Athletic Performance in the National Basketball Association After Arthroscopic Debridement of Osteochondral Lesions of the Talus

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Background: Use of marrow-stimulating techniques to treat osteochondral lesions of the talus (OLTs) in National Basketball Association (NBA) players is controversial.

Hypothesis: NBA players will be able to return to preinjury playing status after treatment of OLTs by arthroscopic debridement alone without marrow-stimulating techniques.

Study Design: Cohort study; Level of evidence, 3.

Methods: Between the 2000 and 2015 seasons, 10 NBA players were treated with arthroscopic debridement of an OLT. The following performance outcomes were compared pre- and postoperatively: seasons played, games played, games started, minutes per game, points per game, field goals, 3-point shots, rebounds, assists, double doubles, triple doubles, steals, blocks, turnovers, personal fouls, assists per turnovers, steals per turnovers, NBA rating, scoring efficiency, and shooting efficiency. In addition, the players were compared with a matched control group using mixed effects regression and Fisher least significant difference modeling.

Results: All 10 players returned to play in the NBA after arthroscopic debridement without microfracture or drilling of an OLT. When compared with preoperative performance, postoperative mean points scored, assists made, and steals made increased by 2.86 ($P = .042$), 0.61 ($P = .049$), and 0.15 ($P = .027$), respectively. Only field goal percentage decreased postoperatively when compared with matched controls; however, this normalized by the end of the second season after surgery. There was no statistically significant change in any of the other performance factors when compared with matched controls. All patients returned to basketball during the same season (n = 1) or the following season (n = 9) if the operation was performed off-season. The mean length of career after surgery was 4.1 years, with 5 players still playing in the league at the time of this study.

Conclusion: After arthroscopic debridement of an OLT without drilling or microfracture, there was a high rate of return to the NBA, with improved points scored, assists, and steals made after surgery when compared with preoperative performance. There was no statistically significant change in any performance factors when compared with uninjured matched controls. Lesion size did not affect player career length. These data should be used to manage patients' and teams' expectations regarding players' ability to return to elite levels of athletic performance after surgery of an OLT.

Keywords: OCD; osteochondral lesions of the talus; NBA players; National Basketball Association; return to sport

The exact incidence of osteochondral lesions of the talus (OLTs) is unknown, as they are commonly diagnosed only when associated with other ankle injuries. A retrospective study among active US military personnel estimated an incidence of up to 56 OLTs per 100,000 persons.[29,40] Articular cartilage injuries have been reported in up to 50% of patients with ankle sprains.[34] Ankle sprains are one of the most common musculoskeletal injuries in the world, with almost 2 million reported each year in the United States alone.[44] The pathophysiological cause of OLTs is also unclear. Several hypotheses have been described, including acute trauma, chronic microtrauma,[33] ankle instability,[24] vascular insufficiency,[6,25] and genetic predisposition.[4,6,18,39,46]

Trauma can lead to chronic lateral ankle instability. In a retrospective review of 61 patients who underwent primary ankle lateral ligament reconstruction for chronic instability, 14 (21%) had an associated OLT.[12] Ferkel and Chams[14] indicated that 95% of patients undergoing a modified Broström procedure for lateral ankle instability had some type of intra-articular pathology. Komenda and Ferkel[21] stated that

25% of patients undergoing lateral ankle stabilization had chondral lesions noted arthroscopically. There appears to be an association between location of an OLT and its cause, with a fairly even distribution between medial and lateral lesions.[5,7] Medial-sided osteochondral lesions are associated with trauma 64% to 82% of the time, while lateral-sided lesions have been reported nearly 100% of the time.[1,8,16] Lateral ankle sprains have been reported as the most frequent orthopaedic injury in the National Basketball Association (NBA) as described in an epidemiological study evaluating 1094 players over a 17-year period.[13,38] Previous literature has examined the effect of lower extremity injuries such as anterior cruciate ligament (ACL) tears in NBA players. In 1 study, 86% of players were able to return to sport after ACL reconstruction, but there were performance changes, including decreases in games per season, minutes played, points and rebounds per game, and field goal percentage.[19] High-quality studies exist in the literature for other sports and for other injuries, with correct methodology to analyze the effects of orthopaedic surgery on professional athletes; however, the literature lacks any studies that examine OLTs treated surgically in the NBA.[2,3,9,19]

In this study, players were matched by multiple performance and demographic variables to obtain a similar objectively matched control group for comparison regarding changes in player performance after surgical debridement of an OLT. We hypothesized that NBA players who underwent arthroscopic debridement of an OLT would perform the same when compared with controls matched by age, body mass index (BMI), position, and performance.

