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**Autograft versus Allograft Failure in Anterior Cruciate Ligament
Reconstruction of Young Athletic Patients**

Doug Cohrs, PA-S & Marissa Wollak, PA-S

Abstract

Objective: To determine if the type of graft, autograft versus allograft, contributes to graft failure in anterior cruciate ligament (ACL) reconstruction in young active patients. **Design:** Systematic literature review. **Methods:** Searches were done in PubMed and Google Scholar, utilizing the terms anterior cruciate ligament reconstruction, allografts and autografts. In PubMed the following filters and terms were used: published in the last 5 years, humans, cohort, randomized control trial, meta-analysis, and English. **Results:** The Pallis et al study was included because it compared allograft and autograft reconstruction in active, military cadets. The Li et al study was included because it included subjective and objective data, including imaging. The meta-analysis by Kraeutler et al was included because it compared the subjective and objective data which was included in the other two studies. **Conclusion:** The use of autograft versus allograft tissue in ACL reconstruction yielded no difference in subjective functional examinations, patient's ability to return to previous activity level or difference in stability and integrity on physical exam. There is a significant difference in re-rupture rate suggesting a higher incidence of re-rupture with allograft tissues used in the reconstruction of the ACL.

Introduction

The anterior cruciate ligament (ACL) is the most commonly injured knee ligament. There are 100,000-200,000 new cases of ACL injuries every year in the US with an individual rate of rupture being 1 in every 3500 individuals (1). Injuries can be either high energy, such as a car accident, or low energy, such as noncontact sports. A majority of ACL injuries, about 70%, come from noncontact sports (1). ACL injuries are very common injuries in young male and female athletes. It is predicted that 3.24 per 100 men and 3.51 per 100 women will rupture their ACL during 4 years as a collegiate athlete (2). ACL injuries are classified on a scale from I to III. A grade I sprain means that the ACL is not torn, just stretched. A grade II sprain means that the ACL is partially torn. A grade III sprain means that the ACL has completely torn.

ACL injuries can be treated operatively or nonoperatively. The decision to undergo surgery is based on the patient's level of activity, future functional demands and any additional ligament or meniscus injury (1). Most people, especially athletes, choose to undergo surgery in the hopes of getting back to his or her previous activity level. Reconstruction of the ACL is the 6th most common arthroscopic knee procedure (3). ACL reconstruction is done using a graft - either an autograft, from the patient's own tissues, or an allograft, tissue donated from a human cadaver. Autografts are typically harvested from either native patellar tendon, hamstring tendon or quadriceps tendon. Allografts are usually taken from cadaver Achilles or patellar tendon. With surgery, followed by rehabilitation and physical therapy, it is possible for athletes to return to their full playing potential. But before any of that is possible, the clinician and the patient must make the decision of which type of graft tissue will be used to reconstruct the ruptured ACL.

There is a clinical debate on whether the type of graft tissue is correlated with more positive or negative clinical outcomes. Autografts have been associated with increased donor site morbidity, such as increased risk of infection, increased healing time and tendon weakness at the site of autograft harvest, as well as anterior knee pain but better graft maturity and less incidence of rejection. Allografts have

been shown to have less knee pain and no chance of donor morbidity, reduced surgical time but have the potential to transmit HIV or hepatitis infections. Re-rupture has been observed in both allograft and autograft tissues. With advantages and disadvantages to each type of graft, is one more superior to the other? Due to a lack of definitive evidence, this study aims to compile and investigate whether autograft or allograft tissues are associated with an increased incidence of graft failure. This study defines graft failure based on patient reported symptoms (subjective findings), knee stability and integrity (objective findings) and graft rupture (rupture and predicted ruptures). Subjective findings consisted of: International Knee Documentation Committee (IKDC) and Tegner Lysholm Knee Scoring scales as well as the patient's ability to return to previous activity level. Objective findings consisted of: anterior drawer test, Lachman test, and pivot shift test. Rupture rate was included in two of the three studies and a pseudorupture rate was predicted using signal-noise-quotient (SNQ) data to analyze the revascularization of grafts via MRI to determine the risk of re-rupture. The SNQ is the MRI signal visualized within an ACL graft less the signal of the quadriceps tendon, divided by the MRI background signal.

