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Do patients with a ruptured ACL, who undergo a hamstring graft, have less kneeling pain than those who undergo a patellar tendon graft?

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Do patients with a ruptured ACL, who undergo a hamstring graft, have less kneeling pain than those who undergo a patellar tendon graft?

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A SELECTIVE EVIDENCE BASED MEDICINE REVIEW

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Abstract

OBJECTIVE: The objective of this selective EBM review is to determine whether or not “Do patients with a ruptured ACL, who undergo a hamstring graft, have less kneeling pain than those who undergo a patellar tendon graft?”

STUDY DESIGN: A systematic review of three randomized controlled trials published after 2011 comparing the intervention of hamstring tendon graft to the patellar tendon graft.

DATA SOURCES: All three sources were obtained from PubMed based on its relevance to the clinical question, the publication date, as well as the inclusion/exclusion criteria.

OUTCOMES MEASURED: The outcome that is being measured is kneeling pain after the patient’s ACL reconstruction. Patients ranked their kneeling pain by a subjective pain scale survey at their respective follow up time period: A-normal/no pain, B- mild pain, C- moderate pain, D- severe pain.

RESULTS: The Mohtadi et al. and Leitgeb et al. studies demonstrated that using the hamstring tendon graft resulted in less kneeling pain for patients at their respective follow up time period. The Sajaovic et al. study demonstrated that those who received the patellar tendon graft actually had less kneeling pain compared to those who had the hamstring tendon graft. However, the p value of this study was 0.376, therefore there is insufficient evidence to conclude that one ACL graft results in better kneeling pain outcomes than the other.

CONCLUSIONS: It can be concluded that there is conflicting evidence as to whether or not hamstring tendon grafts result in less kneeling pain compared to patellar tendon grafts. Two out of the three randomized control trials show that hamstring tendon grafts result in less kneeling pain. The third RCT results showed that the patellar tendon group had less kneeling pain than the hamstring group but had a high p value, making evidence of this study weak. With this said, both patellar tendon grafts and hamstring tendon grafts are effective methods for repairing a torn anterior cruciate ligament and ultimately the decision between the two grafts come down to patient demographics as well as patient and surgeon preference.

KEY WORDS: anterior cruciate ligament, patellar tendon, hamstring tendon

INTRODUCTION

The anterior cruciate ligament (ACL) is a major ligament of the knee that functions to stabilize the tibia and allow for anterior translation as well as preventing valgus and varus stress on the knee[1]. The ACL is the most common ligament to be injured in the knee and many providers (MD, DO, NP, PA) will evaluate these types of injuries in various settings such as the emergency department and private practices. Damage to this ligament can tremendously impact the quality of life of patients due to the decline in function of the knee joint, thus ultimately limiting their activities of daily living as well as causing chronic pain issues. According to a 2005 to 2013 study, 229,446 outpatient arthroscopic ACL reconstructions occurred and cost $2,622,928,663.00 total in the US alone[2]. Not only that but up to 200,000 ACLs rupture every year in the U.S. in patients of all ages, with annual incidence in the general population of 1 in 3500[1].

Anterior cruciate ligament ruptures can occur with not only contact forces, but noncontact forces as well. Regardless, it involves several different movements including knee valgus, hip internal rotation, hip adduction, tibial rotation, tibial anterior translation, and ankle inversion[1]. There are several risk factors thought to be associated with an ACL ruptures, though some have not been completely confirmed. Female athletes are the biggest population at risk due to both hormonal and anatomic factors. Women have a larger Q angle due to having a wide pelvis and short femur, increased amount of serum estrogen and relaxin, as well as having more hamstring weakness, valgus angulation of the knee, hip external rotator weakness, and core muscle weakness[1]. Extrinsic factors may include playing surface, environmental conditions, footwear, and physical fatigue. Despite knowing the fundamental biomechanics of an ACL rupture, researchers are not able to conclude that the neuromuscular and anatomic variances

seen in males vs. females is what definitively leads a person to an ACL rupture[1].

Treatment of ACL ruptures include acute management, non-operative management, and surgical intervention. Acute management includes rest, ice, compression and knee elevation with use of crutches to avoid weight bearing on the affected knee[1]. The extent of the injury as well as the patient and their activity level determine the need for surgical intervention. Surgical management is ACL reconstruction with arthroscopy by using a patellar tendon or hamstring tendon graft. Non-operative treatment includes rehabilitation with a physical therapist with use of closed kinetic chain exercises to strengthen the hamstring and quadricep muscles[1]. Balance, proprioception, and core strength are eventually added to the treatment regimen[1].