METHODS

NBA players who underwent surgery for OLTs performed by the senior author (R.D.F.) were identified through surgical records between 2000 and 2015 via a previously published methodology.[2,3,35] Indications for surgery included (1) failure of nonoperative treatment with persistent symptoms, (2) mechanical complaints such as locking or catching, and (3) presence of an isolated distinct OLT. Inclusion criteria included players who were treated only with arthroscopic debridement of an OLT. At the same time, other debridement procedures were performed, including removal of loose body and/or osteophytes and scar tissue. Exclusion criteria included OLTs that were treated with any more invasive procedures, such as microfracture/drilling, fixation, and cartilage implant procedures. Also excluded were patients with concomitant fractures or any concomitant surgical procedures (eg, anterolateral ligament repair, reconstructions). Institutional review board approval was granted for the retrospective study of our surgical patients.

For selection of the control group, a full roster of NBA players was obtained, and age, height, weight, BMI, position, and player performance were documented. Players were excluded if they had any surgical procedure that resulted in a loss of playing time. Each study player was matched 1:2 to controls with respect to age, height, weight, BMI, position, player performance, and time from his rookie season. The identical performance data were acquired for the study and control groups.

Compiled player data included age at intervention season, height, weight, BMI, position, draft pick, years in league, number of teams before surgery, number of teams after surgery, location of lesion, size of lesion, laterality of extremity affected, and hand dominance. Player performance variables (Appendix Table A1) were compared from before to after surgery. Player and performance variables were also compared with those of matched controls and divided into 6 categories: rookie season, seasons after rookie season before surgery, season after surgery, second season after surgery, third season after surgery, and fourth season after surgery. Institutional review board approval was not required to conduct the analysis of the control group, given that the data gathered were obtained from an publicly available database.

Statistical Analysis

For a given outcome measure, the presurgery score was defined as the mean score per game over all presurgical seasons observed in a player. The postsurgery score was defined as the mean score per game over all postsurgical seasons observed in a player. Change score was computed as postscore minus prescore. Assessment of postsurgery change outcomes was evaluated parametrically using the paired t test and nonparametrically using the Wilcoxon signed-rank test. Evaluation of the bivariable correlations between postsurgery scores and the continuous covariates, such as age or BMI, the Spearman method, or the Pearson method was utilized as appropriate. Evaluation of the mean changes in a given outcome Y (change score) per change in the covariate X was calculated using linear regression models after confirming the parametric assumptions of this model. The assumption of normality was assessed using quantile-quantile plots of the residuals, whereas the constant variance assumption was assessed by evaluating plots of the means versus the residuals under the regression models. Linearity was assessed using splines.

Comparison of the change score by level of each binary variable was calculated using the *t* test (parametric analysis) and the Wilcoxon rank-sum test (nonparametric analysis). The parametric assumptions were assessed using similar methods to those mentioned previously.

For the comparison of study players and controls, the mean change from baseline (base = rookie season) for each outcome measure was compared between groups over time using the mixed-effects regression model after confirming the parametric assumptions of this model, including normality and constant variance. Based on this model, means were modeled as a function of time (5 levels not including baseline) and group (case, control). The group, time, and group × time interaction were modeled as fixed effects. The effect of player was modeled as a random effect, thus taking into account that measurements within the same player over time were not independent. The normality assumption was evaluated using quantile-quantile plots of the residuals under the above model. The constant variance assumption was evaluated by constructing plots of the means versus the residuals under the above model. We confirmed that there were no major violations of the parametric assumptions. The pairwise mean differences between groups over time were evaluated using the Fisher least significant difference criterion under the model. To maximize the power of the statistical analysis, the most complete available data on each NBA player were utilized. An a priori sample size calculation was not performed, as this study did not prospectively enroll any participants. *P* values <.05 were considered statistically significant.