The International Knee Documentation Committee (IKDC) is a qualitative questionnaire examining subjective assessment, symptoms, range of motion and ligament examination of the reconstructed ACL. The Tegner Lysholm Knee Scoring Scale (TLKS) assesses temporal responsiveness to evaluate early return to function after ACL reconstruction. The Anterior Drawer Test is a special test performed as part of a musculoskeletal physical exam to assess end-feel and laxity of the ACL. The Lachman Test is another special test that also evaluates ACL end-feel and laxity, but has been shown to be a much more sensitive test than the Anterior Drawer for detecting ACL rupture. This is partly because positioning for the Lachman test uses only 20 degrees of flexion at the knee, thus reducing the amount of protective spasm by the hamstrings compared to 90 degrees of flexion with the anterior drawer test. At 20 degrees of knee flexion, the ACL is maximally stressed and can be assessed more accurately. The Lachman Test is considered the gold standard physical exam assessment. The Pivot Shift Test is one final physical exam maneuver that can be used to assess the ACL, however it is technically difficult to perform and even more difficult to get patients to relax enough for the test to be valid.

Clinical Scenario

AB is a 21 year old male college basketball player who recently injured his right knee during practice. He states that he heard a "pop" before his knee gave out and collapsed on the court. He was stabilized by the athletic trainers until he could be more thoroughly evaluated by the athletic physician, who observed a swollen right knee with increased laxity and decreased stability measured by a positive anterior drawer and Lachman's test. The athletic physician is suspicious of an ACL rupture and scheduled AB for imaging. Magnetic resonance imaging (MRI) revealed that he has a grade III ACL tear. AB is then referred to an orthopedic surgeon who recommends ACL reconstruction and has given AB the choice of using either an autograft or an allograft tendon. AB's primary concern is being able to play in his senior season next fall. He doesn't know which graft choice will best get him back on the court.

Clinical Question

Does the type of graft, autograft versus allograft, contribute to graft failure in ACL reconstruction in young active patients?

Methods

Our initial search began on Pubmed and Google Scholar to find scholarly articles. Search terms included, “Anterior Cruciate Ligament Reconstruction, Allografts, Autografts.” Studies published in the last 5 years that were cohort, randomized control trials, or meta-analyses, and primarily looked at younger, athletic patients were considered. Studies that did not meet the inclusion and exclusion criteria were not considered (See Table 1 and Appendix 1). This left us with 18 studies.

Inclusion Criteria	Exclusion Criteria
Cohort Randomized Control Trials Meta-analysis English Humans	Studies older than 5 years Studies comparing different types of autografts and allografts Non-active populations

After manually sifting through the populated articles, we eliminated studies that did not compare the same type of autograft to allograft. We wanted studies only comparing bone-patellar, tendon- bone (BPTB) tendons. For example, studies that compared hamstring tendon autograft to patella tendon allografts were excluded. This left us with two cohort studies and one meta-analysis that compared autograft and allograft use in ACL reconstruction. Other databases were used to look for further studies, but yielded no further results.

Not every study considered for this systematic review looked at the same variables, so the studies that included at least two, if not three of the variables that define graft failure, were used to evaluate our clinical question. These variables included: IKDC, TLKS, return to previous activity level, anterior drawer test, Lachman test, pivot shift test, rupture and SNQ.

	Pallis et al. (Study 1)	Li et al. (Study 2)	Kraeutler et al. (Study 3)
Sample Size	122	52	5182
Year Published	2012	2012	2013
Journal Published In	American Journal of Sports Medicine	American Journal of Sports Medicine	American Journal of Sports Medicine
Level of Evidence	2	3	2 *

*Indicates study was graded by the authors of this paper according to “Prognosis” levels of evidence (6). A score of 2 means a lesser quality prospective cohort, retrospective cohort study, untreated controls from an RCT, or systematic review of these studies. A score of 3 means case-control study or systematic review of these studies. The lower the score, the better the study. Scoring is from 1 to 5.

