HAMSTRING TENDON GRAFT VERSUS PATELLAR BONE TENDON GRAFT IN ARTHROSCOPIC RECONSTRUCTION OF THE ANTERIOR CRUCIATE LIGAMENT: A META-ANALYSIS STUDY

FINAL PROJECT

The requirement for the degree of *Sarjana* in General Medicine

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HALAMAN PENGESAHAN

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ABSTRACT

AB Wahab, Khairulanwar. 2011. ***Hamstring Tendon Graft Versus Patellar Bone Tendon Graft in Arthroscopic Reconstruction Of The Anterior Cruciate Ligament: A Meta-analysis Study*** Final Assignment. Medicine Faculty of Brawijaya University. Advisor: (1) dr. Edi Mustamsir, SpOT, (2) dr.Moch Ridwan Sp.KFR

Anterior cruciate ligament (ACL) ruptur umumnya terjadi di antara populasi yang suka berolahraga. ACL ruptur adalah ketika ligamen anterior putus. Penyebab ruptur biasanya non-kontak. Ketika ruptur ACL , suara popping tiba-tiba dapat didengar dan juga rasa sakit dapat dirasakan (untuk beberapa menit pertama). Hal ini dapat diikuti dengan pembengkakan (kadang-kadang tertunda). Stabilitas lutut akan terkompromi dan pasien tidak lagi mampu untuk melanjutkan dengan kegiatan olahraga yang sedang berlangsung. Diagnosis dapat dikonfirmasi dengan tes Lachman itu (positif) dan X - ray . Dengan adanya diagnosis pasti , MRI dapat berguna dalam menampilkan ruptur. Tujuan dari penelitian ini adalah untuk memperjelas perbedaan dalam penggunaan graf tersebut dengan meta-alasis hasil jurnal-jurnal tersebut. Hipotesisnya adalah ada variasi dalam kedua teknik tersebut. Menggunakan google scholar, kata kunci berikut digunakan untuk mencari literatur potensial, anterior, cruciate, ligamen, rekonstruksi, tulang, patella hamstring, korupsi, semitendinosus, gracilis, dibandingkan. Referensi dari jurnal lain juga digunakan untuk mencari literatur yang relevan . Hanya jurnal membandingkan penggunaan graf hamstring dan patela dipilih . Mereka juga harus ditulis dalam bahasa Inggris dan hanya mengandung subyek manusia. Tindak lanjut pasca-operasi dilakukan oleh pemeriksa juga harus dilakukan selama minimal 24 bulan . Studi harus dilakukan antara tahun 1989-2000. Mereka juga hanya harus rekonstruksi ligamen bundel tunggal . Setelah pemilihan , data-data tertentu akan diambil dari jurnal. Data akan menjadi populasi pasien , teknik bedah , hasil dari operasi , tes evaluasi (IKDC, skor Lysholm, ROM) dan komplikasi dan kegagalan. Hasil analisis menunjukkan bahwa kedua graf menunjukkan hasil yang sama. Pasien dapat yakin bahwa baik kedua-dua graf akan menjadi pilihan yang baik.

Kata Kunci: Anterior cruciate ligament, rupture

ABSTRACT

AB Wahab, Khairulanwar. 2011. ***Hamstring Tendon Graft Versus Patellar Bone Tendon Graft in Arthroscopic Reconstruction Of The Anterior Cruciate Ligament: A Meta-analysis Study*** Final Assignment. Medicine Faculty of Brawijaya University. Advisor: (1) dr. Edi Mustamsir, SpOT, (2) dr.Moch Ridwan Sp.KFR

Anterior cruciate ligament (ACL) rupture is a common occurance amongst the sports practicing population.. ACL rupture is when the anterior cruciate ligament is completely torn. Causes of the rupture are usually non-contact When the ACL ruptures, a sudden popping sound can be heard and also intense pain of the ligament tearing can be felt (for the first few minutes). It can be followed by swelling (sometimes delayed). The stabilty of the knee will be compromised (knee instabilty) and patients are no longer able to continue with the ongoing sporting activity. Diagnosis can be confirmed using the Lachman's test (positive) and X-ray. In the presence of uncertain diagnosis, an MRI can be useful in displaying the rupture. The objective of this study is to clarify the difference in the use of the afore mentioned grafts by meta alayzing the results of those journals. It is hypothesized that there are variations in the outcome.. Using google scholar, the following keywords was used to search for the potential literature; anterior, cruciate, ligament, reconstruction, bone, patellar, hamstring, graft, semitendinosus, gracilis, versus, and compared. References from other journals were also used to search for relevant literature. Only journals comparing the use of the hamstring graft and patellar graft are selected. They must also be written in English and only contain human subjects. The post-operative follow up done by the examiner must also be done for a minimum of 24 months. Studies must be done between the years 1989 to 2000. They must also only be of single bundle ligament reconstruction. After selection, certain data will be extracted from the journals. They will be the patient population, the surgical technique, the outcome of the surgery; evaluation tests (IKDC, Lysholm score, Range of motion,) and complications and failures. After selection, certain data will be extracted from the journals. They will be the patient population, the surgical technique, the outcome of the surgery; evaluation tests (IKDC, Lysholm score, Range of motion,) and complications and failures. The outcome of the analysis shows that both grafts perform similarly in test. The patient can be rest assured that either grafts will be good choices nonetheless.

Keyword: Anterior cruciate ligament, rupture

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CHAPTER 1

1.0 INTRODUCTION

1.1 Background

Anterior cruciate ligament (ACL) rupture is a common occurance amongst the sports practicing population. Most of the cases involve intense body pivoting related sports ; football, handball etc. This injury causes disability wherein the patient ability to fully utilize the movement of the knee is limited and the presence of pain will drasticly reduce the confidance in the knee. A study also indicated that women are much more at risk than men (Mountcastle et al 2007).

ACL rupture is when the anterior cruciate ligament is completely torn. Causes of the rupture are usually non-contact. It is normally happen when sudden change of body movement movement involving the use of the knees . Examples of body movements involving the knees include when landing from a jump, pivoting (side stepping) or sudden decelerating. Accompanying meniscal injuries has been associated with the jumping by recent study (Paul JJ et al 2003). The repeticious nature of these manauvers strains and weaken the ligaments making them vulnerable to complete tears.