RESULTS

Ten players with OLTs met the inclusion criteria and were analyzed for return to sport and performance. All 10 (100%) successfully returned to play in the NBA. All patients returned to play basketball during the same season (n = 1) or the following season (n = 9) if the operation was performed during the off season. The mean length of career after surgery was 4.1 years. Five players were still playing in the league at the time of this publication. No one retired

because of issues related to the ankle. When compared with preoperative performance, postoperative mean points scored increased by 2.86 (*P* = .042), assists made increased by 0.61 (*P* = .049), and steals made increased by 0.15 (*P* = .027). Several other performance parameters increased as compared with preoperative performance; however, none reached statistical significance. All players were matched 1:2 to controls by age, height, weight, BMI, position, and player performance during the rookie season. There was no statistical difference in any demographic or performance variable between test participants and controls. Only field goal percentage decreased postoperatively versus matched controls; however, this normalized by the end of the second season after surgery (Figure 1). Difference in mean field goal percentage change from rookie season between patients and healthy controls at each time point was not statistically significant. Characteristics of the players are shown in Tables 1 and 2. Size of the osteochondral lesions ranged from 14 to 100 mm^2 with a mean of 42 mm^2. As far as we know, no player had additional surgery on the affected ankle.

Magnetic resonance imaging (MRI) was performed on all players at 1 year postoperatively and showed excision of the osteochondral lesion and resolution of bone marrow edema.
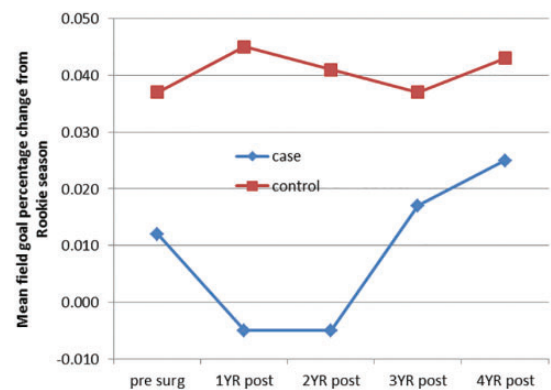
Figure 1. Mean field goal percentage change from rookie season versus time from surgery. YR, year.

TABLE 1
Player Characteristics[a]

Player	Age at Surgery, y	Years in NBA After Surgery	Position	Round Drafted	Location of Lesion (Dome)	Size of Lesion, mm
1	24	4[b]	PG	First	Middle lateral	5 × 3
2	26	1	SG	Second	Anterolateral	5 × 3
3	23	1[b]	PG	First	Centrolateral	10 × 10
4	22	10	PG	First	Posteromedial	12 × 7
5	21	2[b]	SG	Second	Middle lateral	5 × 8
6	24	9	PF	First	Posterolateral	5 × 5
7	24	1[b]	PG	First	Posteromedial	7 × 2
8	28	1[b]	C	Undrafted	Anterolateral	13 × 4
9	28	11	SG	First	Middle lateral	10 × 4
10	32	2	PG	First	Posterolateral	8 × 6

[a]C, center; NBA, National Basketball Association; PF, power forward; PG, point guard; SG, shooting guard.
[b]Active in league as of the end of this study.

TABLE 2
Variables of Cases and Controls[a]

Variable	No.	Minimum	Q1	Median	Mean ± SD	Q3	Maximum
Age, y							
Cases	10	21.2	23.4	24.0	25.3 ± 3.2	28.0	32.0
Controls	20	20.0	22.5	24.0	24.4 ± 2.6	26.0	29.0
Height, cm							
Cases	10	182.9	188.0	190.5	194.3 ± 9.1	200.7	210.8
Controls	20	182.9	190.5	191.8	194.8 ± 8.6	198.1	210.8
Weight, kg							
Cases	10	79.8	86.2	90.7	93.8 ± 11.8	99.2	117.9
Controls	20	79.8	86.2	90.7	93.8 ± 11.5	95.2	117.9
BMI							
Cases	10	23.6	23.8	24.3	24.6 ± 1.1	25.0	27.2
Controls	20	23.6	23.8	24.3	24.6 ± 1.1	25.0	27.2
Years in league							
Cases	10	2.0	4.0	6.5	7.7 ± 5.0	11.0	18.0
Controls	20	6.0	8.0	10.0	10.8 ± 3.9	13.0	18.0
Area of lesion, mm^2							
Cases	10	14	15	32.5	41.88 ± 33.09	63	100