RESULTS

Study #1

Survival Comparison of Allograft and Autograft Anterior Cruciate Ligament Reconstruction at the United States Military Academy. Pallis et al.

Study Objective: To compare the rate of failure between autograft and allograft reconstruction in young, athletic patients.

Study Design

This was a cohort study that included 120 cadets that had undergone 122 ACL reconstructions, of which two were bilateral, before they entered military service. Out of the 122 reconstructed ACLs, 106 used autografts (61 BPTB, 45 hamstring) and 16 used allografts. Surgeries occurred before matriculation and baseline measurements, details about previous injury and surgical treatment were obtained at the start of study. Functionality of the reconstructed ligaments was assessed throughout his or her time in cadet school. All cadets were evaluated by the same military orthopedic surgeon using systematic evaluation techniques including, Lachman test (graded 0-3) and pivot shift test (graded as none, glide or gross). Any cadets that were reinjured during their physical training were evaluated by orthopedic surgeons and re-ruptures were confirmed using MRI. The study’s goal was to identify subsequent ACL failure after previous reconstruction during the follow-up time in military service.

The authors calculated descriptive statistics including the frequency of categorical data within the cohort to control for extraneous variables. They used univariate and multivariate hazard Cox regression analysis (statistical method of comparing one or multiple variables to when a specific event took place, in this study it was to compare variables to the likelihood of a reconstructed ACL to rerupture during physical training) to calculate how long from cadet matriculation did ACL reinjury take place. Using this, 95% confidence interval (CI) hazard ratios were calculated to analyze the survival of reconstructed ACL ligaments. After analysis was performed on each type of graft individually it was determined that there was no difference between the survivability of BPTB and hamstring autografts so they were combined together into one autograft variable. Hazards ratios were then calculated to compare ACL re-injury in autograft against all allograft reconstructions.

Study Results

During follow-up evaluations no participant had knee instability complaints. There was not enough data on IKDC or TLKS scores to perform statistical analysis. Out of all the knees that underwent Lachman and pivot shift testing, 98% of the autograft knees had a grade 0 or grade 1 on Lachman examination and 91% of the allograft knees had grade 0 or grade 1. Pivot shift testing revealed no gross pivot shift gliding in any of the knees of both the autograft and allograft participants.

Twenty graft failures were identified during the follow up period. The average failure occurred 545 days after matriculation. Of these 13 were autograft (7 BPTB, 6 hamstring) and 7 were allografts.

Kaplan-Meier survival analysis, often used in medicine to measure the fraction of patients who have reached the maximum benefit after a treatment, compared autograft to allograft survival and found that allografts were 6.7 times more likely to experience ACL reinjury (HR = 6.71, CI 95%, P < 0.001). The authors took efforts to plot out the survival of each graft with each passing year. During the first year 33% of cadets who had an allograft experienced failure while only 2% of those with an autograft experienced failure. During the second year about 50% of those who had received an allograft had experienced graft failure while only 6% of those with an autograft had experienced failure (See Figure 1).

