Trends in Primary and Revision Anterior Cruciate Ligament Reconstruction Among National Basketball Association Team Physicians

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Abstract

Anterior cruciate ligament (ACL) tears are common in athletes. Techniques and methods of treatment for these injuries continue to vary among surgeons.

Thirty National Basketball Association (NBA) team physicians were surveyed during the NBA Pre-Draft Combine. Survey questions involved current and previous practice methods of primary and revision ACL reconstruction, including technique, graft choice, rehabilitation, and treatment of combined ACL and medial collateral ligament injuries. Descriptive parametric statistics, Fisher exact test, and logistic regression were used, and significance was set at $\alpha = 0.05$.

All 30 team physicians completed the survey. Eighty-seven percent indicated they use autograft (81% bone–patellar tendon–bone) for primary ACL reconstruction in NBA athletes, and 43% indicated they use autograft for revision cases. Fourteen surgeons (47%) indicated they use an anteromedial portal (AMP) for femoral tunnel drilling, whereas 5 years earlier only 4 (13%) used this technique. There was a significant ($P = .009$) positive correlation between fewer years in practice and AMP use.

NBA team physicians' use of an AMP for femoral tunnel drilling has increased over the past 5 years.

Anterior cruciate ligament (ACL) injuries are common in both recreational and high-level athletes.[1,2] Because of its jumping and pivoting requirements, basketball in particular can cause transmission of excessive force to the knees. Of injuries sustained by National Basketball Association (NBA) players, 19.6% were related to the knee, and 4% of these were ACL sprains.[3] ACL injury rates for men playing collegiate basketball have been reported to be as high as 0.13 incident per 1000 athletic exposures.[4]

In high-level athletes, ACL reconstruction is preferred for restoring the translational and rotatory stability of the knee[5,6] and for reducing the risk for meniscus and cartilage damage.[7-9] However, surgeons have not reached a consensus regarding optimal techniques and methods for primary ACL reconstruction. Some surgeons prefer a transtibial (TT) approach for drilling the femoral tunnel,[10] whereas others prefer an accessory anteromedial portal (AMP).[11,12] Graft types—autograft hamstring and bone–patellar tendon–bone (BPTB) tendons,[13] and allograft sources[14]—provide additional options. Other areas lacking consensus are postreconstructive use of bracing[15] and continuous passive motion (CPM) machines[16] and return-to-play guidelines.[17,18]

Revision ACL surgery introduces more variables, including whether to perform reconstruction in 1 stage, or to use a 2-stage procedure with bone grafting.[19] Compared with primary reconstruction, revision surgery also varies with respect

Authors' Disclosure Statement: Dr. Mall wishes to report that he receives royalties, financial, or material support from Vindico Medical Education. Dr. Abrams wishes to report that he he is a paid consultant to and owns stock options in Cytonics Inc. Dr. Azar wishes to report that he owns stock or stock options in Pfizer; receives royalties, financial, or material support from Elsevier; and is a board member of the American Academy of Orthopaedic Surgeons (AAOS), Campbell Foundation, and St. Jude's Children's Research Hospital. Dr. Parker wishes to report that he receives royalties and research support from Zimmer; is a member of the Speaker's Bureaus/Pain Presentations of Zimmer and Smith & Nephew; and is a paid consultant to Smith & Nephew and Zimmer. Dr. Cole wishes to report that he receives royalties from Arthrex and DJO Global; is a paid consultant to Arthrex, DJO Global, Johnson & Johnson, Regentis, and Zimmer; owns stock or stock options in Carticept and Regentis; and receives royalties, financial, or material support from Elsevier, Lippincott, Smith & Nephew, and WB Saunders. Dr. Traina and Dr. Allen report no actual or potential conflict of interest in relation to this article.

to graft selection, reconstruction technique, and postoperative protocols. Another area lacking consensus is the most appropriate treatment for concomitant ACL and medial collateral ligament (MCL) injuries. Options include ACL reconstruction with MCL repair or reconstruction, and ACL reconstruction with nonoperative treatment of the MCL injury.[20,21]

We conducted a study of ACL reconstruction preferences and methods within a group of experienced orthopedic surgeons caring for professional basketball players. Our hypotheses were that a majority of surgeons were using autograft tissue in the primary setting and allograft tissue for revision surgery, and that there are more surgeons using an AMP for femoral tunnel drilling now than there were 5 years earlier.

