

Review Article

Epidemiology of recurrent anterior cruciate ligament injuries according to sport type

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ABSTRACT

The anterior cruciate ligament (ACL) is one of the two cruciate ligaments that helps to strengthen the knee joint. It is a common knee injury, which often occurs in sports players. There is no bias against age or gender; however, it has been suggested in literature that women are at increased risk of secondary ACL injury. These injuries can have serious consequences for an injured athlete, including high medical costs, long off playing time, and an elevated chance of developing early osteoarthritis. Recurrent ACL injuries are described as injuries that occur in the same knee which has been previously treated. A recurrent ACL may be the result of a severe injury to the same position, graft failure, or an improper surgical procedure. Studies have reported significant prevalence of recurrent ACL. The purpose of this research is to review the available information about the epidemiology of recurrent ACL injuries. Athletes returning to sports field within two years of injury have higher chance of recurrent ACL injury. Variable prevalence of recurrent ACL injuries is reported in literature and limited studies are available. The young age, high level of exposure to physical activity, and the use of allograft all increase the chances of further ACL injury. Future population-based epidemiological studies can be beneficial and are need of time.

Keywords: Anterior, Cruciate, Ligament, Recurrent, Prevalence

INTRODUCTION

One of only two cruciate ligaments in the human body, the anterior cruciate ligament (ACL) is made of a sturdy, fibrous substance that supports its extreme mobility. The

ACL's role is to monitor changes in direction of motion, knee joint position, and variations in rigidity, speed, and acceleration. Most ACL injuries also involve injury to the meniscus, articular cartilage, or other ligaments in the knee. There are three categories of ACL injury

mechanisms: direct contact, indirect contact, and non-contact. Non-contact injuries are the most frequent and are brought on by forces produced inside the athlete's body.¹ ACL injuries are among the serious knee ailments that are of growing concern. The prevalence is 3-5 times higher in women than in men, and it is most prevalent in adolescents who play pivoting sports like football, basketball, and team handball. These injuries can result in substantial implications for the wounded athlete, including high medical expenses, time away from the field of play, and a significantly raised chance of developing early osteoarthritis.²

Although engaging in physical activity has many acknowledged advantages, there is a high chance of injury. Athletes' ability to resume sports and the integrity of their long-term knee function are both compromised. ACL reconstruction only results in a 55% return to pre-injury levels of athletic competition; hence these injuries are frequently linked to the termination of a career in team ball sports. Additionally, ACL injuries raise the likelihood of developing early-onset osteoarthritis of the knee, which could require prolonged medical attention. In addition to the financial burden, patients with ACL injuries have significantly lower health-related quality of life than patients with age-matched norms.³ Given the frequent necessity for surgical repair, the length of necessary recovery, and the possibility of long-term health issues, ACL injuries are among the worst that a young athlete may suffer. ACL injuries are not just a problem for female athletes, despite the common perception that they are. Although there will always be an endemic level of ACL injuries in sports, there should be a greater effort made to lessen their frequency and severity in high school athletes.⁴

Among the injuries that are most frequently researched in orthopaedic studies are ACL ruptures. According to estimates, there are 30 to 78 ACL ruptures per 100,000 person-years. Depending on the level of competition, 8 to 18 months following ACL surgery, between 61% and 89 % of athletes successfully return to sports. Re-rupture can be disastrous after primary ACL surgery. ACL injuries or ruptures are known to occur at rates between 1% and 11%. Re-ruptures can be brought about by acute reinjury, graft failure, or poor surgical technique.⁵ A significant rate of secondary ACL injury after original ACL reconstruction has been reported across several studies in the literature. The rate of graft rupture is higher than the frequency of ACL injury in the contralateral knee following primary ACL reconstruction of the ipsilateral knee. Despite this, the cause of the secondary ACL reconstruction higher risk of ACL injuries to the opposing knee from the one that was initially injured is unknown. Some hypothesized but unproven risk factors include notch width, knee alignment, deconditioning of the contralateral knee, and hereditary predisposition.⁶ Recurrent ACL injuries as per literature is defined as injury occurring in the same knee that has been previously treated for ACL. The purpose of this research

is to review the available information about the epidemiology of recurrent ACL injuries.

