletes who undergo hip arthroscopy for the treatment of FAI return to their presurgical levels of competition at a high rate. These athletes demonstrate no significant overall decrease in performance upon their return to play.

Keywords: FAI; hip arthroscopy; return to play; performance

Basketball is a physically demanding sport, and athletes are at risk for a variety of injuries, including injuries of the hip.[25] Hip pathology is present among elite basketball players.[4,9,16] Among high school basketball players, hip/thigh injuries represent 8.2% and 8.7% of all injuries for male and female athletes, respectively.[4] Hip injuries among National Basketball Association (NBA) players account for 6.2% of all injuries and 4.3% of games missed, with most being categorized as sprains/strains.[9,16] However, the understanding and diagnosis of femoroacetabular impingement (FAI) have increased over recent years, and a number of these athletes were likely misdiagnosed as having a "strain" when the etiology of pain was truly FAI.[9,16]

The performance of basketball players depends on high-impact activities, such as repetitive jumping, sprinting, and full-speed cutting. Forceful hip flexion, abduction, and external rotation combined with repetitive loading have been shown to promote chondrolabral dysfunction and separation between the labrum and articular margin.[33] It is thought that the repetitive activities combined with FAI anatomy can result in increased shear forces concentrated on the acetabular rim cartilage and labrum, leading to damage of these structures and resulting in symptoms. These activities are important for basketball players. Additionally, participation in high-intensity sports such as basketball during adolescence may repetitively stress physeal development and lead to the creation of a cam-type deformity.[24,28,37] These changes are characteristic of FAI, which represents an abnormal relationship between the anatomy of the proximal femur and acetabulum, and they are a cause of intra-articular hip pathology and pain.[22]

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Intra-articular hip pathology is a potential cause of significant disability for the elite athlete.[5,11,12,20-22,27,34,36] Expedient diagnosis and effective treatment are paramount, as untreated FAI has been shown to progress and contribute to continued symptoms and subsequent joint degeneration.[22,36] An increased understanding of the condition, with improved arthroscopic techniques and indications, has enhanced the ability of the orthopaedic surgeon to diagnose and treat FAI among athletes.[1,33] Additionally, the minimally invasive nature of the procedure allows for a faster return to play than do open procedures.[5,7,11,20,21,27,29,36] Several studies have described arthroscopic hip procedures to treat symptomatic FAI among elite professional athletes.[20-22,34,36] These prior studies demonstrated high rates of return to play in professional sports, such as ice hockey, football, soccer, baseball, and golf.[12,18,22,26,36] However, the performance outcomes and return-to-play rates of professional basketball players after hip arthroscopy are currently unknown.

The purpose of this study was to determine the return-to-play rates and the postoperative performance of elite professional basketball players who underwent hip arthroscopy for treatment of symptomatic FAI. Our hypothesis was that professional basketball players would return to play at a high rate and would return to preinjury performance levels after arthroscopic treatment of FAI.

METHODS

Patient Selection and Demographic and Performance Data

All professional basketball players (14 men, 4 women) who underwent hip arthroscopic procedures for FAI between 2001 and 2016 by a single surgeon were identified. Inclusion criteria included athletes who had symptomatic FAI causing debilitating hip pain that interfered with their professional performance and that had failed extensive nonoperative treatment. Only active professional basketball players in the NBA, Women's National Basketball Association, or top European basketball leagues were included in the study. The study was approved by the institutional review board.

Data were obtained for each player from statistical websites, including basketball-reference.com, eurobasket.com, and ESPN.com, as well as individual team websites. This method has been validated in multiple studies.[3,6,10,14,23] Successful return to play was defined as playing in a single regular season game at the same competitive level after hip arthroscopy. Operative data, including intraoperative details and the specifics of the procedures performed, were obtained for each athlete retrospectively through a prospectively collected database.

The 18 players who underwent hip arthroscopy were matched to 18 controls, who were selected, when available, on "similarity scores" provided by a comprehensive online database (basketball-reference.com). This score identifies players whose careers are most similar according to performance data and seasons of play. Regarding position, backcourt players were classified as "guards," while frontcourt players were classified as "forwards." The included control group athletes were also matched by position and had no significant history of hip injury or hip arthroscopy. The controls were selected from the online database.

