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Comparison of Anterior Cruciate Ligament Graft Materials and Risk of Rupture/Reinjury in Young Athletes

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Abstract

The anterior cruciate ligament tear is a standard surgical injury seen with young athletes competing at elite, amateur, and recreational capacities. The purpose of this literature review is to determine the rehabilitation guidelines and risks associated with anterior cruciate ligament reconstruction, as well as determining the role of rehabilitation in graft rupture. This literature review also serves to determine if graft choice for surgical repair plays a role in an increased risk of rupture or reinjury. This literature review used various online databases, including Dynamed, Cochran, and PubMed, with the utilization of MeSH terms listed below in "keywords" in order to identify applicable data. A systematic review of the literature was then completed. Data showed that athletes near or younger than the age of 25 were at a higher risk of graft rupture. The patellar tendon graft shows a decreased risk of rupture and instability when compared to hamstring grafts. Allografts were found to have an increased risk of rupture in young athletes when compared to hamstring grafts and should not be considered for young athletes. Failure to complete a rehabilitation program was also determined to play a role in graft rupture.

Introduction

Anterior cruciate ligament (ACL) tears are a standard surgical injury to the knee, especially seen in younger athletes performing at both elite and amateur levels. Although this injury can be debilitating and require surgical intervention, therapy, and significant rehab, many athletes can return to sport and have little to no deficits. The surgical graft material for repairing an ACL tear can vary significantly. Surgical technique, angle of the ligament, and compliance with therapy all play a role in possible reinjury; however, the basis of this paper is to determine if the graft material used can leave an athlete more prone to re-injury and if graft selection plays a role in rehabilitation. An assessment of recent advances regarding new techniques for reconstruction and the risk reduction associated with this procedure was also completed.

Statement of the Problem

An ACL reconstruction is a procedure that follows a rupture of the ACL. Rupture is often due to the increased amount of force and stress put on the knee. Although ACL reconstruction is a relatively standard surgical procedure, there is a wide variety of the type of graft material used. The concern regarding this approach is that based on the graft material type used, the patient may be more prone to reinjury.

Research Question

In young athletes who have undergone ACL repair, do different ACL graft materials increase the chance of reinjury/relapse, and does graft selection impact rehabilitation?

Literature Review

- Rehabilitation and Risks of ACL repair
 - Kyritis (2016) illustrated that an objective rehabilitation program that set discharge goals decreased the rate of reinjury.
 - Murray and Fleming found evidence that one of the major risks that was associated with ACL reconstruction was post-operative arthritis 10-15 years following surgical repair.
- Comparison of Patellar Tendon Graft and Hamstring Tendon Graft
 - Erickson et al. (2015) showed that the preferred graft choice for elite football players by orthopedic surgeons was patellar tendon graft.
 - Heijne (2010) identifies that when compared to hamstring tendon graft, patellar tendon graft showed decreased laxity and more stability as it related to anterior laxity and pivot shift.
 - Laboute (2018) was a large-scale study that showed those that underwent hamstring graft reconstruction were at an increased risk of rupture as well as identified that patients under the age of 25 were at an increased risk of rupture.
 - Gupta (2017) showed that different types of ACL tears did not translate to clinically different outcomes and hamstring tendon grafts comparisons could be made despite different types of tears being identified.
 - Mascarenhas (2012) illustrated that when it came to patient reported outcomes, hamstring graft had increased ROM and as well as patient outcome scores. XR also showed less evidence of osteoarthritis.
- Allograft
 - Bottoni et al. (2015) found that athletes or young athletic individuals who undergo allograft ACL reconstruction are 3 times more likely to suffer rupture or reinjury that ultimately requires surgical revision of the graft.
 - Lenehan (2015) Overall rates of reoperational revision and graft failure in allograft compared to autografts was higher. Furthermore, the authors did show that the rates of rupture and the need for revision were significantly higher in participants that were less than 25 years of age.

- Bridge Enhanced ACL repair (BEAR)
 - Murray et al. (2016) discussed the first in-human clinical trial for this procedure. The study found that Hamstring strength was preserved in BEAR procedure when compared to hamstring tendon graft. They also showed that there was no significant difference between hamstring graft and BEAR when it relates to outcomes (pain, effusion, laxity). However, BEAR could potentially remove the increased risks for osteoarthritis that is typically associated with conventional ACL reconstruction.