METHODS FOR LITERATURE SEARCH

This study is based on a comprehensive literature search conducted on June 22, 2022, in the Medline and Cochrane databases, utilizing the medical topic headings (MeSH) and a combination of all available related terms, according to the database. To prevent missing any possible research, a manual search for publications was conducted through Google Scholar, using the reference lists of the previously listed papers as a starting point. We looked for valuable information in papers that discussed the information about the epidemiology of recurrent ACL injuries. There were no restrictions on date, language, participant age, or type of publication.

DISCUSSION

Young active patients are most at risk for reinjury within the first two years of reconstruction and return to athletics, both to the ipsilateral and reconstructed knee and to the contralateral knee. In comparison to athletes who have not been injured, athletes under 25 years of age who return to sports have a 23% reinjury rate and a 6 times higher risk of suffering another knee injury. Young age, high activity level, and the use of allograft all increase the possibility of further ACL reconstructive damage. Preventing secondary injuries in young athletes is crucial, especially for those who are exposed to ongoing risk due to competitive sports. Even worse functional outcomes are seen following revision ACL repair in individuals whose first reconstruction failed, particularly in adolescents.⁷

Findings of United States database study showed that both males and females suffered from ACL injuries in almost about equal numbers (53.8% versus 46.2%). The mid-substance or proximal fibres were where the bulk of ACL injuries (78.2%) occurred. More subsequent injuries may be linked to hearing more pops at the time of the injury. The prevalence of both primary and secondary ACL tears was comparable to findings from earlier research. The location and kind of tears in second ACL injuries were statistically different from those in first injuries. Multiple variables, including tear type ($p=0.015$) and tear site ($p=0.022$), were linked to second ACL tears. However, there was no discernible difference in concurrent injuries between first and second ACL tears.⁸ Results of an epidemiological study from 2018 showed that numerous sports, including men's football, women's gymnastics, and women's field hockey, continue to have a high prevalence of recurrent ACL tears. Compared to male soccer players, female soccer players had a much higher rate of repeated ACL ruptures. These statistics can be used to pinpoint athletes who are more vulnerable to subsequent ACL tears following ACL reconstruction and who can gain advantage from injury prevention initiatives. Although, to determine the causes and

modifiable risk factors for a recurrent ACL rupture, more research is required.⁵

Chia concluded in his systematic review that in team ball sports, non-contact ACL injuries made up 55% of all ACL injuries also, female players were more likely than male athletes to sustain non-contact ACL injuries. Team ball sports had a higher incidence of non-contact ACL injuries during competition than during practice.⁹ Elbarrany reported that sports was the leading cause of ACL injuries (n=181). An abrupt increase in running caused 18 ACL injuries, while 20 injuries accounted due to abrupt decrease in running. Almost 14 of the participants of them omitted to say whether they were hurt during a game or a practice. 16 ACL injuries were described as car accidents, while 14 ACL injuries were listed as being related to their jobs.¹⁰

Young athletes have a high rate of reinjury, which may be ascribed to risk exposure and the interval between the athlete's index surgical surgery and the point at which they are permitted to engage in unrestricted sports activity. The high rate of graft failures also raises the risk of posttraumatic osteoarthritis, indicating that sports medicine specialists treating young athletes with primary ACL reconstruction should exercise caution when allowing them to resume their sports in order to reduce the risk of secondary injury and long-term effects like the onset of osteoarthritis. Athletes may benefit from continuing their rehabilitation and delaying their return to competition until they have achieved adequate patient-reported outcomes and strength benchmarks.^{11,12}