Materials and Methods

We distributed our survey to all 30 NBA team physicians at the NBA Pre-Draft Combine. Years in practice and number of years as a team physician were recorded. Head team physicians completed the 23-question survey on primary and revision ACL techniques, graft selection, number of bundles, and decision making regarding tunnel expansion, return to play, bracing, CPM machine use, and combined ACL–MCL injuries. They were asked to answer questions regarding both their current and previous (5 years prior) preferences for technique, graft type, and number of bundles.

Team physicians who did not attend the Combine were e-mailed the survey. For teams with multiple physicians, only the head physician's survey was used. When a physician gave multiple responses (eg, multiple techniques for femoral tunnel drilling, multiple graft preferences), these were recorded as "multiple" for data analysis purposes.

Descriptive parametric analysis was performed for the normally distributed data. Techniques and graft choices were broken down into discrete variables. Chi-square tests and Fisher exact tests were used to examine statistical differences between surgeons, and between 2 time points for each surgeon. Logistic regression was used to compare age with femoral tunnel drilling technique. Significance was set at $\alpha = 0.05$.

Results

All 30 head team physicians completed the survey. Mean (SD) number of years in practice was 19.8 (8.0), and mean (SD) number of years as an NBA team physician was 12.5 (7.9). Fourteen physicians (47%) were using an AMP for femoral tunnel drilling, compared with only 4 physicians (13%) 5 years earlier. For revision reconstruction, 14 (47%) were using AMP drilling, and 11 (37%) were using the TT technique (**Table**). Mean (SD) number of years in practice was 15.5 (5.4) for surgeons using the AMP technique and 25.1 (7.0) for those using the TT technique. Regression indicated a significant ($P = .009$) positive correlation between fewer years in practice and AMP use.

In their treatment of NBA athletes, 26 physicians (87%) were using autograft tissue for primary ACL reconstruction. Of these physicians, 21 (81%) were using BPTB autografts; 3 (12%), quadrupled hamstring autografts; 1 (4%), doubled hamstring autograft with or without allograft augmentation; and 1 (4%), quadriceps tendon autograft with bone block (**Table**). Only 2 surgeons were using graft sources different from those they were using 5 years earlier. In the revision setting, 13 physicians (43%) were using autografts as their first choice of graft, and 17 (57%) were using allograft. In cases in which physicians' preferred graft had already been used for primary ACL reconstruction, only 4 physicians (13%) used autograft tissue. No surgeons were using double-bundle reconstructions in the primary setting, and only 4 (13%) were using them in the revision setting, and only under select circumstances.

Mean (SD) tunnel diameter for which the surgeon would favor a 2-stage reconstruction was 14.3 (2.9) mm. The most common additional technique for expanded tunnels was use of a larger bone block from an allograft ACL graft (n = 17). Other common techniques were suspensory fixation (n = 9), use of stacking screws (n = 5), filling the old tunnels with a biocomposite screw and drilling through part of the screw (n = 5), and use of additional bone-grafting techniques, such as cancellous allograft or bone cement (n = 5).

For combined ACL–MCL injuries, the most preferred treatment was waiting for the initial inflammatory response to subside and reconstructing only the ACL (n = 15), followed closely by waiting for full healing of the MCL (4 to 6 weeks) and reconstructing only the ACL (n = 14). Of the 30 surgeons, 24 (80%) preferred bracing for the period immediately after primary ACL reconstruction; 25 (83%) preferred bracing in the revision setting. CPM machines were used by 13 (43%) of the 30 surgeons. Return to full-contact basketball was allowed at a mean (SD) of 6.8 (1.5) months after primary ACL reconstruction and 8.6 (1.9) months after revision ACL reconstruction.