Performance data were recorded before and after surgery and included games played. For the surgical group, preoperative data were collected before the reported onset of symptoms, so data were not affected by symptoms before arthroscopy. Additionally, NBA player efficiency rating (PER) data were collected on patients and controls. PER is a novel statistical method that involves the summation of a player's positive statistical contributions subtracted by one's negative measures.[15] An annual PER of 15 is designated to represent an average NBA player. PER is a comprehensive statistic that accounts for variables such as an athlete's playing time as well as the style of one's team and allows for standardized comparisons among players. It was previously used as a variable in similar studies.[2,3,6]

Clinical Assessment

Patients underwent a thorough history and physical examination of the hip at the time of initial presentation. Clinical symptoms included pain and/or other mechanical symptoms isolated to the hip. All patients noted decreased function and inability to continue their current professional levels of play because of their hip symptoms. Physical examination findings indicative of FAI included a positive anterior impingement sign and/or FABER test (flexion-abduction-external rotation).[31] A positive anterior impingement sign was defined as groin pain with 90° of hip flexion and maximal internal rotation. A positive FABER test was defined as asymmetry between the injured and noninjured extremities when placed in a figure-of-4 position.[21] The distance from the lateral knee to the examination table was measured in centimeters, with an increased distance found in the injured extremity.

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Radiographs of the affected hip were obtained for all patients, consisting of anteroposterior pelvis, false profile, and Dunn view at 45° or cross-table lateral. Advanced imaging, including magnetic resonance imaging without contrast, was obtained to evaluate for the presence of labral tearing, chondral injury, soft tissue lesions, or other pathologic abnormalities in or around the hip joint. A board-certified musculoskeletal radiologist read and interpreted all magnetic resonance imaging studies.

Before arthroscopic treatment, all patients underwent an extensive course of nonoperative treatment that failed to provide satisfactory results. The initial nonoperative treatment protocol consisted of a minimum 6-week course of nonsteroidal anti-inflammatory medication, corticosteroid injections to the hip, physical therapy, and/or activity modification.

Surgical Findings

Intraoperative findings (including labral and chondral pathological changes) and surgical details were recorded. Surgical details included labral treatment (debridement, repair, or reconstruction) as well as whether chondral defects were present and if microfracture was required.

Arthroscopic Procedure

A previously described arthroscopic procedure was performed by a single surgeon (M.J.P.) in all cases using a modified supine approach.[29,30,35] Traction was applied, after which anterolateral and midanterior arthroscopic portals were created and a diagnostic arthroscopy was performed. Pincer impingement was treated with detachment of the labrum and resection of the acetabular rim. The condition of the labrum was evaluated and treated with debridement, repair, or reconstruction according to the labral pathology present. Chondral lesions were treated with either chondroplasty or microfracture, depending on the size and severity of the lesion. The ligamentum teres was assessed and debrided in the setting of synovitis and/or hypertrophy. Intra-articular loose bodies were removed, and a partial iliopsoas tendon release was performed at the level of the labrum if iliopsoas impingement was present. The hip was taken out of traction, and cam-type femoral deformities were addressed with femoral osteoplasty at the head-neck junction. Dynamic examination of the hip was performed to confirm that all aspects of FAI were surgically addressed and to confirm that the suction seal of the joint had been restored. The capsule was closed in all cases, and in the setting of capsular laxity, a capsular plication was performed.

Postoperative Rehabilitation

Postoperatively, all athletes were limited to 20 lb toe-touch weightbearing on the operative extremity, with 4 hours of continuous passive motion daily for the first 2 postoperative weeks. If the patient underwent microfracture, the weightbearing restriction and continuous passive motion regimen were continued for 8 weeks. Supervised physical therapy was initiated on postoperative day 1, consisting initially of gentle hip circumduction exercises and passive range of motion that progressed to active range of motion, followed by strengthening and endurance exercises.

TABLE 1
Radiographic Measurements of 21 Surgical Cases From the Study Cohort

	Degrees	
Angle	Mean	SD
Lateral center edge	33	8.8
Sharp	42	10.1
Weightbearing surface	8.9	7.1
Alpha	67.6	12

Statistical Analysis

Statistical analysis were performed with SPSS statistical software (v 11; SPSS Inc., Chicago, Illinois). Categorical variables were analyzed by chi-square analysis. All reported P values are 2-tailed, with $<.05$ indicating a statistically significant difference.

