

## Return to Sport After Primary Anterior Cruciate Ligament (ACL) Reconstruction: A Survey of The American Orthopaedic Society for Sports Medicine

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### ABSTRACT

**Introduction.** Anterior cruciate ligament (ACL) tears are a common sports injury, and typically require a prolonged post-operative rehabilitation. The purpose of this study was to survey members of the American Orthopaedic Society for Sports Medicine (AOSSM) to determine their return to sport (RTS) criteria after primary ACL reconstruction (ACLR).

**Methods.** A 23-question, anonymous survey hosted through Google<sup>®</sup> Docs was distributed electronically to AOSSM members. This survey included questions regarding the timing, as well as any functional tests or other metrics used to determine when an athlete is ready to RTS.

**Results.** A total of 863 surgeons responded over four months. The most popular graft choice was bone patellar tendon bone autograft (63%). For non-pivoting sports, 43% of respondents allowed RTS at five to six months, while 31% allowed RTS at seven to eight months. For pivoting sports, 34% of respondents allowed RTS at seven to eight months, while 36% allowed RTS at nine to ten months. The most common criteria for return to non-pivoting sports include full knee motion (89%) and time after ACLR (76%). The most common criteria for return to pivoting sports include full knee motion (87%) and passing a hop test (80%). Only 21% of respondents assessed for psychological readiness to RTS.

**Conclusions.** RTS occurred sooner in non-pivoting than pivoting sports, with similar RTS criteria in both groups. Most respondents did not assess for psychological readiness to RTS.

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### INTRODUCTION

Anterior cruciate ligament (ACL) tears are seen commonly in sports that involve cutting and pivoting.<sup>1</sup> As a result, approximately 350,000 ACL reconstructions are performed every year in the United States.<sup>2</sup> While there are various graft options and surgical techniques, each with its own advantages and disadvantages, one of the biggest challenges for an orthopaedic surgeon is when to allow an athlete to return to sport (RTS) and unrestricted activity. To our knowledge, there is no well-defined, validated set of criteria or tests to determine when an athlete is ready to RTS after an ACL reconstruction. Thus, the critical decision

of clearing an athlete is based on criteria defined by individual surgeons.

Previous survey studies have focused more on other aspects of ACL reconstruction including surgical technique, fixation method, and graft type rather than rehabilitation and RTS criteria.<sup>3-6</sup> Similar survey studies on RTS have been performed in other professional societies including the Italian Society of Knee, Arthroscopy, Sport, Cartilage and Orthopaedic Technologies (SIGASCOT), the German Association for AGA, the Croatian Orthopaedic and Traumatology Association, the Australian Knee Society, and the Canadian Orthopaedic Association (COA).<sup>7-11</sup> Additionally, surveys regarding ACL reconstruction and RTS have been performed with orthopaedic surgeons who take care of National Football League (NFL) and National Collegiate Athletic Association (NCAA) teams, Major League Soccer (MLS) teams, National Hockey League (NHL) and U.S. Olympic teams.<sup>12-14</sup> The purpose of this study was to survey members of the American Orthopaedic Society for Sports Medicine (AOSSM) on their criteria to clear an athlete to RTS after a primary ACL reconstruction.

### METHODS

A 23-question, anonymous survey (available at [journals.ku.edu/kjm](http://journals.ku.edu/kjm)) was distributed electronically to members of the AOSSM between February 2019 and May 2019. Institutional Review Board (IRB) approval was not required, as this was an anonymous study without identifiable information. The AOSSM was chosen as it is a national society of orthopaedic sports medicine surgeons with over 3,600 members at the time of this survey. After excluding invalid email addresses, the survey was sent to approximately 3,300 members. This survey included questions regarding the timing, as well as any functional tests or other metrics used to determine when an athlete is ready to RTS following ACL reconstruction.

The survey was distributed through Google<sup>®</sup> Docs (Google<sup>®</sup>, Mountain View, California). All responses were anonymous. Answers were analyzed with Microsoft<sup>®</sup> Excel (Microsoft, Redmond, Washington).