When the ACL ruptures, a sudden popping sound can be heard and also intense pain of the ligament tearing can be felt (for the first few minutes). It can be followed by swelling (sometimes delayed). The stabilty of the knee will be compromised (knee instabilty) and patients are no longer able to continue with the ongoing sporting activity. Diagnosis can be confirmed using the Lachman's test (positive) and X-ray. In the presence of uncertain diagnosis, an MRI can be useful in displaying the rupture.

Treatment involved surgical reconstruction of the ligament using either autograft, allograft or synthetic(still in trial stage). The most common replacements are using autografts ; patellar bone or hamstring (semitendinosus gracilis). Surgery is done using arthroscopy to make

incisions to remove the ruptured ligaments, clear any remaining debris (shaving), extracting the autograft, drilling holes to facilitate the fixation of the graft to the femur and tibia, and then fixating the graft using inteference screws. Rehabilitation is crucial in order for the patient to be able to reach pre-injure level ROM.

There have been many studies comparing the results of the patellar bone tendon and hamstring grafts. The objective of this study is to clarify the difference in the use of the afore mentioned grafts by meta alayzing the results of those journals. It is hypothesized that there are variations in the outcome.

1.2 Problem Summation

What are the differences in outcome of using either a patellar tendon autograft or semtendinosus gracilis autograft?

1.3 Research Objective

Main objective

Use the results of different studies to compare the results of using different tendon autografts.

Specific objective

1. Compare the IKDC score, KT score, Lachman test and the degree of loss of rom (both extension and flexion) of the journals
2. Meta-analyze the data to calculate relevance

Research Benefits

Improved information on the outcomes of the different type of technique.

CHAPTER 2

1. LITERATURE REVIEW

2. Epidemiology

The researcher was not able to obtain information on ACL tear for the Southeast Asia region. What the researcher was able to obtain was studies conducted in the United States of America, parts of Scandinavia, specifically Sweden and Norway and one in Germany. The Swedish study mentioned an incident rate of primary ACL reconstruction surgeries of 34 per 100 000 (85 per 100 000 citizens in the main at-risk group of 16-39 year) in Norway during the year 2007-2008, while in Germany the incidence rate of ACL reconstruction surgeries was 70 per 100 000. On the other hand, in Sweden the incidence of ACL injury in the population aged 10–64 years was 81 per 100 000 citizens. (P Renstrom et al, 2008)

There was also a study conducted in the United States of America comparing the rates of ACL tear between races in professional women's basketball. White European American players had the highest incident rate of 0.45 per 1000 followed by non-white European American player (African American, Hispanic, and Asian players) with a rate of 0.07. (Trojian et al, 2006)

3. The Anatomy of the Knee

The knee is the second largest synovial joint in the body. It is located where the condyles of the distal femur meet the proximal tibia. With hyaline cartilage covering both ends, it is reinforced by the both the fibular and tibial collateral ligament. Being a weight bearing joint, it has a pair of fibrocartilaginous menisci covering the femoral condyles and tibial plateau to absorb the amount of friction generated. It also has an efficient "locking" mechanism to reduce the amount of muscle energy required to keep the joint extended while standing. A pair of cruciate ligaments holds the knee in place. With 'cruciate' in latin meaning shaped like a cross, they naturally cross each other on the sagittal plane between their femoral and tibial attachments. The anterior cruciate ligament prevents anterior displacement of the tibia relative to the femur and the

posterior cruciate ligament restricts posterior displacement. The joint is enclosed in a synovial membrane which is attached to the margin of the articular surfaces and to the superior and inferior outer margins of the menisci. The patellar bone is located on the anterior of the knee. The patellar ligament holds it in place. This aforementioned ligament is basically a continuation of the quadriceps femoris tendon inferior to the patellar. The knee is predominantly vascularized by the descending and genicular branches from the femoral, popliteal and lateral circumflex fibular artery and recurrent branches from the anterior tibial artery in the leg. These vessels form an anastomotic network around the joint. Innervation on the other hand is handled by branches from the obturator, femoral, tibial, and common fibular nerves. (P Brukner et al, 2009) (Richard L. Drake et al, 2005)

4. Knee Kinematics

1. The Flexion and Extension Axis

The knee motion occurs about two fixed, offset axes of rotation. These axes are not perpendicular to the long axes of the bones or to each other, and the axes do not intersect. (Hollister et al, 1994)

2. The Motion of the knee

Knee flexion is accompanied by a gliding motion of the tibia upon the femur during knee extension and an internal rotation during flexion. The first 20° of flexion causes a rocking motion. After that, further flexion is accomplished with a gliding motion. This is so because the ligaments become relaxed, thus permitting both gliding and axial rotation. Rotation occurs throughout the whole flexion and extension action but the majority of it occurs in the final phase of full flexion and during the last 30° - 40° of extension. The rotation of the tibia upon the femur during flexion-extension is passive because of the anatomical configuration of the articular surfaces. The muscle acting upon the joint have a rotary-torque but this is secondary. During the flexion-extension, the tibia follows a configuration of the medial condyle of the femur which is longer than the lateral condyle. As the femur glides upon the tibia it stops when the surface contour of

the lateral condyle has been traversed but continues to move along the longitudinal and more curved medial condyle, which curves in a lateral direction. During extension the tibia rotates upon the femur on a distance equal to half the width of the patella. The knee extensors run medially and thus help rotate the tibia during extension. Flexion, from the fully extended position, begins with simultaneous internal rotation (tibia upon femur) by contraction of the popliteus muscle. Further active flexion results from hamstring contraction. The capsular ligaments which are taut during full extension, relax as flexion begins. The femur glides forward upon the tibia placing the smaller rounded posterior surface of the femoral condyles upon the tibial plateau. The PCL becomes taut and acts as a drag to any forward gliding. (Tyrone et al, 1978)

In flexion and extension the menisci, fixed to the tibia, move with it upon the femur. In rotation, with the knee flexed, the menisci move with the femur upon the tibia. If the femoral meniscotibial spaces are considered to be joint spaces, the upper femoral-menisci joint moves during the flexion-extension and rotation occurs at the lover meniscotibial joint. (Tyrone et al, 1978)