RESULTS

Eighteen professional basketball players (24 hips), including 14 men and 4 women, underwent hip arthroscopy for symptomatic FAI between 2001 and 2016 by a single surgeon. Five players underwent bilateral hip arthroscopy for symptomatic FAI, and 1 player underwent revision hip arthroscopy for labral reconstruction. The mean age of the athletes at the time of surgery was 25.6 ± 4 years (range, 19-30 years). Their mean body mass index at the time of surgery was 24.4 ± 1.4 kg/m^2. Regarding position of play, the study population consisted of 15 forwards and 3 guards. Of 24 injuries, 14 happened within 6 months prior to surgery, 2 from 7 to 12 months, 6 from 13 to 24 months, and 2 before the start of the player's career. Three hips (3 players) had prior surgery: 7, 49, and 88 months before the index arthroscopy. All 3 patients had treatment of cam and pincer FAI. One patient had debridement of the labrum; 1 had a repair; and 1 had labral reconstruction at their prior hip arthroscopy.

Radiographic measurements were available for analysis on 21 hips (Table 1). Ninety-five percent of hips (20 of 21) demonstrated a joint space >2.0 mm, and 85% (18 of 21) had an alpha angle >55°.

Examination results were available for 19 hips. Mean values for hip range of motion are shown in Table 2. For the FABER distance test, 63% (12 of 19) of hips demonstrated a positive test result; 100% had a positive anterior impingement test result; and 16% (3 of 19) had a positive result with the log-roll test on the affected extremity.

Details of arthroscopic surgical procedures performed were available for all 24 hips (Table 3). Labral tears were identified for 100% of hips, and the mean length of the labral tear was 36.9 ± 17 mm.

TABLE 2
Preoperative Examination Results on 19 Hips From the Study Cohort

	Degrees, Mean ± SD	
Examination Maneuver	Surgical Hip	Nonsurgical Hip
Flexion	112 ± 11	127 ± 13
Abduction	41 ± 11	43 ± 6
Adduction	20 ± 8	23 ± 5
Internal rotation	31 ± 6	36 ± 9
External rotation	37 ± 9	38 ± 8

TABLE 3
Documented Surgical Pathology of the 24 Arthroscopic Procedures

	n (%)
Labral tear	24 (100)
Labral debridement	5
Labral repair	16
Labral reconstruction	3
Microfracture	
Acetabulum	6
Femoral head	7
Osteoplasty	20
Acetabular rim trimming	18
Subspine decompression	4
Plication	
Capsular	18
Iliofemoral ligament	17
Ligamentum teres debridement	20
Synovectomy	19

All 18 athletes (100%) returned to play at their previous levels of competition after operative intervention. The amount of time that elapsed between the date of surgery and the date of return to play in a professional game was available for all athletes. Three surgical procedures occurred during the season. Of these, 2 players (66.7%) were able to return to play in the same season (days missed attributed to injury, 99 and 55, respectively). Of 24 surgical procedures, 21 (88%) occurred in the offseason. Overall, 22 of 24 (92%) surgical cases returned to play by the season after surgery. One player underwent bilateral hip arthroscopies in a 6-month period and subsequently missed the next season because of his recovery. The mean ± SD time missed from competition after surgery was 7.1 ± 4.4 months. Athletes played 4.0 ± 3.2 seasons (median, 3; range, 1-12) in the NBA, Women's National Basketball Association, and EuroLeague after hip arthroscopy.

Athletes who underwent hip arthroscopy for FAI were examined for pre- and postsurgical performance variables (Table 4), which demonstrated no significant differences before or after surgical intervention. Additionally, athletes' PER values did not significantly change after hip arthroscopy. Five players (5 hips) had an increase in their mean PER over the 3 seasons after hip arthroscopy, as compared with the 3 seasons before hip arthroscopy. However, only 2 athletes (2 hips) had their PER increase >1 point for this time frame.