ACL ruptures is a common injury in all age ranges, and in patients of both genders. Having a good understanding of ACL surgery and recovery is critical for medical providers of all certifications, as treating these patients may become standard practice. As physician assistants, it is vital for us to educate our patients and help guide them through a potentially life changing injury. As a provider, we need to be able to understand the benefits and risks of either procedure so that we can allow complete transparency as to what the patient could potentially experience. It is for this reason, that staying up to date on treatment modalities, surgical and non-surgical, could be of great benefit to the patient. Medical providers will be able to do all of these things by continuing to educate themselves with research articles, such as the three randomized control trials in this research article, in the hopes of providing a better patient-oriented outcome.

A patellar tendon and hamstring tendon graft are both effective and commonly used methods to reconstruct an ACL, however, they both hold different recovery periods for patients. Therefore, it is imperative for patients to understand what recovery may look like for them, especially with return to activity and basic knee range of motion. This paper will evaluate three

randomized controlled trials by comparing the efficacy of a hamstring graft reconstruction to the patellar tendon graft reconstruction in terms of minimizing kneeling pain in a patient.

OBJECTIVE:

The objective of this selective EBM review is to determine whether or not "Do patients with a ruptured ACL, who undergo a hamstring tendon graft, have less kneeling pain than those who undergo a patellar tendon graft?"

METHODS

The studies that were used in this systematic review were three randomized controlled trials that all compared the intervention of hamstring tendon grafts to the comparison patellar tendon grafts. The population of interest involved in the studies were male and female patients, 14-50 years old who had a ruptured ACL[4,5,6]. The outcome of interest was kneeling pain that was measured subjectively with a pain scale survey.

In terms of choosing the data sources, PubMed via the PCOM library was utilized to select the desired articles. This was based on the inclusion and exclusion criteria as well as the key words used. Key words included anterior cruciate ligament, patellar tendon, and hamstring tendon. Inclusion criteria of the research was any randomized control trial that occurred after 2011, they compared hamstring and patellar tendon grafts, and they had patient-oriented outcomes. Exclusion criteria was anything published prior to 2011, anyone under the age of 14 or over 50, and anyone with previous knee injury in the ipsilateral knee. All of the articles were published data and in English, with the exception of the Leitgeb article which also had a German translation[4]. The statistics that were reported and used in the selected articles included numbers needed to treat (NNT) which is the number of patients who need to be treated to prevent one bad outcome, experimental event rate (EER) which is the proportion of patients that are receiving the intervention that have the outcome of interest, control event rate (CER), which is the outcome

measurement that occurs in the group not receiving the intervention[3]. It also included the relative benefit increase (RBI), which is the proportional increase in rates of good outcomes between experimental and control patients, absolute benefit increase (ABI), which is the increase of a good event due to the intervention, and p-value which is the probability of getting a test result when the hypothesis is true[3].

OUTCOMES MEASURED

The primary outcome being measured in this systematic review is kneeling pain after the patient's ACL reconstruction. Patients were able to rank their kneeling pain by using a subjective pain scale survey and this was done at their respective follow up time period. Pain was ranked as such: A- normal/no pain, B- mild pain, C- moderate pain, D- severe pain[4,5,6]. All three studies used a subjective pain scale survey to determine how many patients experienced kneeling pain at the time of their follow up. Two out of the three randomized control trials used A-D subjective pain scales to characterize their pain level whereas the Sajovic et al. study simply asked patients if they had no kneeling pain (A) or kneeling pain (B-D) of any severity.

RESULTS

This selective EBM review consists of three randomized control trials that assessed kneeling pain in patients with an anterior cruciate ligament reconstruction that received the intervention of the hamstring tendon graft in comparison to the patellar tendon graft.