[a]Cases and controls were matched 1:2 by BMI, height, weight, and position. BMI, body mass index; Q1, 25th percentile; Q3, 75th percentile.

Case Example

A 23-year-old right-handed NBA player injured his left ankle during a game. He jumped and landed on the outside of the left foot, twisting the ankle into inversion. He was unable to continue play. Findings from radiographs taken of the ankle on the date of injury appeared normal. He was treated with laser, pulse, and electrical stimulation therapy, as well as mobility exercises and ice compression, and he underwent 2 MRI scans of the ankle. He missed 12 games because of the injury. Sometime between the injury and presentation, he tried to return to play but got through only half a game before his symptoms exacerbated and he was unable to continue play. His MRI and computed tomography images demonstrated an unstable OLT, as shown in Figure 2. He reported recurrent pain and locking and was taken to surgery because of continued problems. Surgery revealed that the patient had a loose centrolateral OLT, as shown in Figure 3 (A and B). The unstable fragment was removed with a grasper, and the resulting fragment measured 10 × 10 mm, as shown in Figure 3 (C and D). Postoperatively, he was kept nonweightbearing in a splint for 1 week, followed by partial weightbearing in a boot for 1 week while weaning off crutches. At 2 weeks, he was placed in an ankle brace and tennis shoe. Physical therapy was started at 3 weeks postoperatively. Surgery was performed in the offseason, and the athlete returned to play by the start of the following season without pain or problems. He did not miss any games during the season because of his ankle. He continues to play in the NBA.