TABLE 4
Statistical Comparison Pre- and Postsurgery Among Players Who Underwent Hip Arthroscopy[a]

	Before Symptom Onset	After Arthroscopy	*P* Value
Player efficiency rating	15.5	14	.15
Games played	39.6	42.3	.74
Minutes per game	24	21	.09
Field goal, %	47	47	.83
Free throw, %	75	67	.12
Per game			
Rebounds	2.8	4.3	.36
Assists	1.8	1.5	.26
Steals	0.715	0.58	.23
Blocks	0.69	0.66	.69
Points	10.7	9.1	.06
Per 36 min			
Rebounds	7.9	7.8	.75
Assists	2.4	2.4	.48
Steals	0.98	1.1	.21
Blocks	0.83	1.1	.15
Points	14.2	13.1	.054

[a]There were no significant differences in specific statistical measures or player efficiency rating when presurgical performance was compared with postsurgical performance. Values are presented as means unless noted otherwise.

Performance variables were also compared between athletes who underwent hip arthroscopy and matched controls (Table 5). After arthroscopy, the athletes undergoing surgery demonstrated a significant difference in only blocks per 36 minutes when compared with uninjured matched controls. Otherwise, no specific performance variables differed between the groups. Similarly, PER did not significantly differ between the athletes who underwent hip arthroscopy and individual matched controls.

Pre- and postsurgical performance was compared between athletes who underwent microfracture of the hip and those who did not (Table 6). Microfracture results were available for 21 surgical cases. Although average PER before symptom onset was lower in the microfracture group, postsurgical PER did not differ between the groups.

DISCUSSION

The results of this study demonstrate that, overall, arthroscopic treatment for symptomatic FAI allowed elite basketball players to return to the professional level and did not change their performance after recovery. All players included in the study returned to play at a level of competition equal to that before symptom onset. On average, athletes played 4 professional seasons after their surgery, demonstrating that arthroscopic treatment did not lead to a premature end to an athlete's career. Five players (6 hips of 24, 25%) played only 1 season after hip arthroscopy. For 3 of these players, the time of this study occurred at 1 season after arthroscopy, so they have the potential to continue. One player, a 30-year-old center, had both hips done

TABLE 5
Statistical Comparison Between Athletes Who Underwent Hip Arthroscopy and Matched Noninjured Controls[a]

	Before Symptom Onset			After Arthroscopy		
	Patients (n = 18)	Controls (n = 18)	*P* Value	Patients (n = 18)	Controls (n = 18)	*P* Value
Player efficiency rating	15.5	14.4	.44	14	13.9	.76
Games played	39.6	59	.003	42.3	54	.003
Minutes per game	24	23	.77	21	22	.62
Field goal, %	47	47	.77	47	44	.28
Free throw, %	75	68	.31	67	69	.68
Per game						
Rebounds	4.7	4.4	.67	4.3	4.2	.69
Assists	1.8	1.8	.69	1.5	1.8	.19
Steals	0.715	0.77	.86	0.61	0.77	.16
Blocks	0.69	0.56	.53	0.65	0.43	.16
Points	10.7	10.9	.79	9.1	10.1	.26
Per 36 min						
Rebounds	7.9	7.5	.72	7.7	7.1	.54
Assists	2.4	2.8	.19	2.6	2.4	.55
Steals	0.98	1.1	.30	1.1	1.2	.49
Blocks	0.83	0.78	.77	1.0	0.66	.04
Points	14.5	15.6	.40	13.1	15.5	.13

[a]Surgical athletes experienced a decrease in steals per 36 minutes; otherwise, there were no significant differences in statistical performance between the patients and the matched controls. Values are presented as means unless noted otherwise.

TABLE 6
Statistical Performance Comparison Between Athletes Who Underwent Microfracture During Hip Arthroscopy and Those Who Did Not[a]

	Microfracture		
	No	Yes	*P* Value
No.	12	9	
Age, y	25	25	.82
Player efficiency rating			
Before symptom onset	18.7	9.1	.02
After arthroscopy	15.4	12.5	.15
Games played			
Before symptom onset	49.6	58.8	.65
After arthroscopy	41.4	49.3	.48
Minutes per game			
Before symptom onset	28.8	19.1	.19
After arthroscopy	22.6	17.1	.13
Field goal, %			
Before symptom onset	48	41	.19
After arthroscopy	47	51	.33
Free throw, %			
Before symptom onset	73	78	.69
After arthroscopy	71	61	.13

[a]Results are available for 21 athletes. Values are presented as means unless noted otherwise.

in the off-season and returned for only 1 season. The other player was also a 30-year-old center; she played for 12 seasons, had the surgery, and then retired after season 13. Two players continued to play >10 years after hip arthroscopy. Athletes did not experience a significant difference in games played, minutes per game, or PER upon return from surgery.