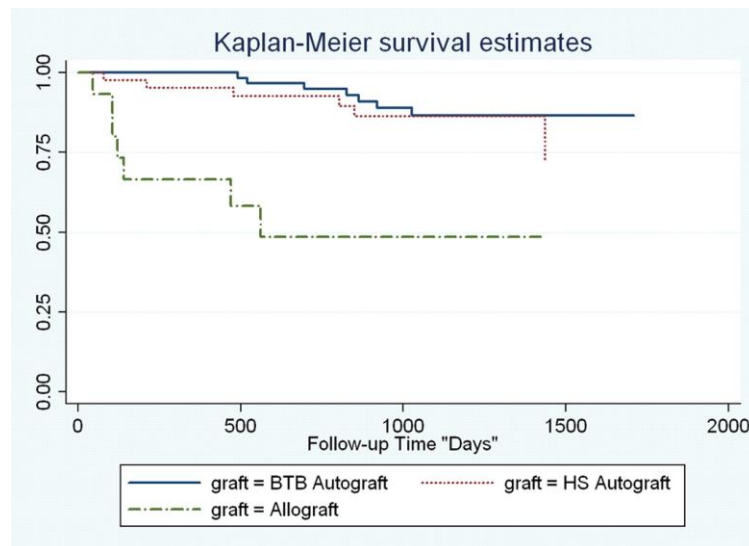


Figure 1. Kaplan-Meier survival estimates by anterior cruciate ligament graft type during follow-up. The unit of time is days from study enrollment. BTB, bone–patellar tendon– bone; HS, hamstring.

Study #2

Difference in Graft Maturity of the Reconstructed Anterior Cruciate Ligament 2 Years Postoperatively: A Comparison Between Autografts and Allografts in Young Men Using Clinical and 3.0-T Magnetic Resonance Imaging Evaluation. Li et al.

Study Objective: To compare graft maturity between allograft tendons and autograft tendons at two years postoperatively.

Study Design

A cohort study was carried out with 52 participants who had undergone previous ACL reconstruction. Of these participants, 30 received allograft tendons and 22 received autografts. Demographic information was controlled within the two groups and the two groups did not differ significantly based on age or BMI (P > 0.05). The authors excluded all females because they did not want to risk any hormonal influence on graft maturity therefore sex did not need to be controlled for. One surgeon performed all of the surgeries and used the same arthroscopic single-bundle ACL reconstruction

techniques in which a single bundle of graft tissue is used. All patients underwent the same postoperative rehabilitation programs and were cleared to begin returning to previous activity level 6 months after surgery.

Follow up consisted of a clinical evaluation and imaging studies. The clinical evaluation was performed by an orthopedic surgeon and consisted of both patient self-evaluation and physical exam findings. Subjective functional evaluations consisted of IKDC and TKLS scores. TKLS scores were rated as either poor (< 65), fair (65-83), good (84-90), and excellent (>90). The physical examination consisted of ADT and Lachman test. Both were graded as 0, I, II or III with grade 0 being normal with 0-2 mm displacement; grade I being abnormal with 3-5 mm displacement; grade II being abnormal with 6-10 mm displacement; grade III being abnormal with greater 10 mm displacement.

Imaging studies consisted of a 3.0-T MRI scan of the knee in a relaxed extended position. The MRI scan had five specific measurements of interest. The first was the tibial tunnel location of the graft measured using a position ratio. The second was the orientation of the ACL ligament using the sagittal ACL angle and the ACL-Blumensaat line angle. Third was the amount of edema seen in the graft which was assigned a I, II, or III rating based on no edema, partial edema, or full edema seen, respectively. The next measurement was the width of the ACL graft at the proximal, middle, and distal sites. Lastly, the signal intensity was calculated at the proximal, middle, and distal sites of the graft as well as the quadriceps tendon and the background located 2 cm in front of the patellar tendon. Signal to noise quotient (SNQ = MRI signal of the ACL graft - signal of quadriceps tendon/signal of background) were calculated to quantify the amount of signal in the ACL graft. Repeated measurements of SNQ quotients were repeated by the same investigator who was blinded to the type of graft each patient had received.

Due to the lower sample size, the studies statistical power was calculated to validate the study. Statistical power was calculated to be 80%. Intraclass correlation coefficients (ICC), which are a measure of the reliability of measurements, were calculated to confirm intraobserver reliability. Chi square analysis (χ^2) was performed to compare categorical variables between the autograft and allograft groups. Two sample T testing was used to compare the variables of interest.