Results of a prospective control study showed that the incidence ratio of ACL severity with ACL reconstruction was 15 times higher than that of control participants [risk ratio=15.24; p=0.0002]. When compared to a healthy population, athletes have a higher rate of second ACL injuries following ACL reconstruction. Contralateral ACL injuries appear to occur more commonly in female athletes than in male athletes and are more common than graft re-tears. To enhance outcomes after ACL reconstruction and return to sports, it is essential to identify high-risk athletes among a population of ACL reconstruction athletes.¹³ Results of a cohort study showed that in comparison to healthy control patients, the total incidence rate of a second ACL injury within 24 months following ACL reconstruction and return to sports was approximately 6 times higher. Female athletes in the ACL reconstruction group experienced an injury rate that was over five times higher than that of female controls within 24 months of return to sports. In all, 29.5% of athletes sustained a second ACL injury within 24 months of return to sports; 20.5% of these injuries were contralateral, and 9% included the ipsilateral graft. In comparison to male participants (10.5%), there was a tendency for a larger percentage of female participants (23.7%) to experience a contralateral injury (p=0.18). Compared to young athletes without a history of ACL injuries, patients with ACL reconstruction and return to

sports are more likely to sustain another ACL injury within 24 months.¹⁴

Wiggins stated in his systematic review that with an ipsilateral reinjury rate of 7% and a contralateral injury rate of 8%, the overall second ACL reinjury rate was 15%. For individuals under the age of 25, the rate of subsequent ACL injury ipsilateral and contralateral was 21%. For athletes who return to their sport, the secondary ACL injury rate was also 20%. When these risk variables are combined, the secondary ACL injury rate for athletes under 25 who return to competition is 23%. The onset of subsequent ACL complication and severity is strongly correlated with younger age and a return to high levels of activity. Approximately 1 in 4 young athletes who suffer ACL injury and return to high-risk sports will eventually suffer another ACL injury and they will probably suffer it early in the return-to-play period. When compared to teenagers who have not been injured, young athletes who return to sport following ACL reconstruction have a 30-40 times higher risk of suffering an ACL injury.¹⁵

Over a twelve-year period, there has been a 77% increase in the prevalence of primary ACL reconstruction in women and a 19% increase in men. Compared to male players, female athletes experience more ACL injuries in sports including basketball, soccer, and lacrosse. Contrary to those who return to less demanding sports after ACL reconstruction, athletes who engage in cutting and pivoting sports have an increased risk of graft rupture and contralateral damage. Nearly half of second ACL injuries occur within two months of an athlete's return to sport, and up to one in three athletes who return. Contralateral ACL injuries have been observed to occur six times more frequently in female athletes than in male athletes, making them more common in female athletes than in male athletes.¹⁶ Patients and the economy continue to suffer from second ACL injuries, whether they are contralateral, graft failure or ipsilateral. Results of population-based cohort study in 2017 showed that the incidence of second ACL tears was 13.8%; and of these, 50% involved the ACL of the knee on the opposite side. According to statistics, second ACL injuries occurred more frequently in male patients between the ages of 26 and 45 than in female patients under the age of 25. Compared to hamstring and patellar tendon autografts, allografts still carried a higher risk of secondary ACL tears. Contralateral rips were more likely to occur with nonoperative therapy than ACL reconstruction.¹⁷ Despite the significant impact recurrent ACL injuries can have on athletes' career and life literature is very limited regarding the prevalence of injuries especially regarding the classification of recurrent ACL as per type of sports. More population-based epidemiological clinical studies are needed to generalize the prevalence of recurrent ACL.

CONCLUSION

Recurrent ACL injuries pose a significant risk to athletes as it not only affects their career but quality of life as

well. Variable incidence of recurrent ACL is seen in literature, population-based research studies in future can be beneficial and also aid in designing better prevention strategies for recurrent ACL.