The ACL is taut in extension and unwinds and relaxes during flexion. The collateral ligament, also taut during extension, relaxes during flexion, the lateral more than the medial. (Tyrone et al, 1978)

The external rotation of the tibia on the femur during the last 20° of extension is termed the “screw home” mechanism and is due to the condylar configuration, muscle pull in torque and ligamentous guidance. (Tyrone et al, 1978)

When the knee extends because of the contraction of the quadriceps, the patella is forcefully pulled upward. The anterior infrapatellar far pad and the alar ligaments connected to the joint capsule are also pulled anteriorly and upward thus preventing their being pinched. (Tyrone et al, 1978)

The ligaments aids in knee extension. When the tibia is fixed from the foot during weight bearing, the ACL acts as the guide wire as the knee approaches full extension. When the femur

is fixed, the ACL controls the lateral rotation of the tibia. As the knee moves from the flexion to extension the motion of the lateral condyle is stopped at 160° by the ACL and collateral ligaments respectively. Continued quadriceps contraction causes the medial condyle to move the additional 20° to full 180° and externally rotates the tibia upon the femur. (Tyrone et al, 1978)

5. Mechanism of Rupture

The majority of ACL tears occur in a non-contact situation, when the athlete is landing from a jump, pivoting or decelerating suddenly. It is common for it to result from an action that the injured athlete has performed repeatedly in their career, often a simple maneuver. The sudden change of direction increases the tension on the ACL ligament thus after constant wear and tear will finally rupture after a sudden overload of force.

6. Anterior Cruciate Ligament

The anterior cruciate ligament is located within the intercondylar region. It is attached to the anterior facet of the tibia and extends posteriorly and laterally to the medial part or the medial surface of the lateral condyle of the femur.

7. Arthroscopic Reconstruction

Debridement is first done before reconstruction where the torn ligaments and other damaged tissue are removed.

1. Surgical Technique

While there are many techniques for ACL reconstruction, below is a general example of how it is performed. It may differ from other techniques.

1. Patellar Graft

The patella graft is extracted using a medial longitudinal parapatellar incision. A handheld helical tube saw is used to harvest the midthird of the ipsilateral patellar tendon with proximal

and distal bone plugs. Then through the anteromedial arthroscopy portal, a femoral tunnel is created. A pilot tunnel is then drilled in the 10:30 position (for right knees) or in the 1:30 position (for left knees) with the knee in maximum knee flexion, followed by serial dilatation up to 9 mm using the technique described by Johnson and Dyk. The tibial tunnel is then position using the standard drill guide system (using cannulated drill bits and serial dilatation to a tunnel diameter of 10mm is performed), and the impingement is then tested. A biodegradable 8 × 23-mm poly-(D,L-lactide) interference screw (Zimmer Orthopedics, Freiburg, Germany) is used to fixate (it was countersunk a few millimeters below the femoral cortex) the femoral bone plug after the graft insertion was done. While the knee was flexed at an angle of approximately 10°, an 8 × 23-mm biodegradable poly-(D,L-lactide) interference screw was use for tibial fixation in an outside-in direction and manual pretension is done. (Michael Wagner *et al* 2005)

2. **Hamstring Graft**

First a 3-cm skin incision medial to the tibial tuberosity is made. The semitendinosus and gracilis tendons are obtain using a tendon hook, while the accessory fibers were cut. Harvesting is done by an open-ended tendon stripper. While arthroscopic preparation of the knee was performed, the 4-strand graft was prepared with the help of a suture board. 4 No. 2 polyester sutures (Ethibond; Ethicon GmbH, Norderstedt, Germany) are used to arm the proximal and distal endings of the tendons in a whipstitch fashion. The tendons were quadrupled, and a polyester passing suture was passed through each loop. A marking suture using No. 0 absorbable suture was set 2.5 cm from the femoral end of the graft to ensure good entry of the graft in the tunnel and to prevent the graft from twisting around the screw during insertion. The tibial end of the graft was sutured in a baseball-stitch technique using No. 0 absorbable sutures. Tunnel creation was identical to the patellar tendon technique. Diameters of the tunnel were matched to the graft diameters, in increments of 1 mm. Graft fixation was achieved with an 8 × 23-mm biodegradable poly-(D,Llactide) interference screw (Zimmer Orthopedics) at both sites. The tibial screw was

advanced just a few millimeters below the joint line using a cannulated screwdriver. Because of the lower bone density of the proximal tibia compared with the distal femur, a tibial backup fixation was done in all cases. A monocortical drill hole was created 2 cm distal to the tibial tunnel exit site. One strand of each attached polyester suture was passed through the hole and then tied over the created bony bridge. (Michael Wagner *et al* 2005).

8. Rehabilitation

1. Preoperative

Before proceeding with surgery the acutely injured knee should be in quiescent state with little or no swelling, have full range of motion, and the patient should have a normal or near normal gait pattern. This can be achieved by immobilizing the knee using a knee immobilizer and crutches. It is also encouraged to bear as much weight on the leg as comfortable. Icing along with non-steroidal anti-inflammatory medications is used to control pain and swelling. Next, it is crucial that the normal range of motion is restores as quickly as possible. This is done using quadriceps isometrics exercises, straight leg raises, and range of motion exercises; for full extension – passive knee extension, heel props, prone hand exercise, for full flexion – passive knee bend, wall slides and heel slides. After normal range of motion is achieved, muscle streght must be developed. This can be done by using a station bicycle, swimming and other low impact exercises.

2. Postoperative

1. Days 1-7

Control pain and swelling by keeping the leg constantly elevated and iced. Next, do passive extension of the knee by using a rolled towel, active-assisted extension (use opposite leg), passive flexion of the knee to 90 degrees. Then, proceed with exercising the hamstring by pulling the heel back.

2. Days 8-10

Continue with quadriceps isometrics, SLR, active flexion, and active-assisted extension exercises.

3. **Week 3**

Maintain full extension by continuing with full passive extension, gravity assisted and active flexion, active-assisted extension, quadriceps isometrics, and straight leg raises. Work towards 90-100 degrees of flexion (bending). Next, patient should develop muscular control by doing partial squats and toe raises.

4. **Weeks 3 – 4**

Expected range of motion is from full extension to 100 – 120 degrees of flexion. Add wall slides and hand assisted heel drags to increase tour range of motion. Continue quadriceps isometrics and straight leg raises, partial squats and raises.

