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THE VALUE OF PRE-OPERATIVE MRI, ANTHROPOMETRIC PARAMETERS AND ACTIVITY LEVEL IN PREDICTION OF AUTOGENOUS HAMSTRING GRAFT SIZE IN ACL RECONSTRUCTION

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Abstract

Background:

ACLR has become the gold standard for active patients, with hamstring tendons being the most commonly utilized transplant type. The key to a successful transplant is obtaining a graft of the right size. Therefore, it is crucial for the treating physician and the patient to arrange the process of making a hamstring transplant or employing another type of graft prior to surgery. Methods: This patient's preoperative T1 weighted MRI picture, with fat saturation in the axial plan at the level of the largest width of the distal femur, was used to estimate the CSA of the semitendinosus and Gracilis tendon, in addition to the patient's prognosis. statistics on anthropometry (height, weight, age, body mass index, thigh size, and degree of physical activity). To measure the diameter of a harvested hamstring tendon, which is done intraoperatively by removing soft tissue from it using normal method, the tendon is then doubled over around a rope. Results: Our study comprised 30 males, with an average age of 30.06 + 7.4 years. Our research shows that grafts larger than 8 mm intraoperatively are the consequence of tendons with total cross-sectional areas more than 18.6 mm2 (11 mm2 for semitendinosus and 7.6 mm2 for gracilis). The sole significant predictor for graft diameter was height. The relationship between graft size, age, and body mass index was weakly negative. No correlation was found between activity level, weight, or thigh circumference. Conclusion: Finally, we have determined that: 1-Preoperative MRI is an effective tool for predicting the size of the hamstring tendon autograft in ACL reconsideration. If the axial MRI of the tendons shows a cross-sectional area greater than 18.6 mm2 at the level of the largest width of

the distal femur, then the graft, when made of four strands, will be more than 8 mm in diameter.
2-When predicting whether patients may have grafts that are too small, a constellation of anthropometric parameters might be helpful. Factors increasing the likelihood of an inadequate transplant include being underweight, having a lengthy time between injury and operation, and being small in stature.

Aim of the study: The accuracy of preoperative magnetic resonance imaging (MRI) in predicting the size of a hamstring autograft for ACL repair, as well as the relationship between graft size and patient anthropometric variables including age, weight, height, body mass index (BMI), thigh circumference, and activity level.

Introduction

Injuries to the anterior cruciate ligament (ACL) are on the rise with other types of sports-related injuries. One of the most common knee ligament injuries, anterior cruciate ligament tears can severely limit a person's ability to move around and do daily tasks. (1) The present gold standard for athletically active people is ACL repair due to the fact that it reduces the likelihood of meniscus tears and knee laxity. two (2) There is currently no universally accepted autograft that meets all of the criteria for an ideal anterior cruciate ligament (ACL) restoration, including minimal donor site morbidity, optimal graft strength, ease and durability of reconstruction, and patient safety. But when the diameter of the extracted hamstring autograft is too small, graft strength difficulties and concerns become apparent. Similarly, when harvesting more than one-third of the entire width of the patella tendon for autograft usage, the risk of donor site problems during the patella tendon harvest may increase. (3) .The gold-standard surgical approach used to be the bone-patellar tendon-bone autograft. However, hamstring tendons have recently surpassed it in popularity as a reconstructive autograft due to its excellent strength, simplicity of harvesting, and decreased donor site morbidity. The size of the graft created from the hamstring tendon will depend upon the size of the tendons harvested during surgery, unlike bone-patellar-tendon, quadriceps tendon, or allografts, which may be acquired in a predefined size. (4) Preserving hamstring muscular strength is another benefit of the hamstring tendon transplant procedure. Most of the series that have been published have demonstrated near-full recovery of knee flexor strength, even after tendon harvest. (5) One possible explanation is that up to 75% of patients experience postoperative regeneration of the harvested tendons; nonetheless, it is common for them to not regain their entire cross-sectional area. the sixth More than 90% of patients in a large series had clinically and KT-1000 stable knees after undergoing an adult ACL replacement using four-strand hamstring tendon autografts, demonstrating their reliability as grafts. Initial harvest and cycle loading measurements reveal that 4-strand semitendinosus (ST) and gracilis tendon (GT) autografts are stronger than BPTB autografts. Some writers have proposed that by 8 months after surgery, the initial autograft resistance to failure drops by 50%. To make up for this weakening, a graft with a diameter that is the same as or greater than the typical ACL should be used. (7) The prior minimal diameter cutoff for hamstring tendon autografts was 7 mm, however there is now evidence that grafts smaller than 8 mm have a relative risk of failure that is 6.8 times higher. (8) When the HT graft diameter was between 7.0 and 10.0 mm, Snaebjörnsson et al. found that for every 0.5 mm increase, the chance of revision surgery decreased by 0.86 times. eight (8) .Since anterior-posterior and rotational stability are essential in high-demand activities performed by young, active patients undergoing

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ACLR, it can be challenging to achieve a graft size larger than 8 mm in diameter. This is because autografts are usually smaller in young patients, with size impacted by various anthropometric and skeletal factors. the ninth Because of size fluctuation, it is not always feasible to harvest an autograft of suitable thickness regardless of the procedure. Various allograft or autograft alternatives must be considered in these instances. Prior to completing the informed consent form, a patient who may have graft size inadequacy should be apprised of all alternative graft possibilities as well as any associated complications. It would be helpful to know how big the semitendinosus and gracilis tendons are before surgery so that we can be ready for insufficient graft harvesting. two (2) Predicting the hamstring graft thickness's sufficiency for ACL restoration before surgery would help in planning different graft options and getting different fixation techniques ready for usage. **Anatomy of the ACL** Running from the tibia to the femur is a thick band of connective tissue known as the anterior cruciate ligament (ACL). Anterior cruciate ligament (ACL) stability against anterior tibial translation and rotational stresses is an important function of the knee joint .Figure 1 shows the two functional bundles of the anterior cruciate ligament (ACL), which are called after the tibiae, which play a significant role in surgical reconstruction. Whereas the posterolateral bundle is more horizontal, loose in flexion but tense at extension, the anteromedial bundle is vertically oriented and tightens around 60° of knee flexion. (10)