In the Leitgeb et al. study conducted at the Vienna General Hospital, 96 total patients were randomly assigned to one of two groups: 56 patients underwent ACL reconstruction with use of the patellar tendon graft (11 females/45 males; average age 28.4) and 40 patients (17 females/23 males; average age 29.2) used hamstring tendon grafts[4]. Zero patients were lost to follow up in both the intervention and comparison groups, with the meal follow up time i

Table 1. Demographics and Characteristics of Included Studies

Study	Type	# Pts	Age (yrs)	Inclusion Criteria	Exclusion Criteria	W/D	Interventions
Leitgeb, 2014	RCT	96	15-45	Patients 15-45 who need ACL surgery and want to return to sports/those with repeated instability	Patients with incomplete datasets, younger <15 or > 45, or those who had undergone previous ACL surgery on same or opposite knee.	0	Bone patellar tendon bone autografts vs. semitendinosus and gracilis tendon autografts fixed with interference screws, posts, buttons/staple
Mohatadi, 2019	RCT	330 total, 220 relevant for my study topics	14-50	Patients 14-50 with ACL deficiency based on the following: traumatic injury, physical exam findings, (+) pivot shift test, no fracture and skeletal maturity on xray.	Combined ligament deficiencies, non-English speaking, connective tissue disease, workers compensation, previous ligament injury on affected/ contralateral knee, grade 4 chondral lesion.	18 lost to follow up/withdrew	Patellar tendon graft vs a hamstring tendon graft using semitendinosus and gracilis tendons in a single bundle.
Sajovic, 2018	RCT	64	Avg STG age: 42.5 +/- 7.5 Avg PT age: 45.5 +/- 8.7	Clinically diagnosed ACL rupture in patients who desire to return to their preinjury level.	Those with ligament injury, previous meniscectomy, radiographic abnormality, abnormal contralateral knee	16 patients were lost to follow up at the 17-year mark	Patellar tendon autograft vs hamstring graft with semitendinosus and gracilis tendon autograft

the hamstring tendon group being 5.4 years and the patellar tendon group being 5.2 years[4]. This slight difference in follow up time showed to have no significant difference in the reported results ($P>.05$). The inclusion criteria for this study were patients 15-45 years old who needed ACL surgery and wants to return to sports as well as those with repeated instability despite physical therapy[4].

At the time of their follow up visits, patients were asked to complete a subjective survey assessing their kneeling pain using the pain scale: A- normal/no pain, B- mild pain, C- moderate pain, D- severe pain. It was during their follow up that it was discovered that 57 of the 96 total patients from both groups had obtained a minor injury to their injured knee at some point between the surgery and follow up date[4]. Injuries included isolated meniscal tears (32 patients), isolated cartilage lesions (14 patients), and a combination of both injuries in 11 patients[4]. Patients were still included in the study and statistical analysis showed that this had no significant influence on the obtained results. In the HT group, 30 patients (75%) stated that they had no kneeling pain, 10 (25%) said they had mild kneeling pain, and 0 had moderate and severe kneeling pain[4]. In the PT group, 13 patients (23%) stated they had no kneeling pain at follow up, 12 (21%) stated they had mild kneeling pain, 19 (34%) said they had moderate kneeling pain, and 12 (21%) had severe kneeling pain[4]. Thus, those who underwent ACL reconstruction with the patellar tendon graft experienced significantly higher kneeling pain at their follow up time compared to those who underwent got the hamstring tendon graft ($P<.001$). Due to the data being presented as continuous data, it was important to dichotomize it. Essentially, the data was split into having no pain (A) and those that did have pain (B-D), therefore combining values and grouping them together as needed. Therefore, 75% (.75) of patients in the hamstring group did not experience pain and 23% (.23) of patients in the patellar group did not experience pain. By

doing this, the numbers needed to treat was able to be calculated. The numbers needed to treat for this study was 2, which was a large treatment effect. The EER (hamstring) was .75 and the CER (patellar) was .23, while the ABI for this study was 0.52 and the RBI was 2.26[4]. The p-value for this particular study was $P<.001$, which indicates that the treatment effect is precise and is statistically significant[4]. Ultimately, this studies results show that use of the hamstring tendon graft with ACL reconstruction does result in less kneeling pain compared to those who receive a patellar tendon graft.