Study Results

Every participant in both the autograft and allograft group was able to return to previous sports activity. There was no cases of infection or synovitis. There was no significant difference between IKDC (P = 0.6448) and TLKS (P = 0.5436) scores between the two study groups. MRI images confirmed that no patient had experienced any additional ligament tears or cartilage defects in his operated knee. The ICC index for evaluating the MRIs was 0.71-0.98 for all measurements. There was no significant difference when comparing autografts and allografts when it came to graft position (P = 0.5908), ACL angle (P = 0.3458), ACL-Blumensaat line angle (P = 0.6444), width of the allograft at the proximal (P = 0.4945), middle (P = 0.6948), or distal sites (P = 0.6431), diameter of the graft at the proximal (P = 0.4347), middle (P = 0.6556), or the distal sites (P = 0.6071). There was a statistically significant difference in the SNQ ratios between the two groups (See Figure 2). The ACL grafts of the allograft group were consistently higher at the proximal (P = 0.0018), middle (P = 0.0149), and distal sites (P = 0.0173). The higher signal correlates with less revascularization of the graft and an incomplete remodeling process. With this incomplete recovery the newly constructed ligament is predicted to be not as strong and more likely to rupture if exposed to increased stress.

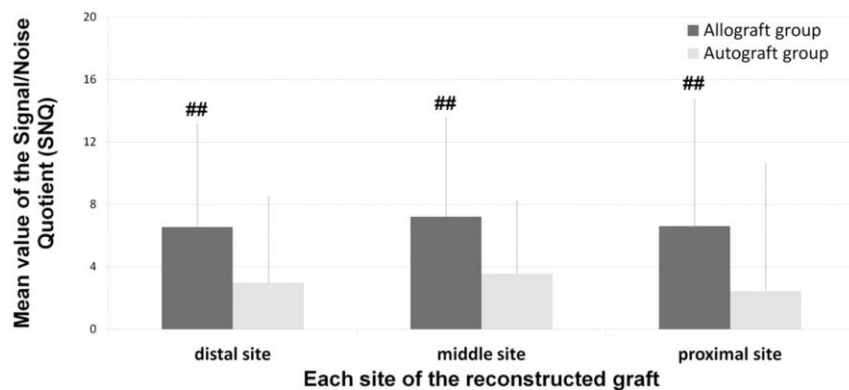


Figure 2. The mean signal/noise quotient of anterior cruciate ligament grafts in both groups. “##” indicates a significant difference between the allograft group and the autograft group.

Study #3

Bone-Patellar Tendon-Bone (BPTB) Autograft Versus Allograft in Outcomes of Anterior Cruciate Ligament Reconstruction: A Meta-analysis of 5182 Patients. Kraeutler et al.

Study Objective

To compare BPTB autografts to allografts for ACL reconstruction, specifically with regard to patient satisfaction, return to preinjury activity level, and postoperative functional outcomes.

Study Design

This meta-analysis used 76 studies published between 1998 and 2012 and included 5,182 patients. It was not necessary for studies to be comparative between allograft and autograft. Criteria determining whether a study was to be included consisted of: published from 1998 to 2012, written in English, only data on BPTB grafts and had at least a 2 year follow up. Exclusions included patients over 40 years old, those involved in worker’s compensation cases and studies that did not define knee pain as anterior knee pain, patellofemoral pain, retropatellar pain or pain while kneeling. Surgeries were performed by different surgeons and therefore graft fixation techniques varied. Because of this, data was stratified based on anteromedial, transtibial and outside-in technique.

Variables assessed in this meta-analysis included: graft rupture rate, return to previous activity level, IKDC, Lysholm, Tegner and Cincinnati Knee Rating System scores, pivot shift test, and anterior knee pain. Follow up time varied at 2 years, 3 years, 5 years, 6 years, 7 years, 10 years and 13 years.

Pivot shift test, anterior knee pain, return to previous activity and overall IKDC were treated as dichotomous variables for a larger group of studies to make a summary odds ratio (OR). The pivot shift test and anterior knee pain were divided into positive or negative outcomes and the return to previous activity was divided into returned or not returned at time of follow up. For overall IKDC, patients were grouped in two groups as normal or nearly normal in one group and abnormal or severely abnormal in the second. For each of these dichotomous variables, the patient population was added up and a summary odds ratio was calculated with a 2x2 table.