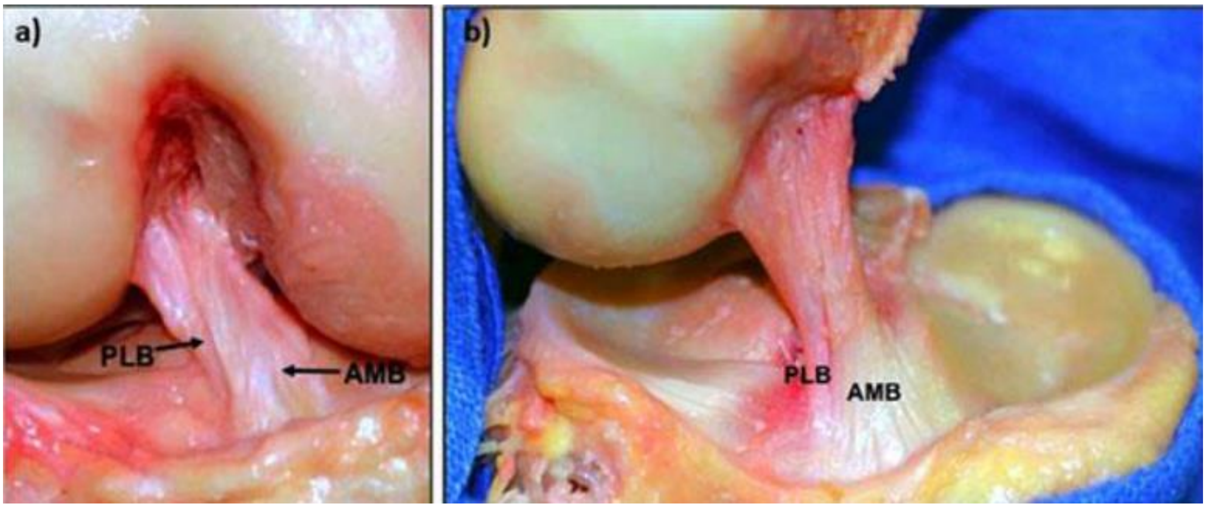

Figure 1. A cadaveric dissection showing the ACL bundles; the anteromedial (AM) bundle and the posterolateral (PL) bundle.

ACL originates from the posteromedial corner of medial aspect of lateral femoral condyle in the intercondylar notch. This femoral attachment of ACL is on posterior part of medial surface of lateral condyle well posterior to longitudinal axis of the femoral shaft. The femoral origin is defined by reproducible bony landmarks. The lateral intercondylar ridge, an extension from the posterior femoral cortex, referred to as "resident's ridge", marks its anterior border. Perpendicular to the lateral intercondylar ridge is the bifurcate ridge that separates the footprints of the posterolateral and anteromedial bundles (Figure 2). [11]

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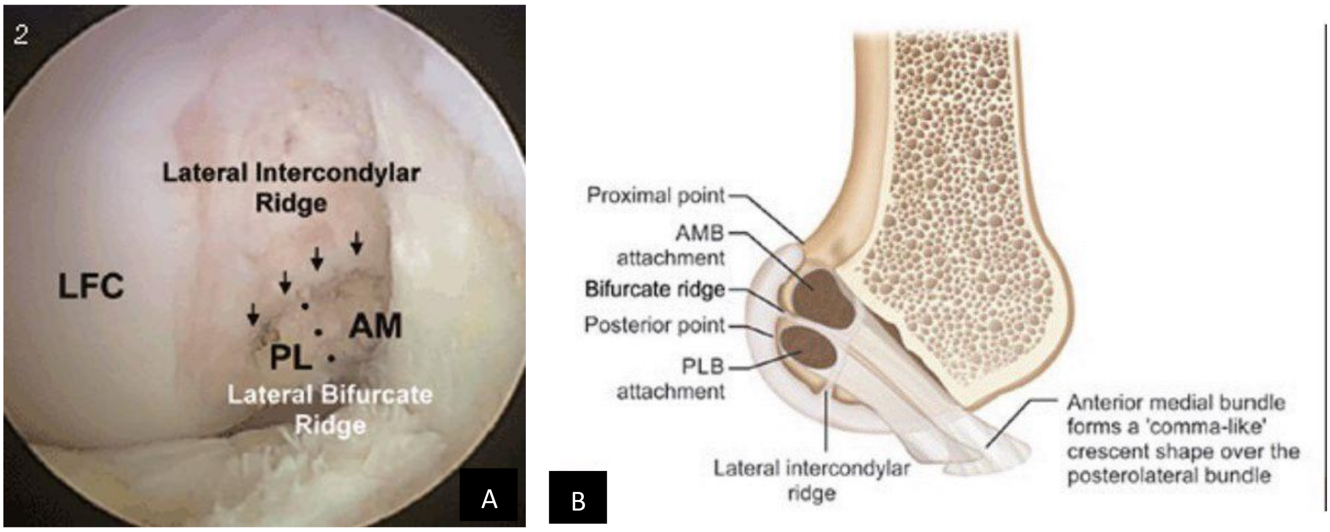


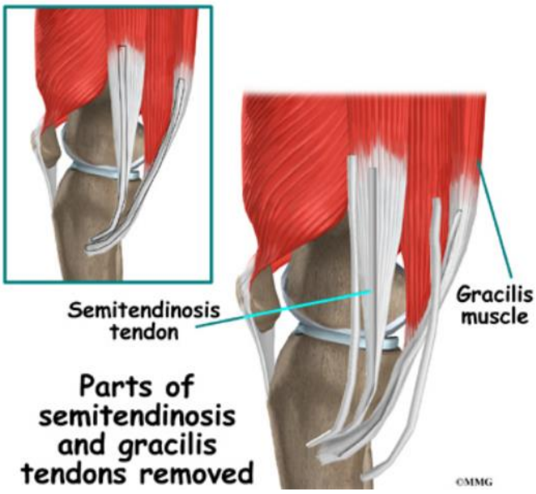
Figure 2 Anatomy of the ACL femoral footprint. (A) Intraoperative photograph during ACL reconstruction in a left knee, highlighting the intercondylar and bifurcate ridges. (B) Bony and soft tissue anatomy of the femoral ACL footprint.

Attached distal to the bifurcate ridge is the posterolateral bundle, while proximal to it is the anteromedial bundle. During ACL reconstruction, the femoral tunnel should be placed using the remnant of the natural footprint as a trustworthy landmark. If the footprint cannot be located, the lateral intercondylar and bifurcate ridges can be utilized. Through a transitional zone of fibrocartilage and mineralized fibrocartilage, the attachment—actually an interdigitation of collagen fibers and rigid bone—travels inferiorly, medially, and anteriorly until inserting anterior to the intercondylar eminence of the tibia, where it blends with the anterior horn of the medial meniscus. A somewhat large region ranging in width from 11 mm in the AP direction to 17 mm in front of and lateral to the anterior spine is where the tibial attachment is located (12) in the fossa. Both the knee's rotational stability and its anteroposterior translational stability rely heavily on the anterior cruciate ligament (ACL). The posterolateral bundle is subject to high in situ forces in early flexion but quickly decreases forces with flexion >30°; in contrast, the anteromedial bundle experiences nearly constant (isometric) in situ forces regardless of knee flexion angle. Both bundles contribute to anteroposterior translational control. (13)

Anatomy of the hamstrings:

When reconstructing a knee's anterior cruciate ligament (ACL), hamstring tendons are frequently utilized (Figure 3). Hamstring tendons can be harvested for either autograft or allograft usage in ACL restoration, but there are certain anatomical factors to consider.