5. **Weeks 4 – 6**

The expected range of motion should be full extension to 125 degrees. The patient must start to push for full flexion. Do wall slides if the flexion range of motion is less than desired. Continue quad sets, straight leg raises, partial squats, toe raises, stationary bike, elliptical machine, leg presses, and leg curls. Also, the patient could do tilt board or balance board exercises to improve balance and proprioception.

6. **Weeks 6 – 12**

Continue quad sets, straight leg raises, partial squats, toe raises, stationary bike, elliptical machine, leg presses, and leg curls. Hamstring patients can start leg curls in sitting position. Continue the tilt board and balance board training, the swimming program, start running on the treadmill (flat only). The patient is permitted to begin outdoor bike riding on flat roads.

7. **Weeks 12 – 20**

Continue week 6 – 12 strengthening exercises, begin light running program, start functional running program after jogging program is completed, determine the need for ACL functional brace and finally start agility drills.

8. **6 months**

The earliest the patient should plan to return to sports. At this stage the patient should have 80% quadriceps and hamstring strength, full motion, no swelling, good stability and have the ability to complete a running program.

9. Evaluation

1. **IKDC**

The International Knee Documentation Committee scoring grades the patient based on history, history of knee, daily activities post-surgery, symptoms, functions, cartilage status, meniscus status, and ligament status. This will be split into 4 grades; A (Normal), B (Nearly Normal), C (Abnormal) and D (Severely Abnormal).

2. **Range of Motion**

The knee is tested if it can be achieve full flexion and extension. This is done by having the patient lay in the prone position and the knee is passively fully extended and then it is fully flexed. The difference in full extension/flexion is measured in degrees.

3. **Lachman's Test**

Lachman's test is to test the knee's stability. While the knee is in 15° of flexion, the examiner draws the tibia forward, feeling for laxity and assessing the quality of the end point. The injured knee is compared with the uninjured one.

4. **Lysholm score**

Lysholm score measure the function of injured knees. Patients are asked to indicate presence of limp, rate pain, instability, locking, swelling, and the ability to climb stairs and squatting.

5. **Instrument Testing**

Instrument testing is done to quantitate the anterior posterior displacement of the knee, something the more subjective Lachman test couldn't do. The most used instrument is the KT1000 arthrometer. The patient is asked to lie in a supine position with the thighs places on bolsters and heels placed in positioning cup; this maintains the knee at approximately 30° flexion and the tibia in a symmetric position of rotation (15°). The arthrometer is then secured to the leg and the reading is then taken.

CHAPTER 3

3.0 CONCEPTUAL FRAMEWORK AND RESEARCH HYPOTHESIS

3.1 Conceptual Framework

Trauma or injury can cause the anterior cruciate ligament to rupture. This is corrected by having the ligament replaced using either the patellar bone tendon graft or the hamstring graft. Reconstruction is done arthroscopically by first clearing the ruptured ligament then extracting the graft of choice, and finally fixating the grafts using interference screws.

This is then followed by intense rehabilitation therapy. The outcome of the surgery is then tested using the IKDC score, then the range of motion is tested, KT score measured and finally the Lachman's test is done. These tests are done after a period of 6 months, 12 months, and 18 months and so on.

This study will meta analyze the results of the journals comparing the use of those two auto grafts. These journals are obtained using Google scholar, using the keywords such as patellar, hamstring, ACL, etc. They are then selected based on criteria such as data consistency, length of postoperative test etc. Data such as IKDC score, surgical technique etc. is extracted and finally, using meta-analysis, the analyzed.

3.2 Hypothesis

Different grafts will yield different outcomes.

CHAPTER 4

4.0 RESEARCH DESIGN

4.1 Journal Search

Using google scholar, the following keywords was used to search for the potential literature; anterior, cruciate, ligament, reconstruction, bone, patellar, hamstring, graft, semitendinosus, gracilis, versus, and compared. References from other journals were also used to search for relevant literature.

4.2 Inclusion Criteria

Only journals comparing the use of the hamstring graft and patellar graft are selected. They must also be written in English and only contain human subjects. The post-operative follow up done by the examiner must also be done for a minimum of 24 months. Studies must be done between the years 1989 to 2000. They must also only be of single bundle ligament reconstruction.

4.3 Data Extraction

After selection, certain data will be extracted from the journals. They will be the patient population, the surgical technique, the outcome of the surgery; evaluation tests (IKDC, Lysholm score, Range of motion,) and complications and failures.

4.4 Data Analysis

The data is tested for data relationship using the chi square crosstabs. The data is placed in a 2x2 table for calculation purposes. This is will indicate the relationship strength of the data. Cochran Q test showed that with increasing r, the distribution of Q approaches a Chi-square distribution with degrees of freedom c - 1, and then the critical value for Cochran's Q test can be

obtained by using table values for the degrees of freedom chi Squares c – 1 ($\chi 2$ tabel = $\chi 2$ 1-α;c-1). Subtract H_0, if Q is bigger or same as $\chi 2$ 1-α; c-1.

CHAPTER 5

5.0 RESULTS AND DATA ANALYSIS

5.1 Literature Search

After screening 27 potential journals obtain from the research, only 4 met the inclusion criteria; Paolo Aglietti et al, K. Eriksson et al, Micheal Wagner et al, and Daniel O'neill.

5.2 Patient Characteristic

5.2.1 Aglietti et al

120 patients followed this study. They were randomized in a strictly alternating manner between autogenous bone-patellar tendon-bone and double hamstring graft. 46 men and 14 women followed the patellar graft and the same amount followed hamstring graft. Mean age for both groups was 25 years old wherein the range for the patellar group is 16-39 and 15-39 for hamstring group.

5.2.2 K Eriksson et al

The study had a total of 164 participants; 84 with the patellar tendon graft and 80 with the hamstring tendon graft. The mean age for the 96 men and 68 women was 25.7 years old.

5.2.3 Michael Wagner et al

The study had a total of 72 patients and a database of 284 documented cases. 72 of the patients were all treated using patellar tendon graft, whilst all the documented cases were of hamstring tendon graft.

5.2.4 Daniel B O'neill

125 patients were evaluated in this study, 40 of which with the hamstring tendon graft while the other 85 with the patellar tendon graft.