DISCUSSION

The most important results of this study showed a high rate of return to the NBA, with improvements in points scored and assists and steals made after surgery when compared with preoperative performance. Professional basketball is a physically demanding sport with almost twice as many game-related injuries documented than at the college level, likely related to comparatively longer games and seasons.[26,38] The rates of injury have significantly increased over the past few decades.[13,30,38] Similar outcomes for the general population as well as elite athletes are desired, such as relief of symptoms and return to daily activities; however, elite athletes require more objective performance-based measurements given the increased physical demands of their occupation. Several foot and ankle–specific outcome rating scales have been published and used for the general population, such as Foot and Ankle Outcome Score, Foot and Ankle Ability Measure, and American Orthopaedic Foot & Ankle Society outcome score; however, none have been validated in high-performing athletes. Some authors have even developed and validated sports-related ankle injury outcome score instruments, such as the Sports Athlete Foot and Ankle Score for high-performing athletes, but they are yet to be widely utilized.[27] There are several publications evaluating the effect of orthopaedic injuries and procedures on the outcome of the professional athlete. The information provided is vital in managing expectations and counseling elite athletes during the decision-making process after career-altering injuries. The return-to-play and performance measure outcomes have been reported in various lower extremity injuries. NBA players who underwent an Achilles tendon repair had the worst prognosis, as the procedure led to the highest rate of retirement without returning to play.[26] Furthermore, these players, similar to their professional football counterparts, exhibited the largest decrease in postoperative season performance and games played as
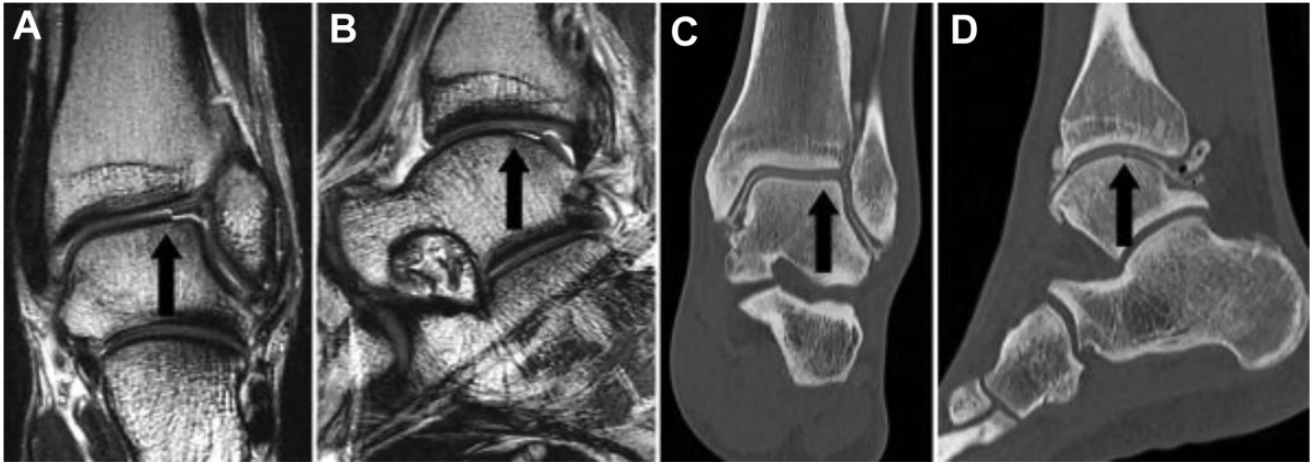
Figure 2. (A) Coronal T2-weighted MRI shows a subtle, small, minimally displaced chondral flap along the posterolateral talar dome (arrow) with minimal fluid tracking beneath the flap. (B) Sagittal T2-weighted MRI depicts the same chondral flap, which appears to remain attached anteriorly (arrow). (C) Coronal CT arthrogram shows a small, full-thickness chondral defect evident along the lateral talar dome (arrow) without significant displacement. (D) Sagittal CT arthrogram again shows a small, full-thickness chondral defect (arrow) with no significant osseous fracture fragment. CT, computed tomography; MRI, magnetic resonance imaging.
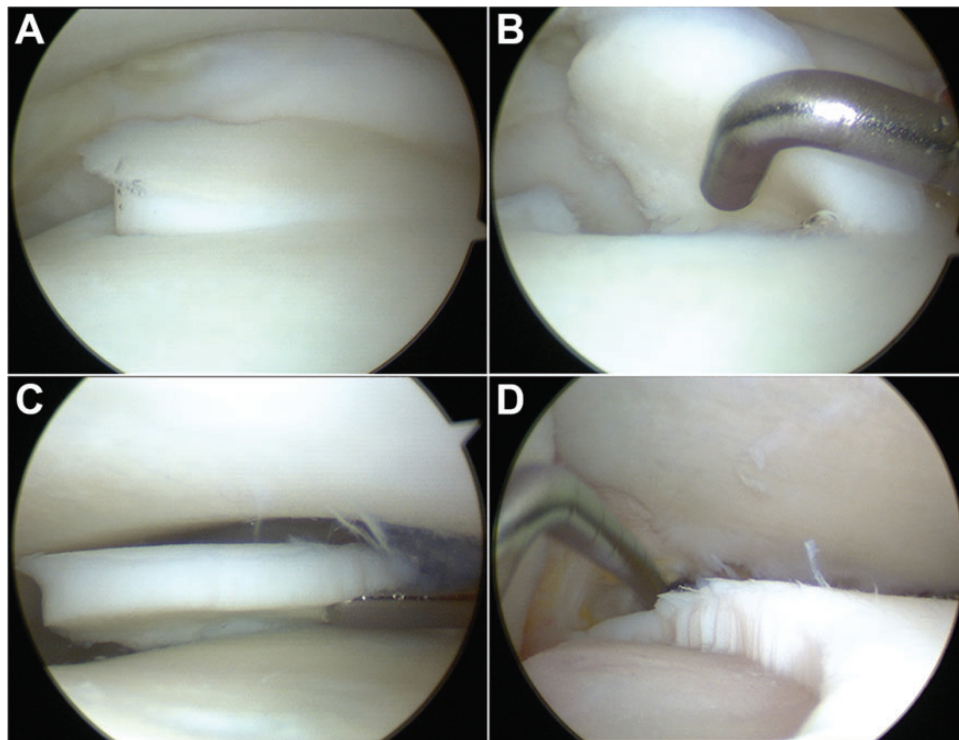
Figure 3. (A) Centrolateral talar dome lesion noted from the anteromedial portal in a left ankle. (B) A probe is inserted from the anterolateral portal and is used to assess the stability of the cartilage flap. (C) The unstable cartilage flap (10 × 10 mm) is removed with a grasper through the anterolateral portal. (D) The centrolateral talar dome after debridement as visualized from the posterolateral portal. The probe is coming from the anterolateral portal.