Sartorius, gracilis, and semitendinosus all enter into the pes anserinus, which is located on the anteromedial side of the tibia. (14)



(Figure 3) Anatomy of the hamstrings [14]

The Sartorius and gracilis muscles are said to meet at a distance of 2.2+/−0.7 cm from the tibial tuberosity and 4.5+/−0.6 cm from the medial side. The infrapatellar branch and the major saphenous nerve are intimately connected to the pes anserinus insertion.The semitendinosus and gracilis tendons, which are intimately linked to the Sartorius fascia, may only be seen by cutting into the fascia, which covers the Sartorius muscle. Another distinguishing feature of the semitendinosus and gracilis structures is that, in contrast to the medial collateral ligament, they are not attached to the bone anywhere other than at their attachment sites. In addition, after locating the tibia's converging gracilis and semitendinosus attachments, it's necessary to trace them further proximally in order to separate the tendons before they merge, and then harvest each one separately. (number one)

Assessment of the patient:

Retina deficiency is the most under-recognized knee ailment that need surgical repair. Incorrectly diagnosing the injury as a "sprain" according to patient symptoms and examination is a common cause of this. Early diagnosis of ACL injury is critical for reducing the likelihood of meniscal and chondral damage due to instability episodes.This is what is meant by a positive test. From zero (not present) to three (excellent), rate the exam as follows: (Minor movement or glide), Intermediate (clear subluxation or "jump"), and Superior (severe movement) ("Definite subluxation and momentary locking").

Figure 9 Pivot shift test

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The pivot shift test has a good specificity for ACL injuries, however guarding causes it to be insensitive in conscious patients. When the patient is under anesthesia for inspection, the pivot shift comes in quite handy. Also, a genuine "partial" damage can be distinguished from an ACL with functional deficiencies by the presence of a positive pivot shift. Patients who continue to have instability after ACL repair can be evaluated using the pivot shift test. The pivot shift can indicate that restoring anterior translation stability with a vertical femoral tunnel position is not enough to address rotational instability.

Imaging:

1. Radiographs

When imaging a patient for a possible ACL injury, radiographs are taken first. The patella should be examined from all angles, including the front, back, side, and tangential ones. Radiographic indicators of anterior cruciate ligament (ACL) damage might include a Next, there is a lateral tibial plateau fracture, a lateral femoral condyle impaction fracture, or a lateral capsular avulsion fracture (Figure 8, Figure 9). Radiographs taken after a long-term ACL tear may show arthritis because of changes in tibiofemoral kinematics.

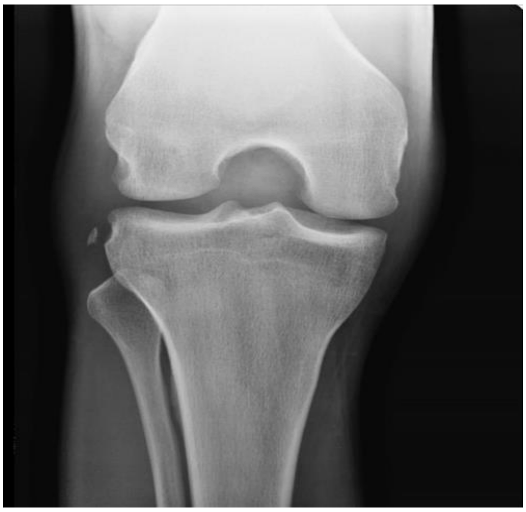

Figure 8 Segond Fracture Figure 9 Lateral femoral notch sign [49]

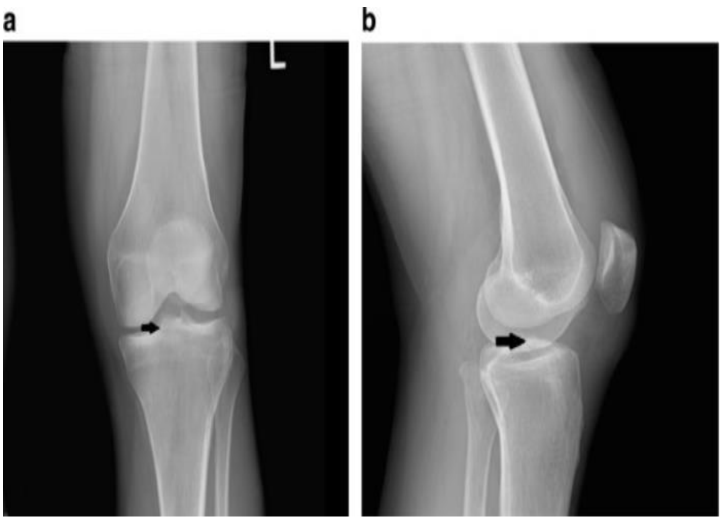

Figure 12 Avulsion fracture of ACL [50]

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2. Magnetic resonance imaging (MRI) (Figure 13)

Provides an ACL injury diagnosis with an accuracy of nearly 95%. Sagittal and coronal images reveal a low-signal structure with a smooth contour and linear fiber orientation when an intact ACL is subjected to normal tension. There are direct and indirect signs that can be detected by magnetic resonance imaging (MRI) of a full ACL tear. There are a number of obvious symptoms, such as a loss of linear fiber orientation, an irregular contour, or a total discontinuity of the ACL fibers, which are more prominent on water-sensitive sequences. The sensitivity of secondary signs is often low, but their specificity is high. Primary collateral ligament "buckling," anterior tibial translation exposing the posterior horn of the lateral meniscus, presence of translational bone contusions in the lateral compartment, and the complete lateral collateral ligament visible on a single coronal picture are the most helpful secondary indicators.

Figure 13 MRI of the knee. **A:** normal ACL. **B:** Torn ACL

Activity level classification:

Preinjury activity level was measured for each patient according to the classification system in table 1 [(52), (53)]

Table 1 activity level classification

Activity level classification		
Level	Sport Activity	Occupational Activity
I	Jumping, cutting, pivoting (basketball, soccer, football)	Activity comparable to level I sports
II	Lateral movements: less jumping, pivoting than level I (baseball, racket sports)	Heavy manual labor, working on uneven surface
III	Straight-ahead activities: no jumping or pivoting	Light manual work
IV	Sedentary	Activities of daily living

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Patients and Methods

was based on whether they had a complete ACL tear, as determined by clinical evaluation and radiographic techniques prior to surgery. 2-ACL damage that is localized. 3. ACLR (Primary)..Acute or prior hamstring injuries, pathology, anatomical variance, or technical mistake (such as premature graft amputation) were all grounds for exclusion, as were partial ACL injuries or prior ACL reconstructions, two or more ligamentous injuries, and three or more injuries involving multiple ligaments.Included in the analysis were 30 patients, all of whom were male and whose ages ranged from 20 to 44 (mean: 31). The identical surgeon used the same single bundle ACL repair procedure on each patient. Before the surgery, the patient's anthropometric data was taken, including their height, weight, and the circumference of their thighs measured 15 cm from the top of the patella and with the knee extended (fig. 12).