Discussion

The primary goals of this study were to evaluate graft choice in primary and revision settings and to evaluate femoral tunnel drilling techniques used by NBA team physicians in ACL reconstructions in high-level athletes. A secondary objective was to determine the treatment preferences for tunnel widening, combined ACL–MCL injuries, and postoperative rehabilitation protocols. We found that NBA team physicians typically were using autograft in the primary ACL reconstruction setting and that there was a trend toward significance for the number of surgeons who modified their technique recently to incorporate use of an AMP for femoral tunnel drilling. In addition, fewer years in practice was found to be significantly associated with AMP use.

The graft most commonly used by NBA physicians for primary ACL reconstructions was BPTB autograft. When Kaeding and colleagues[22] examined patient and surgical variables associated with graft rupture after ACL reconstruction, they found re-rupture rates of 4.9% (autograft group) and 10.1% (allograft group). Both age and allograft use were significantly associated with a higher rate of postoperative graft rupture. Risk for re-rupture was 2.84 times higher in the allograft group, and, when graft type was held constant in the analysis, patients 10 years older had 43% lower odds of re-rupture.[22] In another investigation for the Multicenter Orthopedic Outcomes Net-

work (MOON) group, Spindler and colleagues[23] examined the demographics, surgical technique, and concomitant intra-articular injury factors that predicted return to sport after ACL reconstruction. They found that allograft use, revision surgery, smoking, higher body mass index (BMI), and lateral meniscus treatment were all significantly associated with lower func-

Table. Current and Previous (5 Years Prior) Techniques for Femoral Tunnel Drilling, Primary Graft Choices, and Revision Graft Choices Among NBA Team Physicians

	Primary Femoral Tunnel Drilling Technique		Primary Graft		Revision Graft	
Physician	Current	Previous	Current	Previous	Current	Previous
1	AMP	TT	Quad HS	Quad HS	ATA	ATA
2	AMP	TT	ATA	ATA	ATA	ATA
3	TT	TT	BPTB autograft	BPTB autograft	BPTB allograft	BPTB allograft
4	AMP	TT	BPTB autograft	BPTB autograft	ATA	ATA
5	TT	TT	BPTB autograft	BPTB autograft	BPTB allograft	BPTB allograft
6	2-incision	2-incision	BPTB autograft	BPTB autograft	BPTB autograft	BPTB autograft
7	AMP	TT	BPTB autograft	BPTB autograft	BPTB autograft	ATA
8	AMP	TT	BPTB autograft	BPTB autograft	ATA	ATA
9	TT	TT	BPTB autograft	BPTB autograft	Quad tendon	Quad tendon
10	AMP	TT	BPTB autograft	BPTB autograft	BPTB allograft	BPTB allograft
11	AMP	AMP	BPTB autograft	BPTB autograft	BPTB autograft	BPTB autograft
12	AMP	TT	Multiple	Multiple	BPTB autograft	BPTB autograft
13	TT	TT	ATA	ATA	ATA	ATA
14	TT	TT	BPTB autograft	BPTB autograft	BPTB autograft	BPTB autograft
15	AMP	TT	BPTB autograft	TAA	BPTB allograft	ATA
16	TT	TT	Quad tendon	Quad tendon	ATA	ATA
17	2-incision	2-incision	BPTB autograft	BPTB autograft	BPTB autograft	BPTB autograft
18	TT	TT	Double HS	Double HS	TAA	TAA
19	AMP	AMP	Quad HS	Quad HS	Quad HS	Quad HS
20	TT	TT	BPTB autograft	BPTB autograft	BPTB allograft	BPTB allograft
21	TT	TT	TAA	TAA	TAA	TAA
22	TT	TT	BPTB autograft	BPTB autograft	BPTB allograft	BPTB allograft
23	AMP	AMP	BPTB autograft	BPTB autograft	BPTB autograft	BPTB autograft
24	TT	TT	BPTB autograft	BPTB autograft	BPTB allograft	BPTB allograft
25	AMP	TT	BPTB autograft	BPTB autograft	BPTB autograft	BPTB autograft
26	TT	TT	Quad HS	Quad HS	Quad HS	TAA
27	AMP	TT	Multiple	Multiple	BPTB autograft	BPTB autograft
28	AMP	AMP	BPTB autograft	BPTB autograft	BPTB autograft	BPTB autograft
29	TT	TT	BPTB allograft	BPTB autograft	BPTB allograft	BPTB allograft
30	2-incison	2-incision	BPTB autograft	BPTB autograft	BPTB allograft	BPTB autograft