compared with that after other lower extremity surgical procedures. The reasons for these findings are attributed to the unique physical demands of professional basketball as compared with other sports, including quick accelerations and decelerations, sudden change in directions, cutting maneuvers, and eccentric loading of the lower extremity, making it difficult to return to play at an elite level.[23,26]

Outcomes of cartilage injuries to the lower extremity have been mixed. Results of microfracture in the knee have been varied, with 21% to 33% of NBA players never returning to the professional arena.[10,20,28] Studies have shown that return to sport is possible after arthroscopic debridement and bone marrow stimulation in the ankle, with 76% of the general athletic population returning; however, the activity level decreased at long-term follow-up and never reached the level of that before injury.[42] In addition, Ferkel et al[15] looked at long-term follow-up of drilling and microfracture and found that 35% of patients demonstrated a deterioration in the AOFAS Ankle and Hindfoot Score results over 5 years. In a study on OLTs in patients treated with marrow stimulation techniques (MSTs), van Bergen et al[41] found that at 140 months after surgery, radiographic results deteriorated 1 grade on the van Djik scale in 33% of patients. Polat et al[31] examined 82 patients at long-term follow-up (121 months) after treatment for OLTs. They found that 23% had pain with walking >2 hours or after competitive sports. This group had a larger OLT mean size defect (1.7 cm^2) than patients in our study. Yang and Lee[47] studied 25 patients with OLTs treated with microfracture. Based on MRI and second-look arthroscopy, 36% of the OLTs were incompletely healed and had inferior quality repair tissue. Moreover, Shimozono et al[36] examined the effect of microfracture on 42 patients with an OLT. Their evaluation used examinations and MRI and showed that after microfracture, the subchondral bone was not restored and subchondral cysts developed at midterm follow-up. They postulated that the subchondral bone damage was associated with poorer clinical outcomes at final follow-up.[36]

The size of the osteochondral lesion also helps to determine treatment. Choi et al[11] showed best results using the AOFAS Ankle Hindfoot Score with MSTs in 10 patients with OLTs <150 mm^2. Ramponi et al[32] reviewed 25 clinical studies and found that MST results using the AOFAS Ankle Hindfoot Score for OLTs are best for lesion sizes of less than 107.4 mm^2.

Treatment options for OLTs are numerous and include nonoperative methods, such as immobilization and protected weightbearing or nonweightbearing for Berndt and Harty type 1 and 2 lesions and small type 3 lesions, especially in patients <18 years of age.[17,43,45] Operative treatments for OLT range from open versus arthroscopic excision and debridement with curettage and/or drilling to debridement with microfracture, autologous chondrocyte transplantation, arthrotomy with autograft or allograft using osseous or osteochondral grafts, and other newer treatments.[37,45] Although several studies have shown these treatments to be performed with varying levels of success, the ability to return to sport, especially in elite athletes, has not been well-documented.[22,34] Based on the relatively poor results published for microfracture of the knee in the NBA and the results for MSTs of the ankle mentioned here, we believe that arthroscopic debridement alone without microfracture/drilling is a more effective treatment option for athletes with OLTs <107.4 mm^2. Our results show the following: first, arthroscopic debridement is a viable option for elite athletes who wish to return to sport and perform at a level comparable with that of their unaffected counterparts

within 2 years postoperatively; second, the size of the lesion did not affect the length of the player's career. This is an improvement when compared with previous literature showing that (1) most orthopaedic procedures lead to a decrease in games played in the subsequent season and (2) for surgery other than that of the knee and Achilles tendon, players are able to return to their baseline performance and games played within 3 years postoperatively.[2,19,26] Given that the average NBA career is only 4.8 years, a procedure that provides return to sport with minimal morbidity and an expeditious recovery is ideal for the professional athlete.