Figure 14. Thigh circumference measurement

MRI measurement: In every instance, an MRI of the afflicted knee was sought before surgery. The research was carried out utilizing a Philips 1.5–3.0 T superconducting magnet (figure 15) and a knee specific circular coil (figure 16). To maintain consistency, an ankle positioning device was utilized. The 256 × 256 matrix size was utilized with a 16-cm field of view. All investigations used slices that were 3 mm thick and did not have any space between them. Following this order, we were able to rebuild each patient's standard measurement: rapid spin echo axial with fat saturation and T2-weighting.

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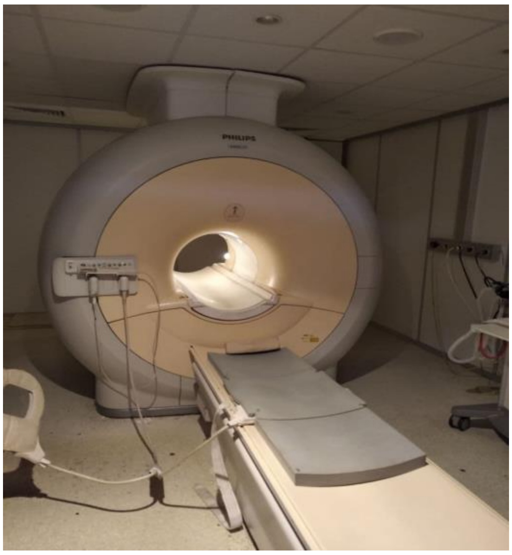

Figure 15. MRI device

Figure 16. MRI knee coil

For each patient, the axial image was used to measure the cross sectional area (CSA) of the gracilis tendon and the semitendinosus tendon at the level of the broadest region of the distal femur. The CSAs of the hamstring tendons were then quantified using this specific slice. Level was chosen because to the tendon's more tubular shape and its very vertical orientation relative to the slice. At this level, all measurements were collected with X 4 augmentation; intertendinous pixels are those with a low signal intensity, while extratendinous structures are those with a high signal intensity. Figure 17 shows the results of the CSA calculation using the RadiAnt DICOM viewer software. This program has a region of interest function that allows the user to manually trace an area, and then the software automatically calculates the CSA (in cm 2). If you need an exact area measurement in any volume or plane, go no farther than the FDA-approved region of interest tool.

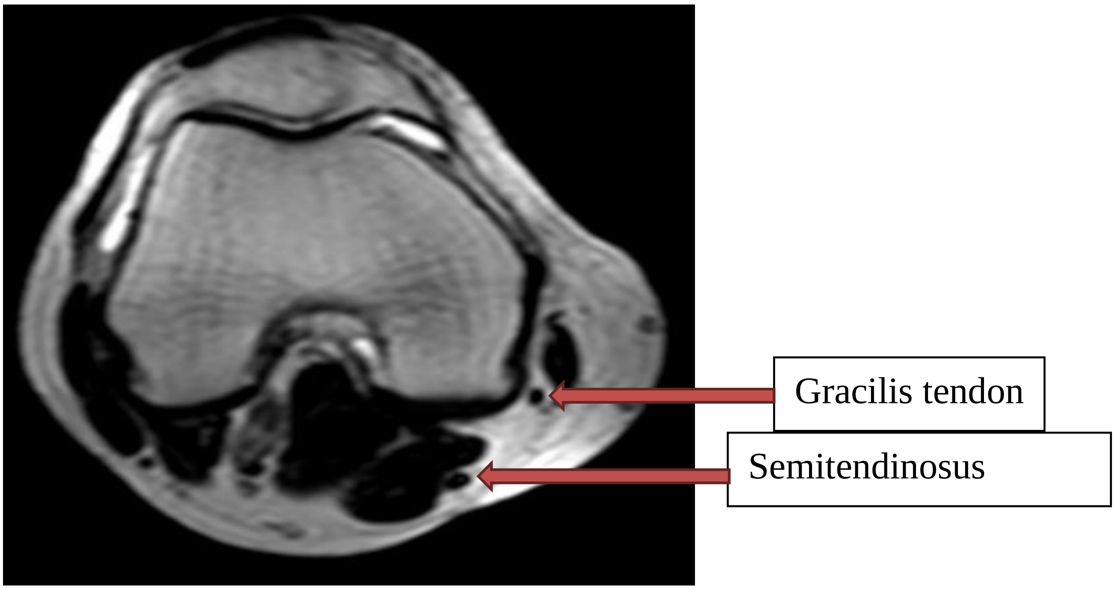

Figure 17. Hamstring tendons on axial T1 weighted image

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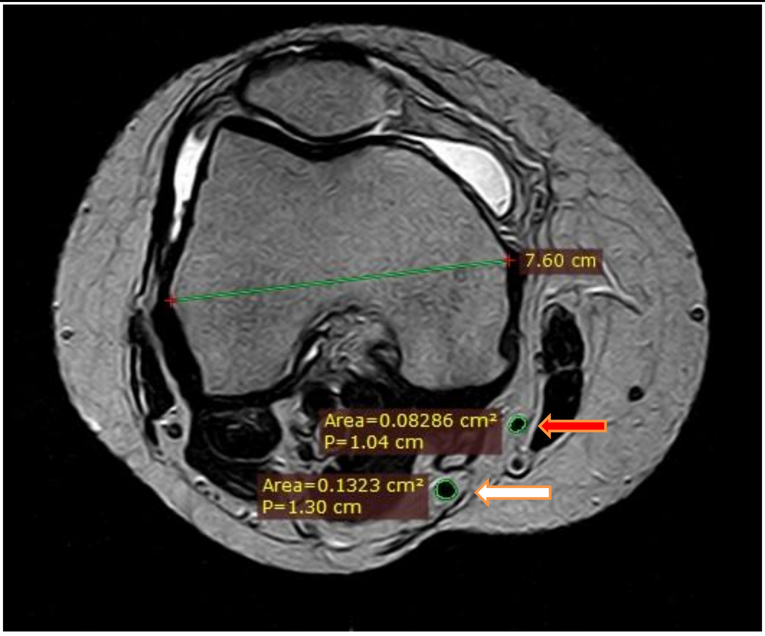

Figure 18. Measurement of semitendinosus (white arrow) and gracilis (red arrow) CSAs in MRI

Hamstring Tendon Harvesting The figure shows the anteromedial side of the proximal leg, where a skin incision of three to five centimeters was made for graft harvesting. The top parts of the pes anserinus bursa and the Sartorius fascia were then opened transversally. We harvested the GT and ST in a sequential fashion. After a 90º curved dissector was used to firmly pull the tendons, they were sutured with no. 2 absorbable suture (figure 18). After that, the insertions were freed and the tendons were removed using a closed-end tendon stripper.

Figure 19. Suturing the ends of both tendons before stripping

Grafts were harvested successfully in all knees except one who had premature graft amputation which was excluded from the study.Blunt removal of all soft tissue around the tendons, the GT

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and ST was doubled over around a suture (figure 19) and passed through a closed-hole sizing block.

