

Best return to sport time after an anterior cruciate ligament reconstruction and its effects on knee strength symmetry

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Received: 04/01/2019; Accepted: 04/01/2019; Published: 04/01/2019

Abstract: The purpose of this scientific literature review is to determine how often athletes return to sport with full strength in the knee with an injured anterior cruciate ligament rupture and what time is the best to return to sport. The methods used to select the best articles for this review were that participants only needed to have one previous anterior cruciate ligament injury prior to the review and that participants needed to have gone through a rehabilitation program designed by a doctor or physical therapists. The results of all the articles determined that the longer a participant worked on strengthening the knee symmetry, the better performance in the return to sport participation was. In the case of many participants, 6 months was not enough time to create a high score of strength and symmetry in the reconstructed knee even though many participants were cleared to return to play in their respective sport. In conclusion, 9 to 12 months is the better option for return to sport and an even longer work period can lower the risk of a second anterior cruciate ligament.

Keywords: Anterior Cruciate Ligament, Anterior Cruciate Ligament Reconstruction, Rehabilitation, Return to Sport, Knee Symmetry, 6 Months, 9 Months, 12 Months.

1. Introduction

The participation in sports can often lead to many serious injuries and one of those is the anterior cruciate ligament (ACL) tear. No matter which sport is played, an ACL tear can occur in a matter of seconds and bring everything to a pause. The most common solution to an ACL tear is a complete surgical reconstruction of the ligament in the knee. Post-surgery is followed up with rehabilitation lasting from 6 months to a full year. Returning to sport (RTS) depends on how much the knee progresses in rehabilitation as well as how the physical therapist judges the progress. Even though at some point rehabilitation does return the athlete to their respective sport, it doesn't always mean the athlete is ready to begin play immediately. Due to some athletes feeling discomfort when returning to play, most don't get to perform at the same level of intensity that they once could before injury. The cause of discomfort is because the injured knee strength, motor control, and overall symmetry is not balanced with the other healthy knee¹. The purpose of this scientific literature review is to determine how often athletes RTS with full strength in the ACL reconstructed knee and approximately how long it would be best to RTS.

2. Methods

Studies were identified by using the PUBMED, PMC and MEDLINE databases. The key words used were: "anterior cruciate ligament", "anterior cruciate ligament reconstruction", "rehabilitation", "return to sport", "knee symmetry", "6 months", "9 months", and "12 months". More than 50 articles were found to be related between all searches but only 10 articles fit the criteria to be used for this scientific review. Scientific studies conducted on ACL tears, rehabilitation methods, and RTS time were taken into consideration when writing this paper. Studies emphasizing on knee strength and knee symmetry improvement were also taken into consideration. Participants that had experienced more than one anterior cruciate ligament reconstruction

(ACLR) and also who had not gone through a rehabilitation program created for the ACLR participant did not qualify.

3. Return to Sport at 6 months

6 month RTS is possible with very hard work and determination. The issues arise when athletes are released and knee strength or symmetry are not 100%. These next studies will mention many athletes and whether they were ready to RTS on a short term rehabilitation program at 6 months.

3.1. No return to sport at 6 months

In this study, 4093 participants who had an ACLR were evaluated with isokinetic quadriceps, hamstring muscles strength and single-leg-hop tests at their 6 month follow up². Before being evaluated, all participants were made sure that they had partaken in the rehabilitation protocol that the doctor had instructed². Of the 4093 participants, only 3541 had the same criteria and were grouped together to determine the percentage of symmetry². The results of the study showed that 693 participants had achieved symmetrical knee functions². Only 19.6% of the participants had achieved symmetry, which means that about 80% were not ready to RTS and had to keep participating in their rehabilitation program². The article suggests that participants with ACLR should use these findings to base their RTS expectations on being longer than 6 months and should also extend their rehabilitation time for maximum knee strength².

In this study, 29 participants who had an ACLR participated in a RTS readiness test at their 6 month mark⁴. All participants had gone through their rehabilitation program before being evaluated for RTS⁴. The method used to measure the readiness was an electromyography (EMG) driven musculoskeletal model of the knee⁴. The RTS testing consisted of 4 unilateral hop tests, 2 self questionnaires, and an isometric quadriceps strength test⁴. To pass these tests patients had to score a 90% or above on every single one and report a positive feeling knee questionnaire⁴. Results after testing showed that there were way more participants that failed the RTS testing than there were who passed⁴. Those who failed had an increase in contact force asymmetries with the reconstructed knee being the lowest in strength⁴. The small group of participants that passed had the highest symmetries amongst both knees⁴. The article suggests that participants take a variety of RTS tests before being cleared to play in order to make sure the RTS time is accurate and safe for them⁴.