For subjective IKDC and TLKS, a mean score was calculated for each group of autografts and allografts. A combination standard deviation was also calculated with the standard deviations that was given in each study. A standardized mean difference and a standardized variance was calculated as were the means and standard deviations. A summary OR and confidence interval was calculated from those numbers using a logistic regression method. This method is commonly used when there is a success-failure outcome (4). It estimates probability that the outcome variable assumes a certain value rather than estimating the value itself (4).

For all the variables, an odds ratio (calculated at 95% confidence intervals) greater than 1 favored autograft and an odds ratio less than 1 favored allograft.

Study Results

Seventeen studies reported data on what proportion of the participants were able to return to his or her preinjury activity level. People were more likely to return to play with an allograft (OR 0.62). However, this result was questioned by the authors because the autograft group was younger than the allograft group and believed to engage in more strenuous activity. This increased level of activity would be harder to return to compared to those who do not engage in more strenuous levels of activity, the allograft group. The subjective scores, IKDC and TKLS scores were both significantly in favor of autografts (OR: IKDC 1.64, TKLS, 3.19). Pivot shift analysis was included in forty five of the studies. An OR of 0.74 was significantly in favor of the allograft group. Fifty three of the studies included had data on rupture rates. The OR for rupture rate was 3.24, showing that allografts are 3.24 more times likely to rupture compared to autografts.

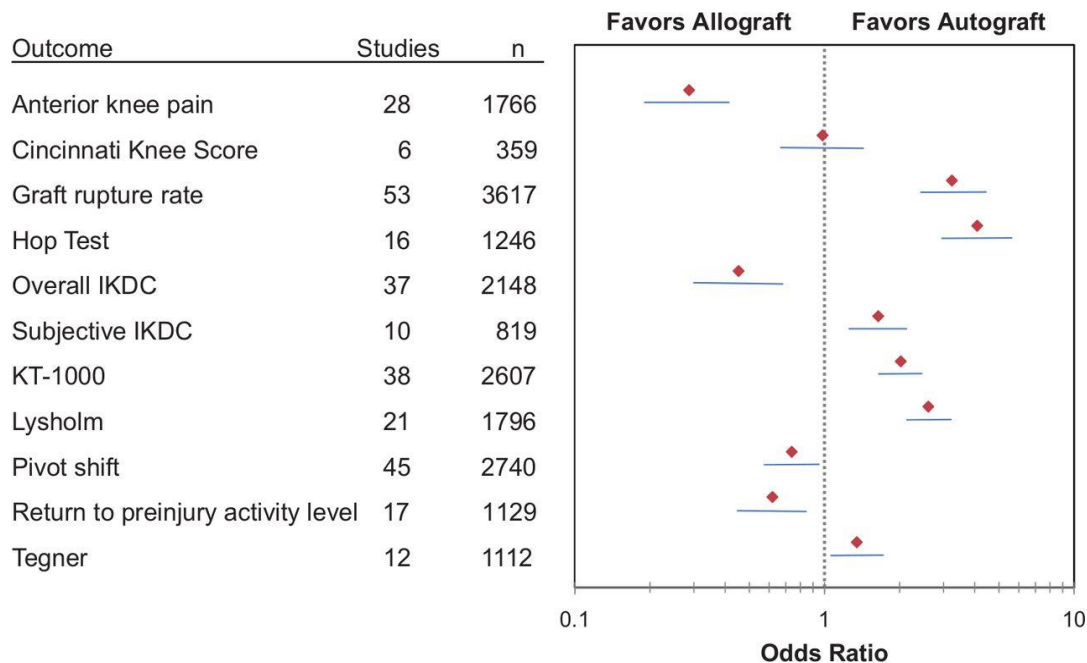


Figure 3. Odds ratios (ORs) for each outcome analyzed. ORs <1 favor allografts; ORs >1 favor autografts. Bars represent 95% confidence intervals. IKDC, International Knee Documentation Committee.