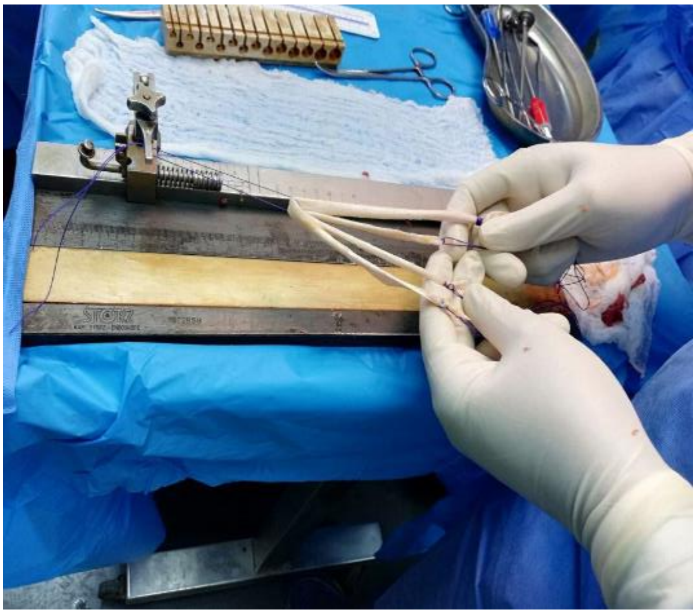

Figure 20. 4-strands hamstring autograft preparation.

The sizing block measured 0.5-mm-diameter increments (figure 18) from 7 to 12.5 mm. Measurements were obtained before any further postharvest alteration such as graft pretensioning or trimming of the graft. The smallest sizing hole through which the proximal end of the 4ST-GT graft could be pulled with maximal manual force was the final diameter considered for the study's purpose. The aim of our work is to get a graft of more than 8 mm in size else we use another graft preparing method to get larger graft.

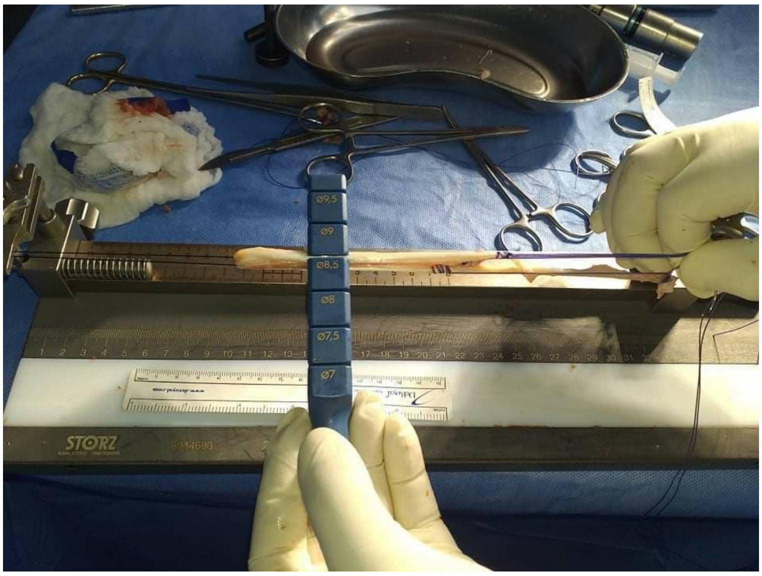

Figure 21. Measuring of the graft size

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Statistical analysis

Version 25 of the Statistical Package for the Social Sciences (SPSS) was used to analyze the data. The data is displayed using standard deviation, ranges, and mean. Statistics shown as percentages and frequencies for categories. The continuous variables were compared according to graft thickness using an independent t-test (two tailed). The correlation between continuous variables was evaluated using Pearson's correlation test (r). In order to estimate the thickness of the graft, the preoperative semitendinosus and gracilis were measured using receiver operating characteristic (ROC) curve analysis. We regarded a P-value less than 0.05 to be statistically significant.

RESULTS

There are a total of 30 men that are participating in the study. The athletes were all identified with anterior cruciate ligament (ACL) injuries and underwent ACL restoration using hamstring auto-grafts.

1. Age and BMI level

Figures (3.1 and 3.2) display the distribution of study patients by age and BMI level. The participants' ages varied from twenty-two to forty-four, with an average of thirty-seven years and a standard deviation (SD) of around seven and a half years. Patients aged 30 years and older were the largest age group (53.3%) in the research. Half of the patients were overweight according to their body mass index.