5.3 Surgical Technique

5.3.1 Aglietti et al

A single incision technique using interference screws for fixation was used for the patellar tendon graft. On the other hand, a two incision technique using a Bone Mulch screw and a Washer Loc device for fixation were used for the hamstring tendon graft.

5.3.2 K Eriksson et al

The study used non absorbable interference screws for both grafts.

5.3.3 Michael Wagner et al

The study used a single incision technique for both the hamstring tendon graft and the patellar tendon graft. Fixation for both grafts was done using biodegradable interference screw.

5.3.4 Daniel B O'neill

There were two techniques used for the patellar tendon graft; two incision and single incision, both used interference screws for fixation. A two incision technique was required for the hamstring tendon graft which was then fixated using 2 small barbed staple on both ends.

5.4 Outcomes

5.4.1 IKDC

All 4 journals conducted the IKDC scoring. The pooled results shows that 60 % of all patellar bone tendon graft recipient had a score of B, C, and D (classified as <A). The recipients of hamstring grafts had fared marginally better with only 59 % having scored B, C and D. Statistical analysis shows data insignificance (p=0.616).

	O'neill et al		Aglietti et al		Eriksson et al		Wagner et al	

A	51	22	38	34	3	4	17	34
B	27	13	22	26	45	37	32	21
C	5	3	0	0	17	19	6	0
D	0	0	0	0	15	14	0	0

5.4.2 Range of Motion

5.4.2.1 Extension

All 4 journals evaluated its participants for the knee‘s range of motion for full extension. The pooled results show that 13 % of the entire patellar tendon graft patients had an extension deficit of more than 3°. On the other hand, the hamstring tendon graft patients fared better with only 8 % having the same deficit. Statistical analysis shows data significance (p=0.033).

	O’neill et al		Aglietti et al		Eriksson et al		Wagner et al	
<3°	82	38	59	60	50	59	50	53
3°-5°	1	0	1	0	30	15	4	2
>5°	0	0	0	0	0	0	1	0

5.4.2.2 Flexion

All 4 journals evaluated its subjects for the knee’s range of motion for full flexion. The pooled results shows that both the patellar tendon graft and hamstring graft had identical results, 11 % or the patients had a flexion deficit of more than 6°. Statistical analysis shows data insignificance (p=0.961).

	O’neill et al		Aglietti et al		Eriksson et al		Wagner et al	

<6°	75	36	60	59	65	53	47	54
≥6°	8	2	0	1	15	21	8	1

5.4.3 Lachman

Only 3 studies (except Wagner et al) conducted the Lachman test on its participants. The pooled results show that 56 % of the patellar tendon graft patients had a +1 and +2 results (deviation of more than 2mm). The aforementioned percentage is better than patients with hamstring tendon graft where 65 % of the patients had a score of +1 and +2. Statistical analysis shows data insignificance (p=0.068).

	O'neill et al		Aglietti et al		Eriksson et al		Wagner et al
0 (0-2mm)	58	26	0	0	40	34	Not Stated
+1 (3-5mm)	18	11	60	60	39	38	
+2 (6-10mm)	7	1	0	0	1	2	

5.4.4 Pivot-Shift Test

3 journals (except Daniel O'Neill) used the pivot-shift test to evaluate its patients. The pooled result shows that of all the patellar tendon graft recipients, 29 % had a positive pivot shift test. The patients with hamstring tendon graft had slightly better results with only 23% having a positive score. Statistical analysis show data insignificance (p=0.148)

	O'neill et al	Aglietti et al		Eriksson et al		Wagner et al	
0		50	49	56	50	32	47

	Not Stated						
+1 (slide)		10	11	23	22	21	8
+2 (clunk)		0	0	1	2	2	0

5.4.5 Instrument Testing

Only 3 journals (except K Eriksson et al) conducted the instrument testing (using either KT 1000 or 2000). The pooled results shows that the patellar tendon grafts were marginally better than the hamstring tendon graft with only 32 % having a deviation of more than 2mm as opposed to the 33% of patellar tendon graft. Statistical analysis shows data insignificance (p=0.764).

	O'neill et al (KT2000)		Aglietti et al (KT1000)		Eriksson et al	Wagner et al (KT1000)	
≤2mm	66	30	39	34	Not Stated	30	38
3 mm to 5 mm	16	7	21	26		22	17
>5 mm	1	1	0	0		3	0

5.5 Complication and Failures

5.5.1 Graft Failures

Graft failure were higher in patient with the hamstring tendon graft; 5 %, to the patellar tendon graft's 2 %. Statistical analysis show data insignificance (p=0.113)

	O'neill et al		Aglietti et al		Eriksson et al		Wagner et al	
Graft	2	2	0	0	2	3	3	16

failure								

5.5.2 Complications

Only Aglietti et al recorded the complications that were present. 13 patients from the patellar tendon group had patelllofemoral crepitation while 14 other from the hamstring tendon had similar symptoms. 37 patellar tendon graft patients complained of harvest site pain, wherein kneeling was deemed a painful experience. 9 patients from the hamstring group had similar experiences.

CHAPTER 6

6.0 DISCUSSION

The journals selected were comprised of 3 randomized trial; Aglietti et al, K Eriksson et al and Daniel O'neill, and one cohort study; Micheal Wagner et al. The reason behind the inclusion of the cohort study was to increase the size of the study population. Even though it leads to the inevitable statistical insignificance (ref) and heterogeneity, the analysis was still able to provide an understanding of the outcomes from the use of the hamstring tendon graft and patellar bone tendon graft.

The first outcome that was analyzed was the IKDC score. The outcome showed a 2% difference in which the patellar tendon graph had more patients being evaluated as having a score of B, C and D. The data from the Ericsson et al study shows a significantly higher number of patients receiving a B score, while having a very small number of patients with an A score when compared to other studies. This evidently affects the result distribution. The reason could be because of the different interpretation of the test done by Ericsson et al. Chi square showed a value of 0.252 with a p value of 0.616 indicating insignificant relationship. Significant heterogeneity was detected as the Q Cochran test gave a p value of 0.000 ($p<0.05$).

The range of motion results was divided into extension and flexion.