### RESULTS

A total of 863 orthopaedic surgeons responded over a four-month time period. Not every surgeon responded to every question, so the number of responses for each question varied from 695 to 861. A total of 90% (775/859) of respondents were male, and 10% (84/859) were female. The majority of respondents (91% [776/856]) completed an orthopaedic sports medicine fellowship, and most respondents (54% [458/853]) practiced in a private practice setting. The number of years in practice varied from 1 - 5 (23% [195/861]) to greater than 30 (13% [114/861]). All regions of the U.S. were represented in this study. The demographic information of respondents can be found on Table 1.

**Table 1. Demographic data of respondents.**

	Variable	Responses	Total Responses
Sex	Male	775 (90%)	859
	Female	84 (10%)	
Years in Practice	1 - 5	195 (23%)	861
	6 - 10	153 (18%)	
	11 - 15	104 (12%)	
	16 - 20	122 (14%)	
	21 - 25	70 (8%)	
	26 - 30	103 (12%)	
	>30	114 (13%)	
Type of Practice	Private	458 (54%)	853
	Academic	268 (31%)	
	Hospital Employed	98 (12%)	
	Solo	29 (3%)	
Location of Practice	Northeast - New England (CT, ME, MA, NH, RI, VT)	79 (10%)	832
	Northeast - Middle Atlantic (NJ, NY, PA)	116 (14%)	
	Midwest - East North Central (IN, IL, MI, OH, WI)	145 (17%)	
	Midwest - West North Central (IA, KS, MN, MO, NE, ND, SD)	79 (10%)	
	South - South Atlantic (DE, DC, FL, GA, NC, SC, VA, WV, MD)	130 (16%)	
	South - East South Central (AL, KY, MS, TN)	45 (5%)	
	South - West South Central (AR, LA, OK, TX)	84 (10%)	
	West - Mountain (AZ, CO, ID, NM, MT, UT, NV, WY)	58 (7%)	
	West - Pacific (AK, CA, HI, OR, WA)	96 (12%)	
Sports Medicine Fellowship	Yes	776 (91%)	856
	No	80 (9%)	

The number of primary ACL reconstructions performed per year varied from < 25 (21% [177/858]) to > 100 (11% [91/858]). Bone-patellar tendon-bone (BTB) autograft was the most popular graft choice for athletes (63% [531/846]), followed by hamstring autograft (24% [208/846]), and quadriceps tendon autograft (11% [90/846]; Table 2).

**Table 2. Anterior cruciate ligament (ACL) characteristics.**

	Variable	Responses	Total Responses
Number of Primary ACL Reconstructions Per Year	< 25	177 (21%)	858
	25 - 50	356 (41%)	
	51 - 100	234 (27%)	
	> 100	91 (11%)	
Preferred Graft Type for Athletes	Bone Patellar Tendon Bone Autograft	531 (63%)	846
	Hamstring Autograft	208 (24%)	
	Quadriceps Autograft	90 (11%)	
	Allograft	17 (2%)	

A specific RTS assessment was performed by 77% (659/856) of respondents. The timing of the RTS assessment varied, with the majority of respondents performing the assessment at five to six months (37% [396/1079]). The RTS assessment was performed most commonly by physical therapists (67% [468/695]; Table 3).

**Table 3. Return to Sport (RTS) assessment.**

	Variable	Responses	Total Responses
Number of Primary Anterior Cruciate Ligament Reconstructions Per Year	< 25	177 (21%)	858
	25 - 50	356 (41%)	
	51 - 100	234 (27%)	
	> 100	91 (11%)	
Preferred Graft Type for Athletes	Bone Patellar Tendon Bone Autograft	531 (63%)	846
	Hamstring Autograft	208 (24%)	
	Quadriceps Autograft	90 (11%)	
	Allograft	17 (2%)	

For non-pivoting sports, 50% (429/854) of respondents began sport specific rehabilitation at three to four months, 37% (317/854) began at five to six months, and 7% (59/854) began at ≤ 2 months. For pivoting sports, 51% (439/857) of respondents began sport specific rehabilitation at five to six months, 29% (250/857) began at seven to eight months, and 11% (90/857) began at three to four months (Figure 1).

Return to non-pivoting sports was allowed at five to six months by 43% (364/856) of respondents, at seven to eight months by 31% (263/856) of respondents, and at nine to ten months by 13% (107/856) of respondents. Return to pivoting sports was allowed at nine to ten months by 36% (310/853) of respondents, at seven to eight months by 34% (286/853) of respondents, and at five to six months by 13% (114/853) of respondents (Figure 2).