Critiques and Limitations of Studies

The study by Pallis et al., did not have subjective measurements on knee stability (IKDC or TLKS) for every participant, so no statistical analysis could be carried out to compare between the autografts and the allografts. Next, only participants who experienced a re-injury to his or her ACL received radiographs to evaluate the reconstructed ligament. Participants who were asymptomatic never received follow up radiographs so these grafts could not be evaluated or compared. If this were possible, then results seen in the Li et al study may not have been observed. The lack of radiographic evidence also prevented the authors to control for surgical and fixation technique because they could not evaluate how the graft was anchored in the participant's knee. The last limitation is that the authors did not have data regarding the type of sterilization that each graft underwent. This could possibly have influenced the rate of re-rupture.

Li et al analyzed the grafts in a way that was unique from the other two studies but it did have its limitations. There were two different fixation devices (Endobutton CL and Rigidfix cross pins) used in this cohort which could have influenced graft health. Next, hamstring autografts and tibial tendon allografts were used. This goes against our ideal study only comparing BTBP tendons but this studies unique radiographic analysis of the grafts made it worth including in the systematic review. The authors also only included male participants in order to avoid any possible hormonal effects on graft maturity. Lastly, every participant in the study may not have had the same level of activity. Some may have been high performing athletes while others only participate in light cardiovascular exercise. Activity level was not controlled in the study as it was in Pallis et al where every cadet underwent the same physical training.

The third study had 5182 participants which helped make the study have greater statistical power but in order to do this they had to include noncomparative studies which may have influenced the results. The follow up time for each study was different. Studies had follow up times that ranged from 2, 3, 5, 6, 7, 10, and 13 years. Also, due to a lack of standard deviations in follow up time overall, there was no way to know if follow up time had an influence on the meta-analysis' results.

Pallis et al. (Study 1)	Li et al. (Study 2)	Kraeutler et al. (Study 3)
Different surgeons Small degree of dropout Male predominant study No way of determining fixation device or tunnel positions due to lack of imaging studies Type of allograft sterilization is unknown	Two different types of fixation tools were used (Endobutton CL and Rigidfix cross pins) No females included Activity levels of participants are unconfirmed Small sample size (52 participants)	Includes non-comparative studies in order to increase the amount of data Varying follow-up time within each study Study hypothesis does not match the tone of the paper

Discussion

ACL injuries are very common injuries. They can cripple a high performing athlete and take a first string, star athlete and pull them back to the bench in a split second. With surgery and proper rehabilitation, an athlete has the potential to return to his or her full playing capacity. However, the potential to return to play could all begin with the type of graft used to reconstruct the new ligament.

The literature available today has conflicting results. Some studies favor allografts, while some favor autografts. In some studies there doesn't seem to be a clear difference between the type of graft used and clinical outcomes. We choose 3 of the most compelling studies we could find in order to find evidence to show that one type of graft was superior to the other. Table 3 shows the overall results of all three included studies in our systematic review.

The Pallis et al study looked at military cadets who had previously undergone ACL reconstruction. These newly matriculated cadets were thrown into a rigorous physical training regimen that would test the integrity of any reconstructed ligament. The authors found little difference between the integrity and stability of the different types of reconstructed knees, except for a threefold increase in rupture rates seen in the allograft group.

The results of the study are extremely salient to our patient case. It is important to note that the activity load of an athlete and a cadet are both strenuous but are different due to varying biokinetics of their associated activities. The surgeries were performed by different surgeons because the study participants were only recruited at matriculation and review of medical records. This helps to prevent any bias from military surgeons trying to change the protocol for cadets requiring ACL reconstruction but it does not allow for surgical technique to be controlled for. Subjective scores, IKDC and TKLS, were not available for everyone and statistical analysis could not be performed for these variables. The patient's self-evaluation of his or her reconstructed knee is extremely important. Since knee stability seems to be similar when comparing autografts and allografts it puts even more importance on the patient's experience and evaluation of his or her reconstructed knee.

The Li et al study looked at patients who had received ACL reconstructions and compared them over multiple radiographic and nonradiographic measurements. They found there was almost no significant difference between autografts and allografts except for differences found on MRI. The increased SNQ seen with the allografts suggests that allografts experience a slower or poorer remodeling of the reconstructed ligament and thus are more prone to rupture if not given time to heal.