The hamstring tendon had 5 % less participant with a deviation of more than 3°. Amongst the journals, Eriksson et al recorded an unusually higher number or patients with a deviation of 3°-5°. Even so the results were fairly constant across the board. Chis square showed a value of 4.561 with a p value of 0.033 indicating significant relationship. Significant heterogeneity was detected as the Q Cochran test gave a p value of 0.000 ($p<0.05$).

The same could not be said for there was virtually no difference between both the grafts when tested for maximum flexion. Though Eriksson et al did record a higher amount of patients with a deviation of more than 6°. Chi square showed a value of 0.002 with a p value of 0.961 indicating

insignificant relationship. Significant heterogeneity was detected as the Q Cochran test gave a p value of 0.000 ($p<0.05$).

The Lachman test showed interesting results. Of the 3 journals that conducted the test, the results were anything but uniform. O'neil had the highest amount of patients receiving scores of 0 when compared to scores of +1 and +2, Aglietti et al evaluated all their patient as having a score of +1 while and finally Eriksson et al gave 50% of his patients score of 0 and the other half scores of +1 for both patellar tendon and hamstring tendon grafts. This had consequential effects on the statistical findings as it promotes not only heterogeneity but also correlations between the data when pooled together. The analysis shows that the patellar tendon graft had 9% less patient being graded as +1 and +2. It is being influenced nonetheless by the aforementioned varying data of the journals. This translated to a chi square value of 3.323 with a p value of 0.068 indicating insignificant relationship. Significant heterogeneity was detected as the Q Cochran test gave a p value of 0.000 ($p<0.05$).

The pivot shift test indicated a better performing hamstring tendon graft than the patellar tendon graft by 6%. More patients had scores of +1 (slide) and +2 (clunk) for patellar tendons than those who received the hamstring tendon. When compared to other journals Wenger et al had more than half its patellar tendon graft patients having a score of +1 than a score of 0. Suffice to say that the data is partially affected by this. Chi squared showed a value of 2.092 with a p value of 0.148 indicating insignificant data relationship. Significant heterogeneity was detected as the Q Cochran test gave a p value of 0.000 ($p<0.05$).

The instrument testing demonstrated the patellar tendon graft surpassing the hamstring tendon by 2%. O'neil had a surprisingly low number of patients with a deviation of 3mm-5mm when compared to the other two. Chi square showed a value of 0.090 with a p value of 0.764 indicating insignificant data relationship. Significant heterogeneity was detected as the Q Cochran test gave a p value of 0.001 ($p<0.05$).

Finally, there was more graft failure for hamstring tendon graft than the patella graft tendon. Chi squared showed a value of 2.507 with a p value of 0.113 indicating insignificant data relationship. Significant heterogeneity was detected as the Q Cochran test gave a p value of 0.000 ($p<0.05$).

The scarcity of complications documentation amongst the journal reduced the comparative ability of this study. Only Aglietti et al recorded such details. The study stated that there exist patellofemoral symptoms, specifically crepitation on 13 of the patellar tendon graft and and 14 patients from the hamstring tendon graft. Harvest site pain was also present in the form of kneeling pain in which affected 37 patellar tendon graft and 9 hamsting tendon graft. This influences the choice for patients whose lifestyle require a higher than normal amount of kneeling. No meta-analysis calculation was done because of the insufficient data.

In conclusion, the study did not find any significant differences between the PT and HT grafts. What it did find was that there was a very distinct evaluation pattern between the journals. Considering the age of such journals, perhaps current results are more uniform. Even so, both grafts are excellent choices as an ACL replacement and choice should come down to the doctor's skill and depending on one's lifestyle; for Muslims' who kneel frequently during prayer, the HT graft is more suitable as it recorded less anterior knee pain and kneeling pain.

CHAPTER 7

7.0 SUMMARY

7.1 Summary

1. The outcome of the analysis shows that both grafts perform similarly in test. No more than a difference of 10% was documented between the two grafts
2. There exists a very prominent disparity of results between the studies. This showcases multiple interpretations of the examinations.
3. The hypothesis was proved as both graft had differences, but they were trivial and insignificant at most. The patient can be rest assured that either grafts will be good choices nonetheless.

7.2 Recommendation

1. All included studies should be of level 1 origin.
2. Research should be done to investigate the ambiguity of the test results between the journals.
3. Journals with similar types of technique and evaluation so more statistical significant and unifying results can be obtained.

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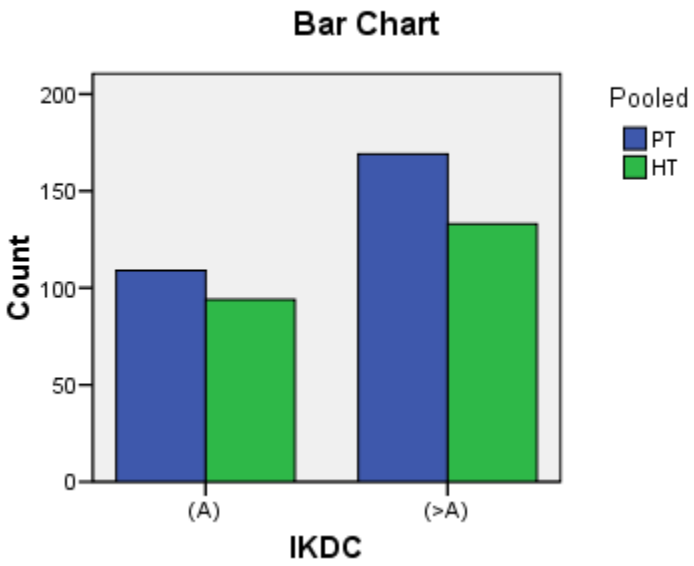
APPENDIX 1