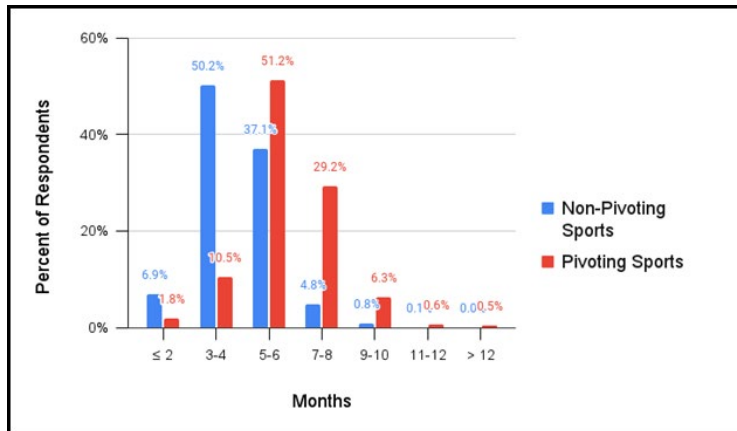


Figure 1. Beginning of sports specific rehabilitation for non-pivoting and pivoting sports.

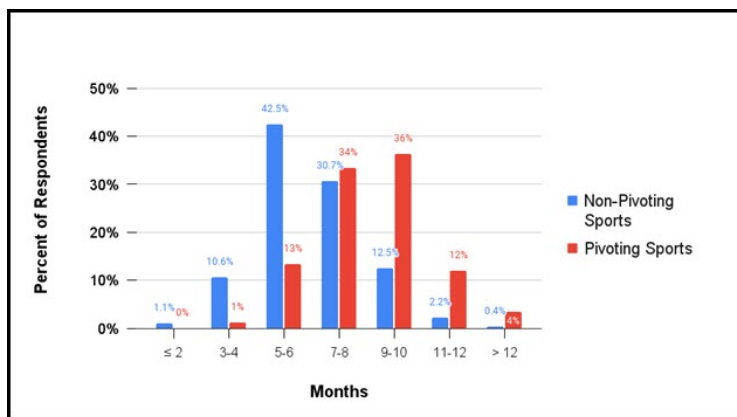


Figure 2. Return to non-pivoting versus pivoting sports.

The most common criteria for return to non-pivoting sports included full knee range of motion (89% [761/859]), time after ACL reconstruction (76% [653/859]), and Grade 1A Lachman Test (72% [614/859]). The most common criteria for return to pivoting sports included full knee range of motion (87% [750/858]), passing a hop test (80% [686/858]), and time after ACL reconstruction (77% [657/858]; Figure 3).

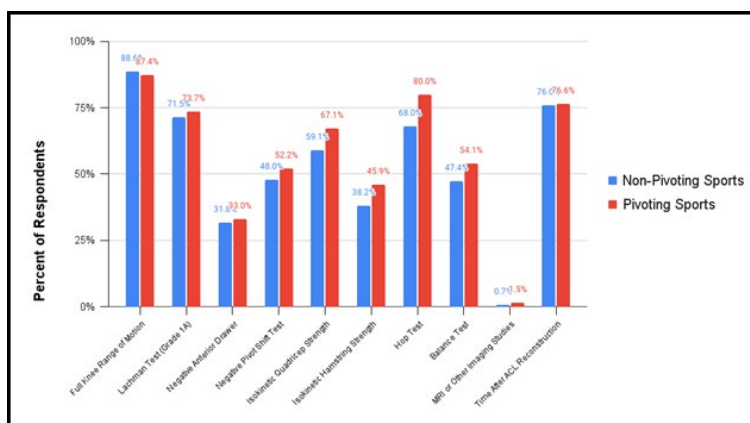


Figure 3. Criteria for return to non-pivoting and pivoting sports.

Most respondents did not utilize a clinical score in their RTS assessment for either pivoting (80% [681/848]) or non-pivoting (81% [689/850]) sports. The most common clinical score utilized for both pivoting and non-pivoting sports was the International Knee Documentation Committee (IKDC) score (14% [119/848 and 119/850, respectively]).