4. Return to Sport at 9 months

An athlete has a better chance of RTS at 9 months than the previous studies mentioned. This still doesn't mean there can't be any issues in the knee. These next few studies will mention many athletes and whether their RTS was effective at this time or if lingering issues stayed around.

4.1. Closer knee symmetries at 9 months

In this study, 16 male soccer players who had an ACLR and 16 who didn't have an ACL injury were studied to see if there was any asymmetries in the knee associated with an uneven force step⁷. The ACLR participants had gone through their rehabilitation program before being evaluated for RTS⁷. The ACLR participants were split into groups of either <9 months after ACLR or into >9 months after ACLR and the healthy participants were used as a control group⁷. All participants were required to run on a treadmill at different speeds of 12, 14, and 16km/h for 6 minutes⁷. While running they had a "Pedar-X insole" inside their shoes to measure the plantar loading data⁷. Results showed that with ACLR participants at <9 months had the highest asymmetries with plantar force as the speed increase⁷. Those at >9 months as well as the control group had closer symmetries no matter the speed tested on⁷. The article suggests that force should be taken more into consideration when determining a good RTS time for the person with an ACLR⁷.

In this study, 106 participants who had ACLR were studied for 2 years to assess their knee function⁵. All participants underwent their rehabilitation program after their ACLR and were recorded monthly on their sport

participation and knee progress⁵. The tests used to evaluate the knee progress were the isokinetic quadriceps strength, four single-legged hop, and a two self-outcome report⁵. The results showed that as more months went by the risk of injury decreased by 51% up until the 9 month evaluation in which it showed greater symmetry between both legs⁵. The evidence from the article suggests that the longer a participants work on the knee symmetries and strength balance, the better a RTS performance will bring⁵. If RTS happens before the 9 month period a higher risk injury can occur and a poor RTS performance could linger for the rest of the participants athletic career⁵.

4.2. Low symmetries at 9 months

In this study, 62 participants who had ACLR were evaluated at 6 months and 9 months post-surgery using a back in action (BIA) test battery¹⁰. The test included an isokinetic hamstring and quadriceps test, a jump landing test, a single, triple, and side hop test and two self-questionnaires¹⁰. All participants had gone through their rehabilitation program before being evaluated for RTS¹⁰. Results showed that at the 6 month mark only 2 participants had passed all the criteria to RTS compared to 7 participants at the 9 month mark¹⁰. Another result showed that at the 6 month mark only 5 participants passed all the strength tests compared to 13 participants at the 9 month mark¹⁰. Lastly, the final results showed that at the 6 month mark only 39 participants had passed all the hop tests compared to 48 participants at the 9 month mark¹⁰. Although participants had a slight advantage to RTS at the 9 month mark over the 6 month mark, both were still very low percentages to RTS¹⁰. This means that in order to be sure that RTS is safe and effective it would be better to wait at a further time mark than 6 or 9 months¹⁰.

5. Return to Sport at 12 months or more

RTS at 12 months is usually the last marker goal before a doctor takes the recovery process a different direction. Past those 12 months rehabilitation can actually benefit the ACLR patient by beginning to reduce the chance of a second ACL injury as more time goes by. These next few studies will mention many athletes and whether their RTS was beneficial to them at 12 months or on a longer rehabilitation processes.

5.1. Low scores for 12 month tests

In this study, 40 ACLR participants were evaluated at the 6 month mark and at the 11.3 month mark using 2 different methods³. The first method used was the standard hop tests that included single, triple, and triple crossover for distance along with a isokinetic knee extensor and flexor strength assessment³. The second method used was a BIA test battery that included speedy jump tests, plyometrics tests, stability tests, quick feet tests, and single and double leg countermovement jumps (CMJ)³. Before being evaluated, all participants were made sure that they had partaken in the rehabilitation protocol that the doctor had instructed³. All participants that underwent the first method were evaluated at the 6 month mark and were determined to have passed all tests to RTS³. Once evaluated at the almost 12 month mark, the results showed that many participants had not passed various tests within the BIA test battery³. This showed that if at the 6 month mark the participants were supposedly ready to RTS they, in reality, were not because it couldn't have been possible for the participants to fail various test within the BIA test battery³. Even though more time had passed after ACLR, it did not mean the participants were ready to RTS even after being cleared to play at 6 months³.