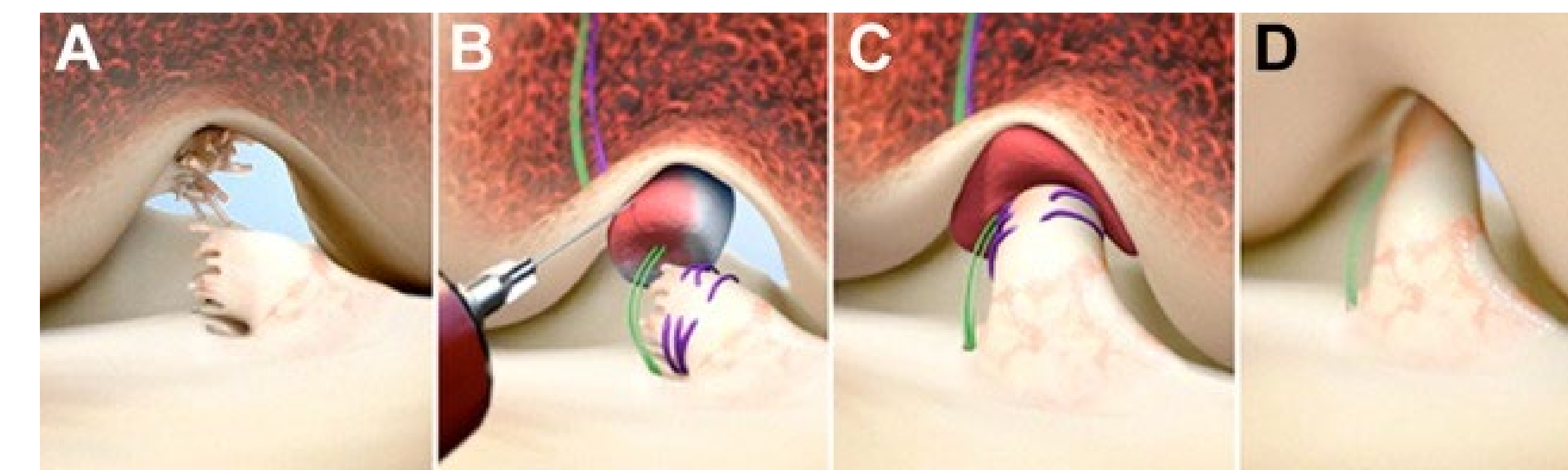


Figure 1: An illustration of the stepwise fashion of BEAR. A) initial tear of ACL, B) connecting two torn ends of ACL with BEAR scaffolding with the addition of whole blood to scaffolding, C) facilitated healing with the blood and scaffolding, D) healed ACL.

Discussion

- Kyritis (2016) shows the importance of completing a comprehensive rehabilitation regiment following the surgical repair of the ACL and found that those that did not complete their physical therapy regiment and were discharged from treatment were at four times greater risk of rupture. Furthermore, Malempati (2015) illustrated that graft selection does have an impact on the rehabilitation process. For example, a patient that undergoes hamstring tendon graft repair would be expected to show increased hamstring weakness post-surgery. Murray & Fleming (2013) illustrated that those that undergo an ACLR with a graft are at an increased risk for post-traumatic osteoarthritis after about 10-15 years.
- Laboute found that participants that underwent hamstring tendon graft were at an increased for rupture when compared to the patellar tendon as well as those under the age of 25. Heijne (2010) although a smaller study, also complements Laboute (2018) showing more stability of the patellar tendon graft compared to the hamstring graft one-year post-surgically.
- Allografts should not be considered in young athletes as they have a higher rate of rupture and reinjury than hamstring grafts.
- With the recent clinical trials of the BEAR procedure, some of the risks including post-traumatic arthritis at 10-15 years could be eliminated using a scaffolding and the surgical procedure itself.

Applicability to Clinical Practice

- Rural primary care providers frequently serve as the initial provider assessing knee pain and making the diagnosis of an ACL injury. While orthopedic specialists handle the surgical intervention for this injury, rural primary care providers (PCPs) assess the patient pre and post-operatively along with the surgical team. A significant component of primary care is patient education. Clinicians in primary care who have an in-depth understanding of not only the procedure for ACL repair but the knowledge regarding potential graft materials can assist with both patient education of the procedure as well as setting realistic goals and the timeline for return to sport. A risk assessment by a PCP can also be made with the knowledge of graft failure rates and the age of the patient. After completing this risk stratification, proper referral for surgical intervention can be made that would be in the best interest of the patient. Risks, including long-term arthritis, can also be discussed with the patient before surgical intervention. Having this knowledge would allow a primary care provider to serve a patient population better and integrate it into practice, especially in the rural setting.

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