The survey inquired about bracing preferences for sports after ACL reconstruction. A total of 47% (398/853) of respondents did not have their patients wear any kind of brace, 25% (209/853) had their patients wear a brace for ≤ 1 year, and 25% (210/853) had their patients wear a brace for one to two years.

Psychological readiness to RTS was examined. The majority of respondents (79% [672/852]) did not assess for psychological readiness to RTS. For those that did, the most common test was the Anterior Cruciate Ligament Return to Sport After Injury (ACL-RSI) scale (38% [59/156]). Of the respondents who assessed for psychological readiness, 51% (114/222) offered some type of intervention, with referral to a sports psychologist being the most common.

## DISCUSSION

Return to sport rates after ACL reconstruction varied widely in the literature, ranging from 60 - 80%.<sup>1,15</sup> While there have been studies looking at RTS criteria after ACL reconstruction, there was not a universal protocol to clear an athlete. This survey of sports medicine surgeons across the country highlighted some of the current trends regarding RTS.

The preferred graft for athletes among respondents was BTB autograft (63%), followed by hamstring autograft (24%), and quadriceps autograft (11%). In their 2017 survey study on AOSSM and Arthroscopy Association of North America (AANA) members, Budny et al.<sup>6</sup> found hamstring autograft to be the most popular graft (45%), followed by BTB autograft (41%). In their 2009 survey study on AOSSM members, Duquin et al.<sup>5</sup> showed BTB autograft to be the most popular graft choice (46%), followed by hamstring autograft (32%). In survey studies of surgeons treating elite athletes, BTB autograft was used more commonly than any other type of graft, which was consistent with our findings.<sup>12-14,16</sup> There have been studies comparing BTB autograft to hamstring autograft with similar results in terms of functional outcomes, knee stability, and longevity.<sup>17-20</sup> Potential disadvantages of BTB autograft included increased anterior knee pain and decreased knee extension strength, while potential disadvantages of hamstring autograft include decreased knee flexion strength.

The timing of sports specific rehabilitation and subsequent RTS after ACL reconstruction varied between athletes returning to non-pivoting versus pivoting sports. Survey respondents generally allowed athletes to begin sports specific rehabilitation earlier if they were returning to a non-pivoting sport versus a pivoting sport. Grassi et al.<sup>8</sup> found the majority of SIGASCOT members in their survey study started sports specific rehabilitation within six months after ACL reconstruction, while Petersen et al.<sup>10</sup> found most AGA instructors in their survey started between four to six months. However, neither study differentiated between pivoting and non-pivoting sports, which our study showed can affect the timing of sport specific rehabilitation.

Similar to the timing of sports specific rehabilitation after ACL reconstruction, respondents allowed athletes in non-pivoting sports to RTS sooner than those in pivoting sports. The longer time period before return to pivoting sports likely was due to the fact that more stress is placed on the graft with these types of sports. In their systematic review, Barber-Westin et al.<sup>21</sup> found the majority of studies did not allow for RTS until  $\geq 6$  months after ACL reconstruction. Similarly, other survey studies have found the majority of respondents allowed return to play at six to nine months after surgery.<sup>4,7,10,11,22</sup> Harris et al.<sup>23</sup> reported that 45% of studies in their systematic review allowed return to pivoting and cutting sports at six months post-operatively. About the six-month mark appeared to be the time when athletes generally were allowed to RTS, however, our study found that respondents tended to permit earlier return in athletes involved in non-pivoting sports, and a later return in athletes involved in pivoting sports. With increased rates of injuries for up to two years after an ACL reconstruction, the need for stringent RTS criteria is imperative to minimize the risk of a subsequent ACL injury.<sup>24</sup>

There are various functional tests and clinical scores utilized to clear an athlete to RTS after ACL reconstruction. Our study found that full knee range of motion, time after ACL reconstruction, Grade IA Lachman on exam, and passing a hop test were important in return to both pivoting and non-pivoting sports. Similarly, Barber-Westin et al.<sup>21</sup> found time after ACL reconstruction and full knee range of motion to be the most common criteria in their systematic review. Budny et al.<sup>6</sup> and Duquin et al.<sup>5</sup> found time after ACL reconstruction, knee range of motion, pain with sport specific activity, degree of effusion, and quadriceps strength to be amongst the most important factors for return to unrestricted activity. Grassi et al.<sup>8</sup> found full knee range of motion, Lachman testing, and Pivot-Shift testing to be the most common objective criteria for RTS. Petersen et al.<sup>10</sup> found a negative Lachman, full knee motion, and a negative pivot shift to be the most popular criteria to RTS in their survey.