In the Sajovic et al. study, 64 total patients participated in this randomized control trial, 32 patients in the patellar tendon group (15 males/9 females; average age 45.5 ± 8.7) and 32 in the hamstring tendon group (13 male/11 female; average age 42.5 ± 7.5)[5]. Patients were asked to follow up at 2 weeks, 6 weeks, 3 months, 5 months, 5 years, 11 years, and 17 years[5]. For the purposes of this review, results are based on the 17 year follow up date. At this 17 year follow up time period, 16 patients were lost to follow up, thus leaving 24 patients in each group (48 total) to be evaluated at this particular time[5]. It was also at this follow up time, that it was discovered that two patients from the hamstring group had a full thickness chondral lesion and were treated with microfracture, one patient from the patellar group underwent an open wedge valgization osteotomy of the tibia due to degenerative joint disease, and another patient from the patellar group had meniscal surgery on the contralateral knee[5]. Despite injuries, these patients were still included in the data analysis. The inclusion criteria for this study included those that had been clinically diagnosed with an ACL rupture in patients who desired to return to their preinjury level of activity.

At the patients 17 year scheduled follow up, patients were asked to subjectively classify their pain while kneeling. Results were reported as either having no pain (A-no pain) or having

pain (B-mild pain, C- moderate pain, and D- severe pain). In the hamstring tendon graft group, 46% of patients reported kneeling pain whereas 54% of patients in that group did not and in the patellar tendon graft group, only 33% of patients reported kneeling pain and 67% in that group did not[5]. With this said, the estimate of the treatment effect is not precise due to this study having a *P*=.376[5]. Although the results of this study show that those in the hamstring tendon group had more kneeling pain than those in the patellar tendon group, the p-value suggests that this is not precise data. Numbers needed to treat was 8, making this a large treatment effect[5]. The EER was 0.54, the CER was 0.67, the RBI was -0.19, and the ABI was -0.13[5].

In the Mohtadi et al. study, 330 patients were randomized into two groups: 110 patients into the patellar tendon group and 110 patients into the hamstring group, with the remaining 110 patients in the double bundle group, which will not be discussed in this paper[6]. At the five year follow up, 7 people were lost to follow up in the patellar group to have a total of 103 patients analyzed (60 males/43 females; average age at 5 year follow up 33.8$\pm$ 9.8) and 5 people were lost in the hamstring group to have a total of 105 patients analyzed (58 males/47 females; average age at 5 year follow up 33.7 $\pm$ 10.0)[6]. Inclusion criteria for this particular study was any patient 14-50 years old that had a history of a traumatic injury that led to an ACL tear, physical exam findings (positive Lachman test and/or anterior drawer test) were consistent with an ACL injury, positive pivot-shift test, and radiographic images proving skeletal maturity[6]. For both groups, follow up's occurred at baseline (preoperatively), and postoperatively at 1, 2, and 5 years, but for the purpose of this study, results are only looking at the five year follow up. The rehabilitation schedule for both groups were also the exact same.

Their five year follow up was conducted at the University of Calgary Sport Medicine Centre, and patients were asked to subjectively rank their kneeling pain as mild (B), moderate

(C), and severe (D) or none (A) if they are not experiencing any pain. The data was analyzed on an intention-to-treat basis with a 5% significance level[6]. In the hamstring tendon group, 4% (4/98) experienced moderate to severe pain while the patellar tendon group had 10% (10/98) experience moderate to severe pain[6]. With this study, $P = 0.029$, which makes the estimate of the treatment effect precise[6]. Therefore, those that received the patellar tendon experienced more kneeling pain compared to the hamstring tendon group. With this said though, the kneeling pain results only examined those with moderate ("C") to severe ("D") pain and did not report those who experience no pain ("A") or mild ("B") pain, so it is hard to determine which category patients fell under and just how many were in each category to compare. The numbers needed to treat for this study was 17, making this a large treatment effect[6]. The EER (the hamstring group), was 0.96, the CER (the patellar group), was 0.90. The RBI was 0.066, and the ABI was 0.06[6].

DISCUSSION

In the Mohtadi et al. study, not only did they have patients in the patellar tendon and hamstring tendon graft groups, but they also had a double bundle hamstring reconstruction group. With this double bundle hamstring group, this study actually showed that patients who received this kind of tendon graft had the least amount of moderate to severe kneeling pain at 2% (2/101) compared to the hamstring tendon (4%) and patellar tendon (10%)[6]. Although the other Leitgeb and Sajovic randomized control trial studies used in this review did not include this double bundle group in their trial, results from the Mohtadi et al. have shown benefit to using this reconstructive method.