This study used a very small sample size, 52, but the number of individuals in each group was more equal than the groups in the other two studies. Unlike the Pallis et al study, the Li et al study used the same surgeon for every reconstruction. This lowers the possibility that the surgery itself could influence the results. The clinical pearl of this study is found in the use of imaging to evaluate graft maturity. The authors were able to look at the signal in the grafts and use pathophysiology of the remodeling process to help illustrate the difference between autograft and allograft integrity before a traumatic event, like a rupture, occurs. We took the calculated SNQ differences to predict a rupture rate based on the immaturity associated with increased SNQs. The study also took place in China, which may have different protocols (surgical, rehab, etc.) to ACL reconstruction that could make these results not salient to our patient.

The last study, Kraeutler et al, was a meta-analysis including 5182 patients. Almost all of the author's variables of interest were in favor of autograft reconstruction and those in favor of allografts (return to previous activity and pivot shift) were believed to be false due to the idea that those who

received allografts typically did not partake in as strenuous activities as those who received autografts. Kraeutler also found a similar result as the previous studies, the allografts were three times more likely to experience a re-rupture.

All of these studies were found in the same journal, The American Journal of Sports Medicine. This could be a possible source for bias as the journal may not want to publish conflicting evidence in a prestigious journal. Many of the top journals go on to influence medical protocols and too much conflicting evidence halts the potential for progress and better patient outcomes.

Table 3: Compiled Subjective, Objective, and Rupture Data of the Three Reviewed Studies			
	Pallis et al. (Study 1)	Li et al. (Study 2)	Kraeutler et al. (Study 3)
Number of patients	122	52	5182
Autografts:Allografts	106:16	22:30	4276:906
Male:Female	90:30	52:0	N/A
Average Follow Up	1, 2, and 3 years	2.5 years	2-13 years
International Knee Documentation Committee (IKDC)	Not enough individual scores recorded for statistical analysis	No difference (P=0.65)	Favors Autograft
Tegner Lysholm Knee Scoring Scale (TLKS)	Not enough for statistical analysis	No difference (P=0.5436)	Favors Autograft
Return to Previous Activity Level	100% of matriculating cadets meet entrance military fitness standards	100% of participants returned to normal sports activities	57.1% autograft patients and 68.3% allograft patients returned to preinjury activity level
Anterior Drawer Test (ADT)	N/A	Auto: 100% Grade 0-1 Allo: 100% Grade 0-1	N/A
Lachman Test	Auto: 98% Grade 0-1 Allo: 91% Grade 0-1	Auto: 100% Grade 0-1 Allo: 100% Grade 0-1	N/A
Pivot Shift Test	No gross pivot shifts in both autografts or allografts	N/A	Favors allograft
Ruptures and predicted ruptures (Higher SNQ on MRI)	12.3% Autografts 43.8% Allografts	Allografts have a higher predicted rupture rate (P<0.05)	4.3% Autografts 12.7% Allografts

Conclusion

Allograft and autograft tendons are viable options for ACL reconstruction. Both types of grafts are associated with similar patient satisfaction scores, as well as minimal differences on physical examination post reconstruction. However, when it comes to looking at the maturity of these grafts, imaging reveals that the allografts undergo a slower remodeling and thus may have less integrity compared to autografts. This discrepancy may contribute to the large difference in rupture rates.

Allografts have been shown to have a threefold increase in rupture rates when compared to autografts. Therefore, in spite of donor site morbidity (specifically donor site pain and possible minor weakness in the harvested muscle), the best choice to get athletes back to their full playing potential, without as much worry about re-rupture, the autograft is a better option in those requiring ACL reconstruction.

Clinical Recommendations

AB is a young college athlete with a ruptured ACL who needs to be able to play at his full capacity next year. It is important that he receives the type of graft that will provide him with the most stability and least chance of re-rupture.

Based on our analysis, we recommend that AB receive autograft tissue for his ACL reconstruction. This type of graft has been shown to be associated equivalent patient satisfaction and measurements of knee stability and integrity on physical exam as well as a decreased rate of re-rupture.

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