Output Hasil Analisis Data

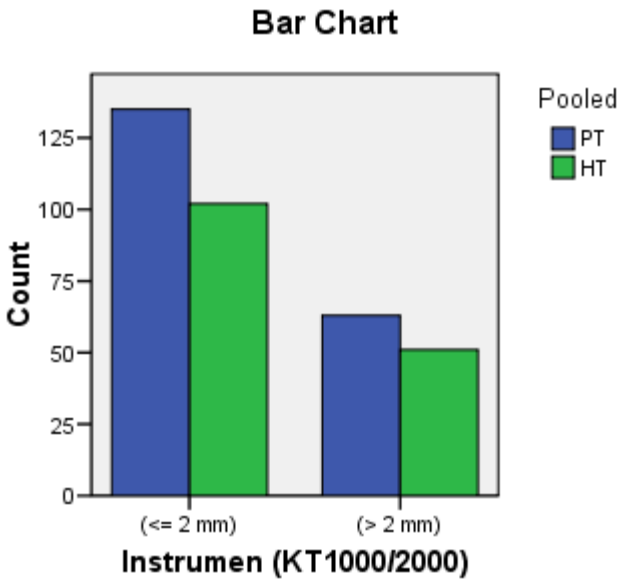
Crosstabs



NPar Tests

Cochran Test

Crosstabs



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Cochran Test

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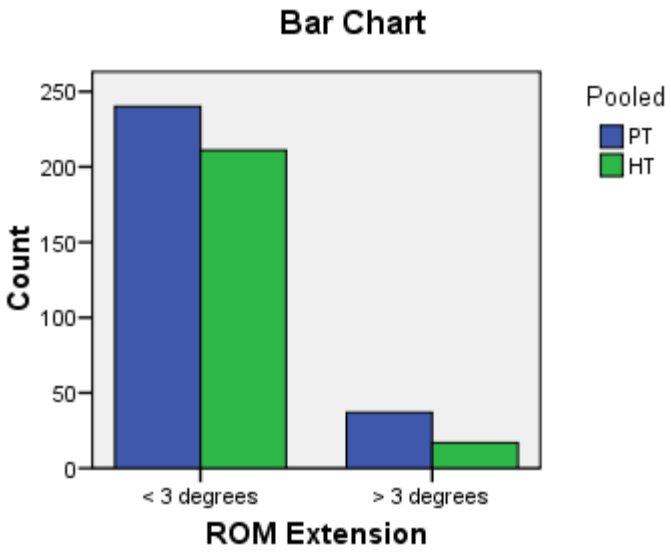

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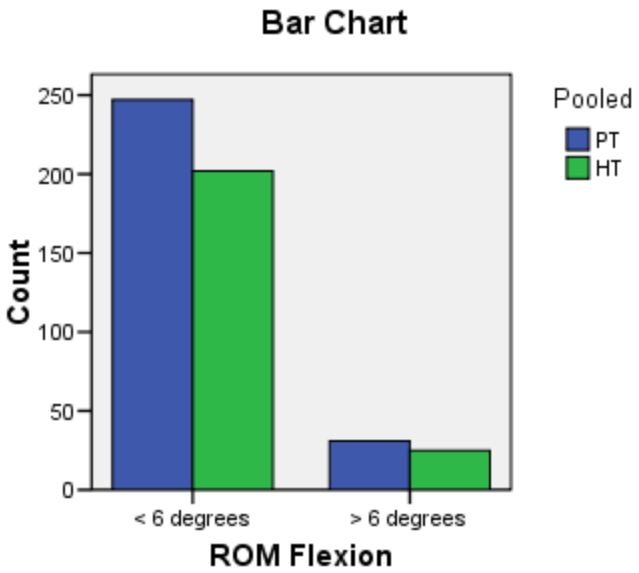
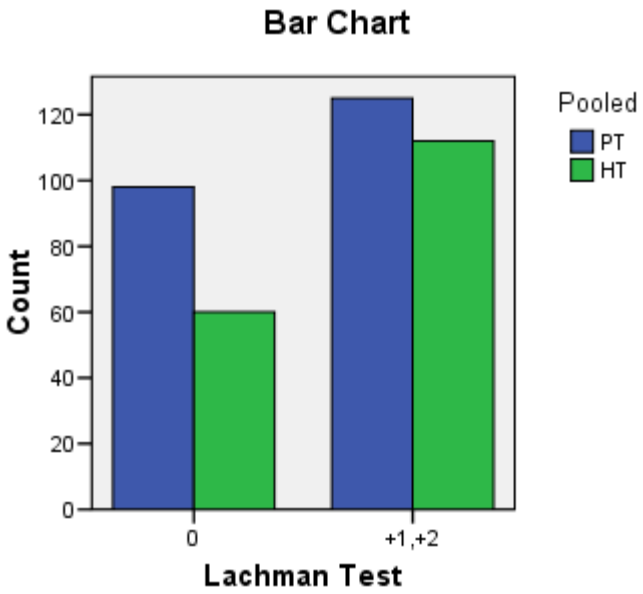


NPar Tests

Cochran Test

Crosstabs



NPar Tests

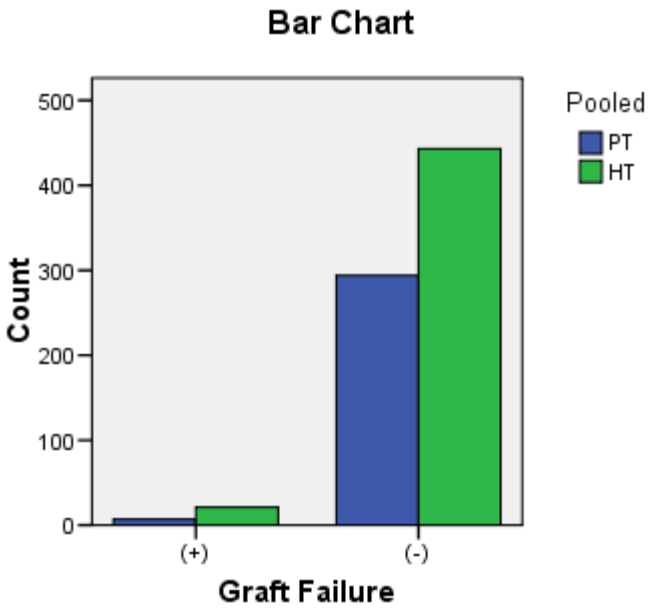
Cochran Test

Crosstabs

NPar Tests

Cochran Test

Crosstabs



NPar Tests

Cochran Test

Interpretasi Hasil Analisis:

1. Hasil Uji Chi square:

<u>Contoh interpretasi uji chi-square</u>

Untuk mengetahui ada atau tidaknya hubungan antara IKDC dengan Pooled, maka perlu dibentuk tabulasi silang (*crosstabs*) yang dapat menggambarkan penyebaran data secara lebih terinci, sebagaimana disajikan pada tabel berikut.