As with any surgery, ACL reconstruction surgery not only has its benefits, but also several risks and complications associated with it. A general risk of surgery that is concerning for all patients includes infection as well as deep vein thrombosis. Although the risk for this

occurring in an ACL reconstruction is less than 1%[1], it is important to consider the patient population when preparing for a procedure like this. If the patient is older, they might be able to undergo the necessary physical therapy post-operatively to reduce their DVT risk, but due to their age, they are also at risk of being immobile, which can increase their risk of developing one. Another complication is a loss of joint mobility and loss of full extension that occurs in 8% of patients but this risk is reduced with pre-operative and post-operative physical therapy[1]. More long-term complications of surgical repair include osteoarthritis, graft failure, and arthrofibrosis[1]. Graft failure is likely to occur with poor operative technique as well as reinjury if the patient were to return to high-risk sports earlier than allowed[1]. Arthrofibrosis is essentially scarring, abnormal tissue growth, and adhesions that can develop in the joint that can restrict movement and cause pain.

Contraindications to surgical repair of anterior cruciate ligaments with patellar or hamstring grafts is based on the degree of the tear as well as the patients plan to return to high level activity. Those with a partial tear do not need to undergo surgical repair and can manage the injury nonoperatively with proper rehabilitation management and strength training[1]. Those who also have low functional demands who do not need to put high demand on the knee joint can also be treated nonoperatively. In terms of graft selection (hamstring vs patellar and autograft vs allograft), patient factors such as prior knee injury, comorbidities, resources, and surgeon training/preference play a significant role in deciding the type of graft chosen[1].

A study limitation that was particularly of note, was that patients and researchers were not kept blind to the type of surgical repair that they had received, so that may have ultimately impacted the way that patients experienced their pain. In the Sajovic et al. study as well as the Mohtadi et al. study, patients were asked to subjectively describe their kneeling pain as either A

no pain, B-mild pain, C-moderate pain, and D-severe pain, however, when these studies both presented their results, they did not specifically include the number of patients that fell in each category and instead just presented it as how many patients had pain and how many didn't[4,5,6]. Ultimately, this did not change the fact that the study was looking for how many people experienced kneeling pain and still allowed them to compare the patellar group to the hamstring group, but it would have been better to be able to see the appropriate breakdown. Not only that, but the Sajovic et al. study also had a P=0.376 which makes the estimate of the treatment effect not precise[5]. Another important detail to consider is that the published results of these studies included patients who had suffered a knee injury of some kind, whether it was a bone, chondral, or ligamentous issue in either the ipsilateral or contralateral knee. This ultimately could have played a significant role in subjective kneeling pain scale that patients completed at the time of their follow up. With the way that the data was presented in the article, there is no way of knowing how their injury influenced the data and the number of patients who expressed mild-severe knee pain at the time of their follow up.

CONCLUSION

In conclusion, there is conflicting evidence whether those who received the hamstring tendon graft reported less kneeling pain compared to those who received the patellar tendon graft. According to Mohtadi et al. and Leitgeb et al., those who underwent the hamstring tendon graft ACL reconstruction had less kneeling pain than the patellar tendon group[4,6]. According to the Sajovic et al. study, those who had the patellar tendon graft actually experienced less kneeling pain than the hamstring tendon group[5]. With this said though, this study had a P=0.376, which makes this evidence weak and not statistically significant.

These studies could have done a better job at keeping the patients blinded to the type of surgical repair they received as ultimately this could have biased the patients and ultimately could have impacted the way they perceived their kneeling pain on follow up. The Mohtadi et al. study had patients blinded to treatment group allocation until the 2 year follow up period but upon the 5 year follow up, patients were no longer blinded, which is when they collected the subjective kneeling pain reports[6]. Future studies are warranted to evaluate the kneeling pain in patients who undergo ACL reconstruction with a hamstring tendon graft compared to those who receive a patellar tendon graft before one can be declared significantly better than the other in terms of that particular outcome. For future studies, it is imperative that the rehabilitation program between the two groups is the same, and that the patients remain blinded to the treatment they receive. I also believe that in terms of demographics that are to be included in future studies should focus solely on athletes who are looking to return to a high level of activity. Many studies say that age is not a contraindication to receiving ACL reconstructive surgery, but healing time can vary between age groups and even gender. So, for future studies, it would be interesting to see how those results appear in younger and more athletic populations compared to the three randomized control studies evaluated in this systematic review who had a wide age range of 14-50 years old. The medical field is changing constantly, and it always leaves room for improvement, so ultimately, there is always more work to be done when comparing kneeling pain in hamstring tendon grafts to patellar tendon grafts for ACL reconstruction.

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