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REFERENCES

- Rodriguez K, Soni M, Joshi PK. Anterior Cruciate Ligament Injury: Conservative Versus Surgical Treatment. *Cureus*. 2021;13(12):e20206.
- Bahr R, Krosshaug T. Understanding injury mechanisms: a key component of preventing injuries in sport. *Bri J Sports Med*. 2005;39(6):324-9.
- Mouton C, Gokeler A, Urhausen A, Nührenbörger C, Seil R. High Incidence of Anterior Cruciate Ligament Injuries Within the First 2 Months of the Season in Amateur Team Ball Sports. *Sports Health*. 2022;14(2):183-7.
- Joseph AM, Collins CL, Henke NM, Yard EE, Fields SK, Comstock RD. A multisport epidemiologic comparison of anterior cruciate ligament injuries in high school athletics. *J Athletic Training*. 2013;48(6):810-17.
- Gans I, Retzky JS, Jones LC, Tanaka MJ. Epidemiology of Recurrent Anterior Cruciate Ligament Injuries in National Collegiate Athletic Association Sports: The Injury Surveillance Program, 2004-2014. *Orthop J Sports Med*. 2018;6(6):2325967118777823.
- Koh BTH, Sayampanathan AA, Bin Abd Razak HR, Chong HC, Andrew Tan H-C. Injury patterns in patients presenting with a recurrent anterior cruciate ligament tear following primary reconstruction. *Ann Translational Med*. 2016;4(12):1.
- Slater LV, Wasserman EB, Hart JM. Trends in Recurrent Anterior Cruciate Ligament Injuries Differ From New Anterior Cruciate Ligament Injuries in College and High School Sports: 2009-2010 Through 2016-2017. *Orthop J Sports Med*. 2019;7(11):2325967119883867.
- McMurray NS, Bates NA, Fischer S, Schilaty ND, Hewett TE. Investigation of primary and second anterior cruciate ligament tears using a geographic database. *Int J Sports Phys Ther*. 2020;15(4):593-602.
- Chia L, De Oliveira Silva D, Whalan M. Non-contact Anterior Cruciate Ligament Injury Epidemiology in Team-Ball Sports: A Systematic Review with Meta-analysis by Sex, Age, Sport, Participation Level, and Exposure Type. *Sports Med*. 2022.
- Elbarrany W. Prevalence and mechanism of Anterior cruciate ligament injury among Makkah City, Saudi Arabia. *World J Pharmaceutical Res*. 2017;6:383-91.
- Grassi A, Ardern CL, Marcheggiani Muccioli GM, Neri MP, Marcacci M, Zaffagnini S. Does revision ACL reconstruction measure up to primary surgery? A meta-analysis comparing patient-reported and clinician-reported outcomes, and radiographic results. *Br J Sports Med*. 2016;50(12):716-24.
- Nagelli CV, Hewett TE. Should Return to Sport be Delayed Until 2 Years After Anterior Cruciate Ligament Reconstruction? Biological and Functional Considerations. *Sports Med (Auckland, NZ)*. 2017;47(2):221-32.
- Paterno MV, Rauh MJ, Schmitt LC, Ford KR, Hewett TE. Incidence of contralateral and ipsilateral anterior cruciate ligament (ACL) injury after primary ACL reconstruction and return to sport. *Clin J Sport Med*. 2012;22(2):116-21.
- Paterno MV, Rauh MJ, Schmitt LC, Ford KR, Hewett TE. Incidence of Second ACL Injuries 2 Years After Primary ACL Reconstruction and Return to Sport. *Am J Sports Med*. 2014;42(7):1567-73.
- Wiggins AJ, Grandhi RK, Schneider DK, Stanfield D, Webster KE, Myer GD. Risk of Secondary Injury in Younger Athletes After Anterior Cruciate Ligament Reconstruction: A Systematic Review and Meta-analysis. *Am J Sports Med*. 2016;44(7):1861-76.
- Johnson JL, Capin JJ, Arundale AJH, Zarzycki R, Smith AH, Snyder-Mackler L. A Secondary Injury Prevention Program May Decrease Contralateral Anterior Cruciate Ligament Injuries in Female Athletes: 2-Year Injury Rates in the ACL-SPORTS Randomized Controlled Trial. *J Orthop Sports Physical Therapy*. 2020;50(9):523-30.
- Schilaty ND, Nagelli C, Bates NA. Incidence of Second Anterior Cruciate Ligament Tears and Identification of Associated Risk Factors From 2001 to 2010 Using a Geographic Database. *Orthop J Sports Med*. 2017;5(8):2325967117724196.

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