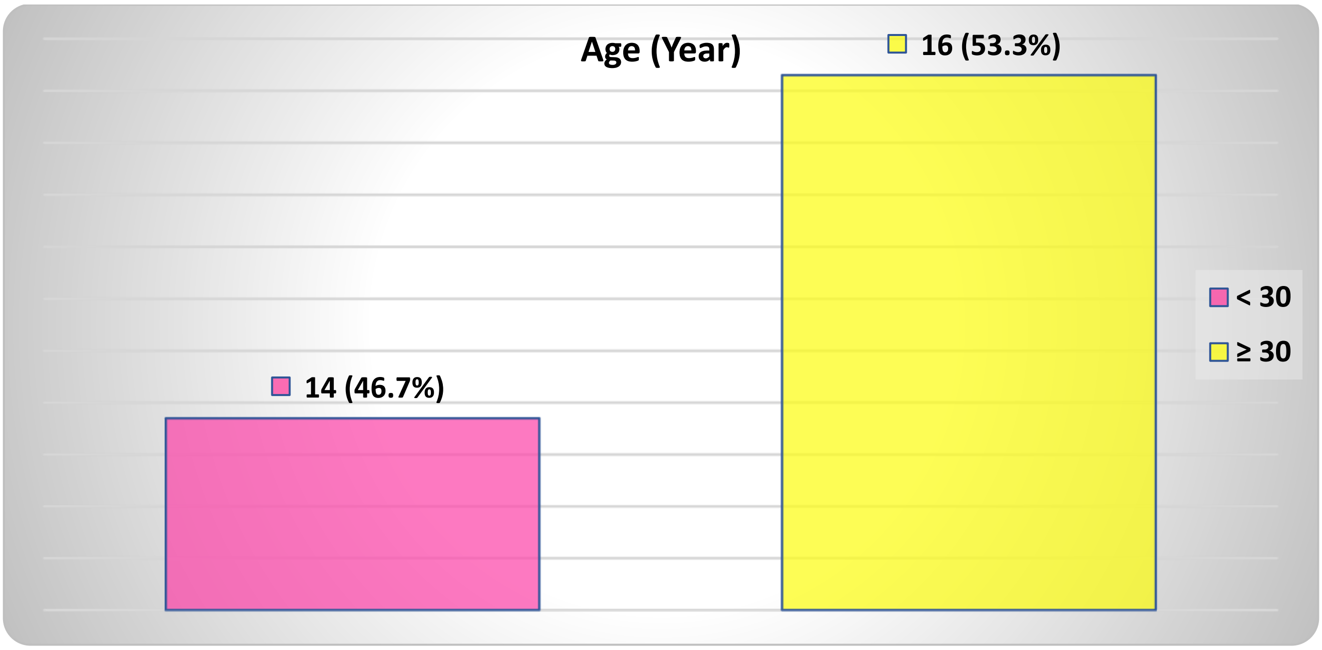

Figure 22: Distribution of study patients by age

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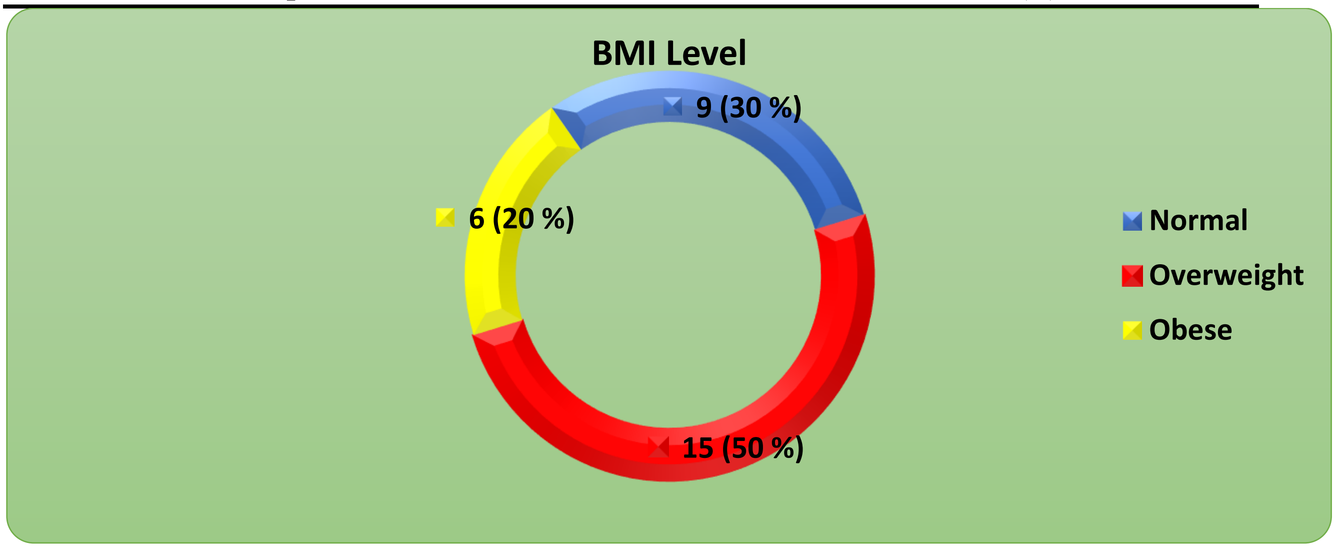

Figure 23: Distribution of study patients by BMI level

2. Clinical information

You may see the average values of several clinical data in Table 3.1. On average, the subjects were measured for the following: height (1.69 ± 0.06 m), weight (78.93 ± 12.2 kg), body mass index (BMI) (27.44 ± 4.1 kg/m2), length of time since the tear (3.43 ± 3.95 years), level of physical activity (2.36 ± 0.8), circumference of the thigh (54.3 ± 5.6 cm), and total cross-sectional area (CSA) (the sum of the preoperative semitendinosus CSA (12.28 ± 2.3 mm2) and preoperative gracilis CSA (7.67 ± 1.5 mm2). Table (3.3) shows a comparison of specific clinical data and measures by graft thickness. Patients with graft thickness greater than or equal to 8 mm had significantly higher means of height and preoperative measurements of semitendinosus, gracilis, and combined ST + GT compared to those with graft thickness less than or equal to 8 mm (1.72 versus 1.67 m, P= 0.011; 13.06 versus 11.26 mm2, P= 0.045; 8.37 versus 7.12 mm2, P= 0.017; 21.44 versus 18.39 mm2, P= 0.022 respectively). The CSA of the semitendinosus and gracilis muscles together make up the total CSA. There were no notable variations in any other measures between patients whose graft thickness was greater than 8 mm and those whose graft thickness was less than or equal to 8 mm.

Table 2: Average measurements of certain clinical information

Variable	Mean ± SD	Range
Height (m)	1.69 ± 0.06	1.6 – 1.85
Weight (kg)	78.93 ± 12.2	55.0 – 110.0
BMI (kg/m^2)	27.44 ± 4.1	21.3 – 38.06
Duration of tear (Year)	3.43 ± 3.95	1 month – 16 years
Activity level	2.36 ± 0.8	1 – 4
Thigh Girth (cm)	54.3 ± 5.6	45.0 – 71.0
Semitendinosus CSA at WDF (mm^2)	12.28 ± 2.3	7.5 – 20.4
Gracilis CSA at WDF (mm^2)	7.67 ± 1.5	4.7 – 11.2

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3. Graft Thickness (4 Strands)

The distribution of study patients by graft thickness is shown in table (3.2) and figure (3.3). We noticed that the four strands graft thickness was measured 8 mm in 40% of study patients and 56.7% of them were measured ≤ 8 mm.

Table 3: Distribution of study patients by graft thickness

Graft Thickness (4 Strands) (mm)	No. (n= 30)	Percentage (%)
6.5	1	3.3
7.0	1	3.3
7.5	3	10.0
8.0	12	40.0
8.5	9	30.0
9.0	4	13.3