In this study, 1440 participants, who had gone through ACLR, were evaluated to see how many participants would RTS at 12 months⁸. Participants were split into 3 age groups that were 817 in the 25 and younger group, 440 in the 26-35 group, and 183 in the 36 or older group⁸. All participants had gone through their rehabilitation program before being evaluated for RTS⁸. The tests that determined RTS and an equal symmetry between knees were several single legged hop tests for distance, a measurement of the side to side differences with a KT-1000 arthrometer, and a self reported questionnaire⁸. Results showed that 48% of the 25 and younger group returned to satisfactory functional recovery in the knee at 12 months, leaving the other 52% with more time to work on

their RTS performance⁸. The results for the 26-35 year old group showed that 32% RTS at the 12 month mark while 68% did not meet criteria to RTS⁸. The results for the 36 or older group showed that 19% RTS at the 12 month mark and that 81% were not eligible to RTS⁸. Whether age played a factor or not, the data showed that less people RTS at 12 months compared to those who did not qualify and show significant knee symmetry⁸. The evidence suggest that even if an ACLR participant is at the last mark before RTS, which should be at 12 months, it won't always mean the athlete is actually ready to play⁸.

5.3. High scores for 2 year follow up

In this study, 67 young athletes were evaluated over a 2 year period to determine which time would score higher on a number of tests on the knee, at RTS or 2 years⁶. The ACLR participants had gone through their rehabilitation program before being evaluated for RTS⁶. The tests used to determine the best RTS were hamstring, quadriceps, and hip abduction tests, knee range of motion tests, effusion tests, anterior laxity tests, and a Knee Injury and Osteoarthritis Outcome Score (KOOS)⁶. The first time evaluated was at the time of RTS for each athlete, which varied from person to person, and the second evaluation took place at the 2 year mark from ACLR of each individual⁶. The results showed that at the 2 year mark every athlete showed scores that were higher in every category of knee evaluations than when the original RTS time was scored⁶. Those that had originally scored high at their RTS time also had the highest scores at the 2 year mark⁶. The article suggests that if RTS scores are low from the first time of evaluation, there should be more time to work on knee strength symmetry in order for better RTS and maintenance of knees in the future⁶.

6. Return to Sport at 7 weeks

An athlete RTS in less than 2 months is practically unheard of. To the disbelief of the ACLR community, it happened and in a smooth manner. There are not many cases like this next study but with this one of a kind case existing, it can lead to many more trials with ACL patients.

6.1. An exception to Anterior Cruciate Ligament Reconstruction

In this study, procedures were done differently than just having ACLR⁹. This case is rare among the injury because a men's English Premier Football player decided to take a different route and not go through with surgery⁹. Instead doctors evaluated his knee and decided to customize rehabilitation workouts using various ways to increase his lower limb strength with weights, electrode stimulation and eccentric movements⁹. The "single leg hop and crossover hop test" would be measured daily in order for his rehabilitation to be modified and to see his knee stability progress so far⁹. Around 5 weeks after ACL rupture, the football player delayed no further and began jogging at 70% max speed slowly increasing to 90%⁹. In short time, he progressed to running at 50% max speed and once the 7th week mark of his injury came around he returned to full team practice⁹. Once there, he practiced 4 full sessions with his team while participating in small scrimmages and drills with cutting, sprinting, jumping, and acceleration involved⁹. Despite his injury he was made available for the first team and participated in many second half games along with full matches⁹. The results showed that in less than 8 weeks the football player was ready to RTS without any restrictions⁹. A follow up on his 18 month mark post injury showed he had no issues with his knee and he was a regular started for the football club he was playing for⁹. Even though this case is rare with ACL injuries, the fact that an athlete was able to RTS in little time without ACLR can't go unnoticed⁹.

7. Summary and Practical Applications

Despite short term rehabilitation being an option for an athlete to RTS, the findings showed that it might not be the best route for an athlete to take. As more time passed after ACLR and rehabilitation participation, the athletes gained more strength in the knee area and obtain a higher symmetry than those released to play at 6 months. My advice to future athletes faced with the dilemma to hurry and RTS is to wait until 9 months or

later until longer rehabilitation approaches are taken in order to allow the knee to strengthen more and for knee symmetry to balance out. In the long run, the more an athlete waits to RTS, the lower the chance will be to have another ACL injury.

Future research could be involved with finding a better solution to ACLR instead of just surgery. As with the rare case of the English football player, surgery was not needed and neither was a lot of time to RTS. As more cases of ACL injuries increase, so can the non-surgery trials in order to contribute to an ever growing issue.

Acknowledgments: I would like to thank the authors and participants of the studies cited in this paper. Thank you to the peer-review team, Jonnel Root, Valerie Ramos and Richard Kreider, who gave feedback on this paper.

Author Contributions: Conceptualization, JR, VR; Methodology, JR, VR; Formal Analysis, JR, VR, RK; Writing – Original Draft Preparation, JR, VR, RK; Writing – Review & Editing, JR, VR. All authors read and approved the final manuscript.

Conflicts of Interest: Authors have no competing interests to declare. Comments and conclusions drawn do not constitute endorsement by the authors and/or the institution. Authors independently reviewed, analyzed and interpreted the results from this review and have no financial interests in the results of this study.

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