The data shown here suggest that player performance was diminished after surgery but returned to baseline within 2 years and even matched that of their uninjured counterparts after 2 years. This is important because a player usually improves his performance statistics the longer he stays in the league; most orthopaedic procedures affect a player's performance such that his baseline is never achieved. The reasons for this are likely multifactorial. Theories include postoperative deconditioning, image of reliability, and perceived limitation of the team's athletic performance based on the injured athlete's length of time as the "disabled player" who is affecting team dynamics; however, there are no scientific data to support such claims. The players in this study showed return to play within the same or following season with improved points, assists, and steals as compared with their preoperative performance. All surgery was performed in the off-season except for 1 patient who returned to play in the league 7 weeks after surgery. Given the short nature of the average NBA career, it was integral to match players to controls according to preinjury performance to account for normal career-related performance attrition and progression. Although the data shown appear promising for the treatment of OLTs with arthroscopic debridement alone, it is important to keep in mind that measures such as return to sport and performance are multifactorial, and many confounders will invariably be present. A randomized trial study would be ideal; however, given the high-profile patient population, such a study would be difficult to conduct. Regardless, the conclusions drawn from this study can be used to establish career and performance outcome expectations of an NBA athlete with an OLT who wishes to pursue arthroscopic debridement of an OLT once nonoperative measures have failed.

Limitations

There are certain limitations to this study. The sample size was small, and a larger multicenter study may give more insights. We utilized publicly available data, which are susceptible to reporting and selection bias. Several confounders existed that cannot be accounted for, such as playing style, team and coach preferences, and minor postintervention injuries that may affect player statistics, although this has been the case in multiply cited studies in high-level evidence sports medicine journals.[2,13,20] There also may have been personal reasons for retirement, which cannot be controlled for through our methodology. Additional limitations include the lack of comparison with other treatment options, such as

microfracture and osteochondral grafting, which have shown some promising results in the literature. Moreover, our data did not have biomechanical information, such as mechanical joint alignment, which could play a role in player recovery after surgery. Additionally, we did not use player efficiency rating (PER) scores, as used in other studies. The PER largely measures offensive performance and does not place as much emphasis on defensive performance. Some have argued that the PER gives undue weight to a player's contribution in limited minutes or against a team's second unit, and it undervalues players who have enough diversity in their game to play starter's minutes. We utilized performance measure statistics that were raw values; these data can be calculated into various efficiency ratings. Finally, long-term effects are hard to extrapolate to the general population given the relatively short career of NBA athletes. To our knowledge, this is the first and largest study of its kind to report the outcomes of NBA players who have undergone arthroscopic debridement alone for an OLT.

CONCLUSION

Debridement of an OLT in an NBA athlete allows return to sport at a level equal to that his preoperative, noninjured performance. These results should aid physicians who care for professional as well as high school, college, and recreational basketball athletes, along with their coaches, trainers, and agents. However, the long-term results of such treatment are unknown at this time.

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APPENDIX

TABLE A1
NBA Player and Performance Variables[a]

Variable (Abbreviation)
Seasons played (SP)
Games played (GP)
Games started (GS)
Minutes per game (MIN)
Points per game (PPG)
Field goal percentage (FG%)
Three-point percentage (3P%)
Rebounds (REB)
Assists (AST)
Steals (STL)
Blocks (BLK)
Turnovers (TO)
Personal fouls (PF)
Double doubles (DBLDBL)
Triple doubles (TRIDBL)
Assists per turnovers (AST/TO)
Steals per turnovers (STL/TO)
NBA rating (RAT)
Scoring efficiency (SCEFF)
Shooting efficiency (SHEFF)

[a]NBA, National Basketball Association.