The mean time missed from competition after surgery was 7.1 ± 4.4 months, and 90% of cases returned to play by the season immediately after surgery. Comparatively, this recovery period is shorter than that experienced by athletes in other sports.[8,17,18] Degen and colleagues[8] reported that elite baseball players returned at a mean 8.6 ± 4.2 months after hip arthroscopy. Levy et al[17] examined return to performance after hip arthroscopy among competitive runners with symptomatic FAI and reported return to activity at a mean 8.1 ± 5.7 months, while Locks et al[18] published a 9.2-month mean time between surgery and return to play among professional soccer players. While the nature of this discrepancy is unknown, the relatively long length of the NBA season as well as smaller roster sizes may have promoted faster recovery periods.

Basketball is a sport that requires dynamic and explosive repetitive motions—activities that require coordination of the lower extremity kinetic chain, which relies on a healthy hip joint. Forceful hip flexion, abduction, and external rotation—as required in basketball activities such as high-intensity jumping, cutting, and defending—subject the femoral head-neck junction and chondrolabral interface to stress and may lead to labral tears and symptomatic FAI.[28,33] Indeed, FAI morphology is common among basketball players. Siebenrock et al[38] found that basketball athletes were 10 times as likely to have an alpha angle >55° when compared with age-matched controls. As the understanding of FAI continues to evolve, the diagnosis of the condition among elite basketball players has increased, and the potential effect on performance has become a question of interest for the athletic and orthopaedic communities.

When postsurgical athletes were compared with individually matched healthy controls, steals per 36 minutes

was the only statistical performance measure that differed significantly between the groups. Minutes per game and PER did not differ between patients and controls. Therefore, this study demonstrates that hip arthroscopy allowed the athletes to return to play without loss of performance and without negatively affecting their careers. Interestingly, 2 athletes did have their mean PER over 3 seasons increase >1 point after hip arthroscopy, suggesting that some athletes may have been trying to "play through" their preoperative FAI symptoms.

Radiographic evidence of FAI was prominent among the study population, with 95% of athletes demonstrating an alpha angle >55°, indicating a cam-type deformity. Specifically, increased hip alpha angles were associated with increased rates of articular lesions and labral pathology.[13,32,34] Additionally, the FABER distance test, which demonstrated a relatively high positive predictive value for FAI[19,39] and correlated with significant alpha angles,[39] was positive among 63% of examined athletes.

Our study has several limitations. It involves a relatively small number of athletes. Given the sample size, the analysis may be subject to type II error, and larger future studies would be of value; however, this study represents the largest cohort of elite basketball players after hip arthroscopy. Specifically, our cohort includes 15 forwards and 3 guards, and larger studies that include more guards could more effectively compare outcomes and results by position. Additionally, we cannot definitively exclude concomitant injuries among athletes over the study period, although efforts were made to account for such potential confounding variables and controls were highly matched according to position, performance, and experience. Furthermore, we included patients undergoing primary and revision hip arthroscopy for analysis, which may represent different patient populations. However, both populations returned to play, which we believe is important information for a treating orthopaedic surgeon to know.

FAI exists on a continuum, and there was likely a period when FAI was radiographically present but asymptomatic. We do not have data to define when this transition happened for each player. We compared pre- and postoperative player outcomes and PERs but were unable to account for exactly when the athlete's hip progressed to being symptomatic. The preoperative measures could represent a time when the players were playing through early symptoms. This could have resulted in lower measures of player function versus a truly asymptomatic state. Finally, it is possible that off-court confounding variables existed, such as players' personal lives and teams' styles of play and systems, and that these factors influence players' performance and timing of return to play. However, a strength of the study is the use of PER as the primary performance variable, as it is a comprehensive performance statistic designed for maximal standardization.

CONCLUSION

After hip arthroscopy, elite basketball players returned to play at a very high rate. Additionally, athletes did not experience a significant postsurgical decrease in performance levels as compared with their presurgical statistics or when compared with matched controls. With appropriate diagnosis and management, most elite basketball players may be expected to make a full athletic recovery after arthroscopic treatment of symptomatic FAI.

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