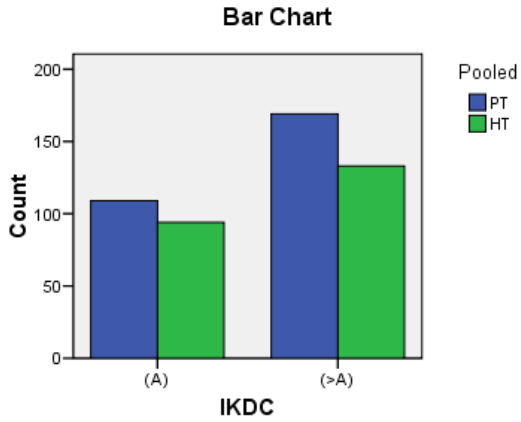
Berdasarkan hasil tabel silang (*crosstabs*) di atas terlihat bahwa jumlah IKDC dengan kategori A dan Pooled tergolong Patellar Tendon (PT) ada sebanyak 109 kasus (21.6%), dan 94 kasus (18.6%) Pooled tergolong Hamstring Tendon (HT). Sedangkan jumlah IKDC dengan kategori >A dan Pooled tergolong Patellar Tendon (PT) ada sebanyak 169 kasus (33.5%), dan 133 kasus (26.3%) Pooled tergolong Hamstring Tendon (HT).

Selanjutnya, untuk menguji adanya hubungan antara IKDC dengan Pooled, maka dapat digunakan uji fisher exact test atau uji chi-Square ($\square^2$) sebagai *test independency*.

Berdasarkan hasil pengujian pada Tabel di atas menunjukkan nilai Chi-Square untuk mengetahui adanya hubungan antara IKDC dengan Pooled yaitu sebesar 0.252, dengan

nilai signifikansi (p) sebesar 0.616 yang lebih besar dari alpha 0.05, sehingga dapat disimpulkan bahwa antara IKDC dengan Pooled tidak mempunyai hubungan yang signifikan.

Adanya kaitan erat antara IKDC dengan Pooled dapat digambarkan dalam bentuk histogram sebagai berikut.



APPENDIX 2

Hasil uji Chi square Keseluruhan

	Chi square	Sig. (p)	Kesimpulan
IKDC dengan Pooled	0.252	0.616	Tidak ada hubungan yang signifikan
Instrumen (KT1000/2000) dengan Pooled	0.090	0.764	Tidak ada hubungan yang signifikan
ROM Extension dengan Pooled	4.561	0.033	ada hubungan yang signifikan
ROM Flexion dengan Pooled	0.002	0.961	Tidak ada hubungan yang signifikan
Lachman Test dengan Pooled	3.323	0.068	Tidak ada hubungan yang signifikan
Pivot shift dengan Pooled	2.092	0.148	Tidak ada hubungan yang signifikan

Graft Failure dengan Pooled	2.507	0.113	Tidak ada hubungan yang signifikan

Berdasarkan hasil pengujian dengan Chi square di atas dapat diketahui bahwa hanya antara ROM Extension dengan Pooled yang mempunyai pengaruh yang signifikan ($p<0.05$), sedangkan lainnya tidak mempunyai hubungan yang signifikan dengan pooled ($p>0.05$).

Hasil Risk Ratio Keseluruhan

	95% Confidence Interval		
	Odds ratio	**RR (Pooled=PT)**	**RR (Pooled=HT)**
IKDC dengan Pooled	0.913 (0.638-1.305)	0.960 (0.816-1.129)	1.051 (0.865-1.278)
Instrumen (KT1000/2000) dengan Pooled	1.071 (0.683-1.680)	1.031 (0.845-1.257)	0.962 (0.748-1.237)
ROM Extension dengan Pooled	0.523 (0.286-0.955)	0.777 (0.636-0.949)	1.486 (0.991-2.229)
ROM Flexion dengan Pooled	0.986 (0.564-1.724)	0.994 (0.774-1.276)	1.008 (0.740-1.373)
Lachman Test dengan Pooled	1.463 (0.971-2.206)	1.176 (0.991-1.396)	0.804 (0.632-1.022)
Pivot shift dengan Pooled	0.713 (0.450-1.129)	0.852 (0.692-1.050)	1.196 (0.929-1.539)
Graft Failure dengan Pooled	0.502 (0.211-1.196)	0.627 (0.328-1.198)	1.248 (1.000-1.558)

2. Cochran (Q statistics)

Teori Cochran Q statistics

Rumus

$$Q = \frac{\left(c(c-1)\sum_{j=1}^{c} C_j^2\right) - \left((c-1)N^2\right)}{cN - \sum_{i=1}^{r} R_i^2}$$

Uji Q Cochran memperlihatkan bahwa dengan meningkatnya r maka distribusi Q mendekati distribusi Khi-kuadrat dengan derajat bebas c – 1, maka nilai kritis untuk ***Uji Q Cochran*** dapat diperoleh dengan menggunakan Tabel nilai-nilai Khi Kuadrat untuk derajat bebas c – 1 (χ^2 tabel = $\chi^2_{1-\alpha;c-1}$).
Tolak H_0 , jika Q lebih besar dari atau sama dengan $\chi^2_{1-\alpha;c-1}$.

Hasil uji *Q Cochran* Keseluruhan

	Q Cochran	Sig. (p)	Kesimpulan
IKDC dengan Pooled	21.388	0.000	Significant Heterogeneity
Instrumen (KT1000/2000) dengan Pooled	9.218	0.001	Significant Heterogeneity
ROM Extension dengan Pooled	122.081	0.000	Significant Heterogeneity
ROM Flexion dengan Pooled	125.498	0.000	Significant Heterogeneity
Lachman Test dengan Pooled	22.838	0.000	Significant Heterogeneity
Pivot shift dengan Pooled	39.020	0.000	Significant Heterogeneity
Graft Failure dengan Pooled	236.600	0.000	Significant Heterogeneity

Berdasarkan hasil pengujian dengan ***Uji Q Cochran*** di atas dapat diketahui bahwa semua parameter terhadap Pooled mempunyai nilai p yang lebih kecil dari alpha 0.05, yang mengindikasikan adanya heterogenitas yang signifikan ($p<0.05$).