Abbreviations: AMP, anteromedial portal; ATA, Achilles tendon allograft; BPTB, bone–patellar tendon–bone; double HS, double hamstring; quad HS, quadrupled hamstring; quad tendon, quadriceps tendon with bone block; TAA, tibialis anterior allograft; TT, transtibial.

tional scores. Other investigators have found an association between allograft use and graft failure.[14,24] As our present investigation found that 87% of NBA team physicians were using autograft in ACL reconstructions in high-level athletes, these physicians likely agree with the recent literature showing autograft associated with the lowest re-rupture rate and the highest chance of return to sport.

Some of the surveyed physicians indicated they would use allograft in the revision setting. Allograft use in the revision setting provides some technical advantages but may be associated with a higher re-rupture rate. It allows for larger bone blocks in the event of tunnel widening, and for larger amounts of collagen, as there are no constraints related to intrinsic hamstring size or amount of bone or patellar tendon being harvested.[25] However, recent data from the Danish Registry for Knee Ligament Reconstructions showed that use of allograft tissue for the revision procedure resulted in a statistically significantly higher rate of re-revision.[26]

NBA team physicians' recent alteration in their femoral tunnel drilling technique may have been in response to the recent literature better elucidating ACL anatomy.[27-31] Biomechanical studies have shown that, although anteroposterior stability can be restored with either TT or AMP techniques, rotational stability can more reliably be restored with AMP techniques,[32,33] likely related to difficulty in recreating the anatomical femoral footprint when using TT drilling.[33,34] Others have reported that the TT technique allows for anatomical femoral tunnel placement; achieving this position, however, may require positioning the tibial tunnel more posteriorly.[35] In addition, some have reported that attempting to reach the anatomical femoral footprint through a TT tunnel can lead to eccentric reaming of the tibia and creation of a wider tunnel.[33,36]

The present study found that fewer years in practice was significantly associated with AMP use. This association may derive from the fact that younger physicians may have been educated and first exposed to the AMP technique during their training and therefore may have become more familiar with the technique. In addition, physicians with more years in practice may not feel the need to change techniques, as clinical outcomes have not shown significant differences between the 2 techniques at mid- and long-term follow-up.[37]

Treatment of combined ACL–MCL injuries also lacks surgeons' consensus. The literature suggests that MCL injuries typically heal with nonoperative treatment.[38] Although no agreement exists regarding optimal treatment of these combined injuries, most NBA physicians stated they would allow time for both the MCL injury to heal and the acute inflammatory response to subside. The MCL could then be reassessed before planned ACL reconstruction. Absent an opening to valgus stress, only ACL reconstruction would be performed; if valgus opening is present during reexamination, however, most surgeons would reconstruct the ACL and concomitantly repair or reconstruct the MCL. This treatment method is consistent with a recent systematic review of combined ACL–MCL injuries, conducted by Grant and colleagues.[39] They examined 5 different treatment approaches for this combined injury pattern and concluded that ACL reconstruction should be performed when full motion has returned and that concomitant MCL repair or reconstruction should be performed only in the presence of persistent valgus instability.

The present study is limited in that it did not examine treatment at the patient or athlete level and did not report on specific functional outcomes. In addition, as with any survey, bias or inconsistencies may have occurred between survey responses and actual practice patterns. Last, our results represent the practice habits of only 30 orthopedic surgeons and may not be generalizable to the orthopedic community at large. The goal of this study, however, was to report on NBA team physicians' practice habits in treating ACL injuries. This goal was achieved, and the data represent how orthopedic surgeons approach ACL injuries in the NBA athlete patient population.

Conclusion

NBA team physicians demonstrated varied practice patterns in the treatment of ACL injuries. In general, autograft was the preferred graft choice, and AMPs increasingly are being used for femoral tunnel drilling. Furthermore, postoperative and return-to-play guidelines varied between surgeons. Last, although treatment of combined ACL–MCL injuries varies among surgeons, the predominant preference was to reassess the MCL after return of full range of motion after injury.

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Am J Orthop. 2014;43(6):267-271.

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