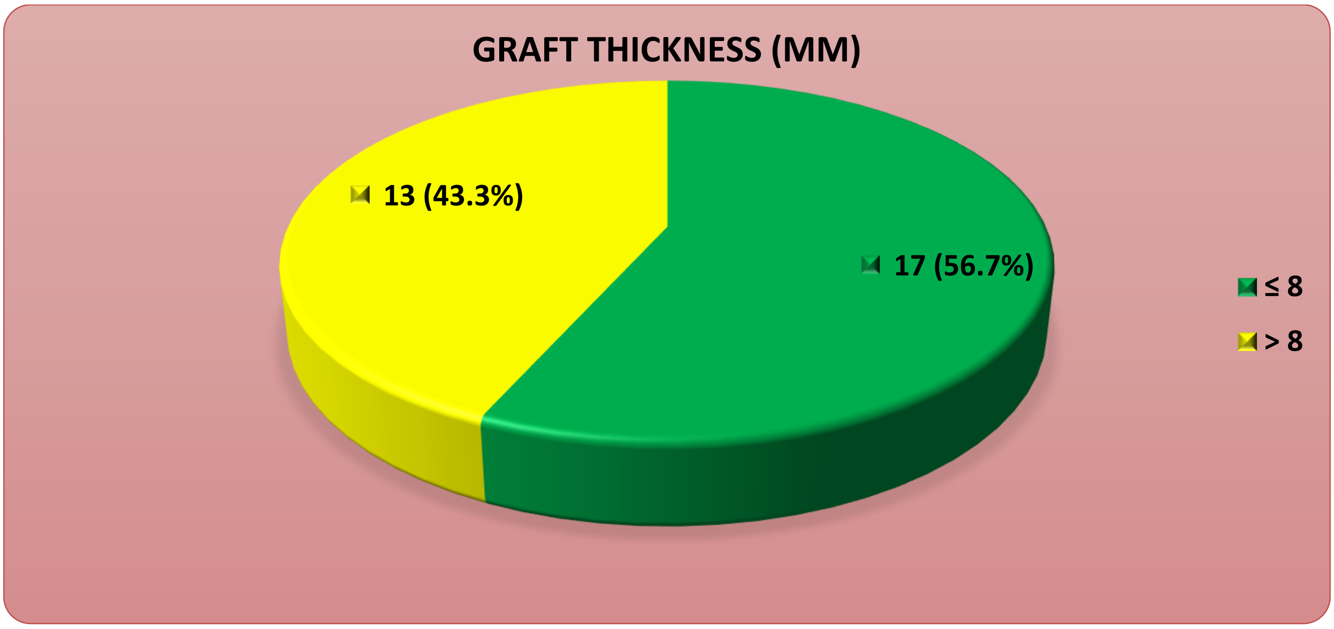

Figure 24: Distribution of study patients by graft thickness

The comparison in certain clinical information and measurements by graft thickness is shown in table (3.3). We noticed that means of height, and preoperative measurement of semitendinosus, gracilis and combined ST + GT were significantly higher in patients with graft thickness > 8 mm than that in those with graft thickness ≤ 8 mm (1.72 versus 1.67 m, P= 0.011; 13.06 versus 11.26 mm^2, P= 0.045; and 8.37 versus 7.12 mm^2, P= 0.017; 21.44 versus 18.39 mm^2, P= 0.022 respectively). Total CSA is the sum of both semitendinosus and gracilis CSA. No significant differences in all other measurements between patients with graft thickness > 8 mm and those with graft thickness ≤ 8 mm.

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Table 4: Comparison in certain clinical information and measurements by graft thickness

Variable	Graft Thickness (4 Strands) in mm		P - Value
	≤ 8 Mean ± SD	**> 8 Mean ± SD**	
Age (Year)	31.52 ± 7.9	28.15 ± 6.5	**0.21**
Height (m)	1.67 ± 0.04	1.72 ± 0.06	**0.011**
Weight (kg)	77.76 ± 10.8	80.46 ± 14.1	**0.573**
BMI (kg/m^2)	27.88 ± 4.0	26.87 ± 4.3	**0.518**
Duration of tear (Year)	3.26 ± 3.6	3.66 ± 4.5	**0.798**
Activity level	2.47 ± 0.7	2.23 ± 0.9	**0.448**
Thigh Girth (cm)	53.5 ± 4.9	55.34 ± 6.4	**0.398**
Semitendinosus at WDF (mm^2)	11.26 ± 1.9	13.06 ± 2.7	**0.045**
Gracilis at WDF (mm^2)	7.12 ± 1.5	8.37 ± 1.22	**0.017**
Combined ST + GT (mm^2)	18.39 ± 3.0	21.44 ± 3.7	**0.022**

To estimate the thickness of the graft, preoperative measures of the semitendinosus and gracilis were used in the receiver operating characteristic (ROC) curve analysis. A large significant area under the curve (AUC= 69.7% for preoperative semitendinosus measurements and 84.2% for preoperative gracilis measurements) indicates a significant association between higher levels of preoperative measurements and the prediction of graft thickness > 8 mm. This is supported by the data presented in figures (3.4 and 3.5) and table (3.4), which show that the cut point for preoperative semitendinosus measurement was 11 mm2 and the cut point for preoperative gracilis measurement was 7.6 mm2. The prediction accuracy for graft thickness > 8 mm using preoperative semitendinosus measurement was 70%, with a sensitivity of 84.6% and specificity of 58.8%. As a predictor for graft thickness > 8 mm, preoperative gracilis assessment had a sensitivity of 92.3%, specificity of 76.5%, and accuracy of 83.3%.

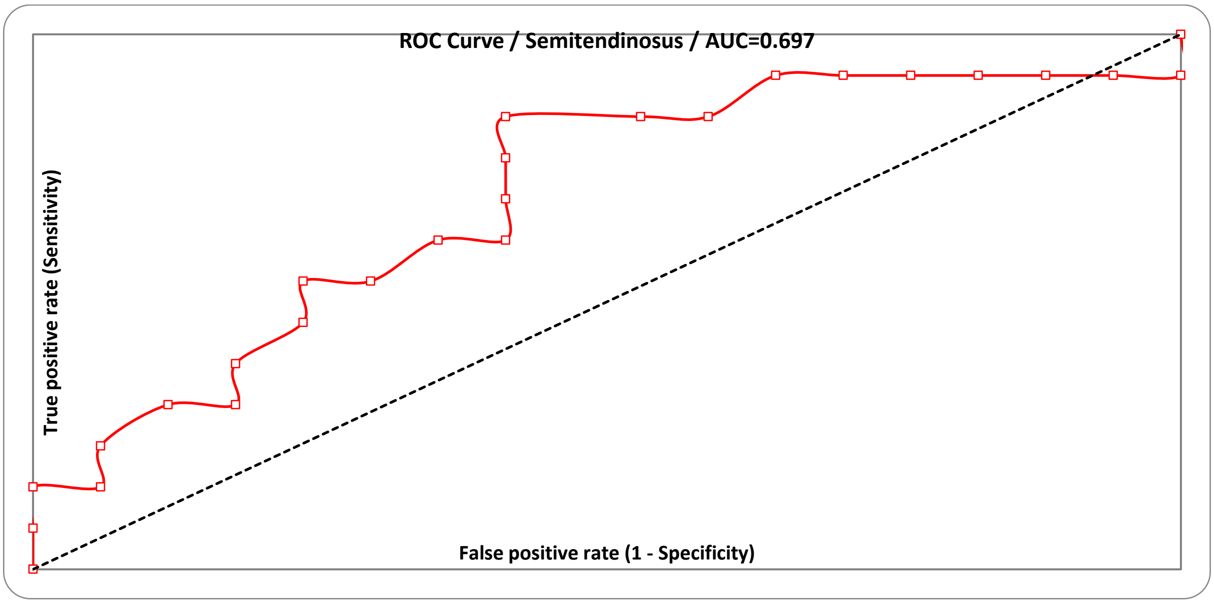

Figure 25: ROC curve for preoperative semitendinosus measurement as a predictor for graft thickness