While full knee range of motion was the most popular criteria for both pivoting and non-pivoting sports, passing a hop test was more important in pivoting athletes compared to non-pivoting athletes. Variations in the hop test included single hop, triple hop, crossover hop, and timed hop.<sup>1,21</sup> In a systematic review of Level I randomized control studies looking at RTS guidelines after ACL reconstruction, the single leg hop test was the most common functional test used post-operatively.<sup>23</sup> Muller et al.<sup>25</sup> found the single hop test to be the strongest predictor for RTS. Marshall et al.<sup>22</sup> found the hop test and time after ACL reconstruction to be important criteria for RTS. A hop distance using the operated leg of at least 90% of the contralateral leg was a commonly used criteria for passing, and may be a reliable test to simulate the demands of athletic activities.<sup>1,21</sup> However, using the contralateral limb as a reference standard may overestimate knee function due to potential neuromuscular changes and strength deficits affecting the contralateral limb after ACL reconstruction.<sup>26</sup>

Bracing after ACL reconstruction remains a controversial topic with about half of respondents not requiring athletes to wear a brace after RTS, while half of respondents do. In a study by Budny et al.<sup>6</sup>, 48.4% of respondents utilized functional bracing post-operatively, with six months to one year being the most popular (53.7%) followed by one to two years (34%). Similarly, Duquin et al.<sup>5</sup> found that 43% of

respondents utilized a post-operative brace for six months to one year after surgery. Some benefits of functional bracing were noted in improving mechanics and coordination after ACL reconstruction, but not in all studies.<sup>1,27</sup>

While most practitioners focus on the physical criteria and tests in clearing an athlete, the psychological readiness to RTS must be considered. In our study, only 21% of respondents assessed for psychological readiness to RTS. Of those, 51% of respondents offered any type of intervention, with referral to a sports psychologist being most common. Previous studies have demonstrated the importance of psychological readiness in RTS and pre-injury level of play after ACL reconstruction.<sup>15,28-30</sup> In their systematic review, Nwachukwu et al.<sup>15</sup> found that 64.7% of patients that did not return to play named a psychological reason for not returning. Fear of reinjury, lack of confidence in the operated knee, and depression have been shown to be psychological factors in patients not returning to sport.<sup>11,15,29</sup> The Anterior Cruciate Ligament-Return to Sport After Injury (ACL-RSI) scale, which measures psychological readiness to RTS after ACL reconstruction, was the most popular tool used among respondents, and a higher score has been shown to be associated with increased likelihood of returning to sport.<sup>28,29</sup> While the importance of optimizing psychological factors after ACL reconstruction has been shown, many orthopaedic surgeons still did not address this significant aspect of rehabilitation.

**Limitations.** One limitation to this study was the low response rate of approximately 26%, likely due to the electronic nature of the survey. Additionally, not every respondent responded to each question, so there was variability in the number of responses for each question. Another limitation was the overall generalizability of this study due to only surveying members of the AOSSM. While there may be many orthopaedic surgeons who perform ACL reconstructions and were not a part of the AOSSM, the large size of the AOSSM was a good representation of our target cohort. Additionally, 863 individual responses provided a good sample of current trends in RTS criteria after primary ACL reconstruction. Finally, respondents from all regions of the U.S. participated, which would cut down on any regional biases.

## CONCLUSIONS

This survey study highlighted the post-operative practices of orthopaedic sports medicine physicians that routinely perform ACL reconstructions. As there were no definitive or validated set of criteria or tests to clear an athlete to RTS after an ACL reconstruction, it was important to show what surgeons around the country did. Most respondents utilized a specific RTS assessment following ACL reconstruction. As expected, sport specific rehabilitation and RTS occurred sooner in non-pivoting than pivoting sports. Similar RTS criteria were utilized in both non-pivoting and pivoting sports, with full knee range of motion being the most common test in both groups. Most respondents do not assess for psychological readiness to RTS, and even fewer offer any intervention.

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