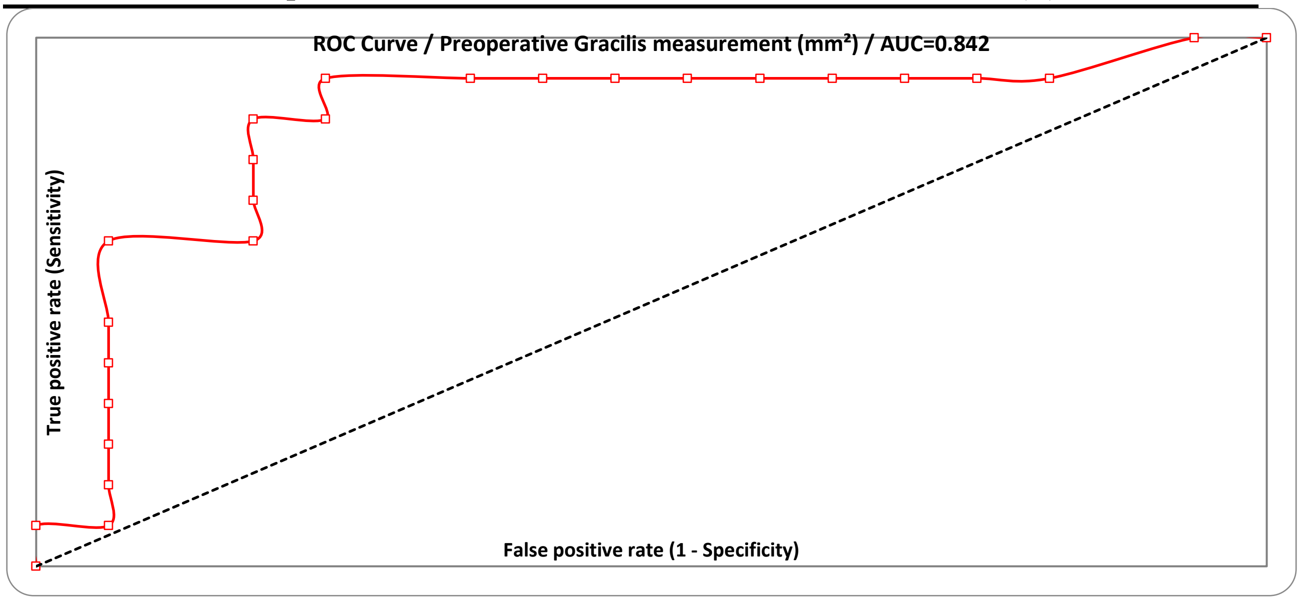

Figure 26: ROC curve for preoperative gracilis measurement as a predictor for graft thickness

Table 5: Diagnostic accuracy for graft thickness

Preoperative measurement (mm^2)	Cut-off value	Sensitivity	Specificity	PPV	NPV	Accuracy
Semitendinosus	11.0	84.6%	58.8%	61.1%	83.3%	70%
Gracilis	7.6	92.3%	76.5%	75%	92.9%	83.3%

Statistically significant moderate positive correlation was detected between graft thickness and height (r= 0.485, P= 0.007), preoperative semitendinosus measurement (r= 0.451, P= 0.012), preoperative gracilis measurement (r= 0.573, P= 0.001), and preoperative combined ST + GT (r= 0.555, P= 0.001).

Statistical significant weak negative correlation was detected between graft thickness and age (r= - 0.38, P= 0.038). No statistical significant correlations (P ≥ 0.05) between graft thickness and all other variables as shown in table (3.5) and figures (3.5, 3.6, 3.7, 3.8 and 3.9).

Table 6: Correlation between graft thickness and certain variables

Variable	Graft Thickness (mm)	
	r	**P - Value**
Age (Year)	**- 0.38**	**0.038**
Height (m)	**0.485**	**0.007**
Weight (kg)	**0.065**	**0.731**
BMI (kg/m^2)	**- 0.171**	**0.367**
Duration of tear (Year)	**- 0.194**	**0.303**
Activity level	**- 0.122**	**0.519**
Thigh Girth (cm)	**0.122**	**0.519**
Semitendinosus at WDF (mm^2)	**0.451**	**0.012**
Gracilis at WDF (mm^2)	**0.573**	**0.001**
Combined ST + GT (mm^2)	**0.555**	**0.001**

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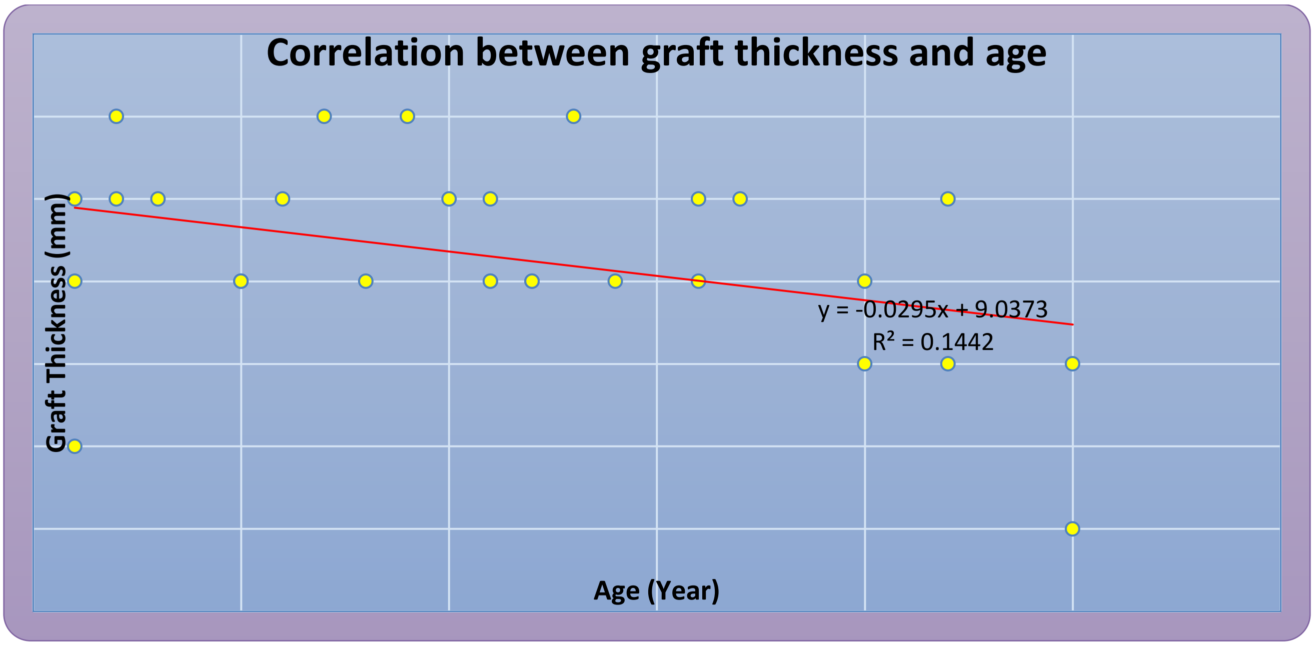

Figure 27: Correlation between graft thickness and age

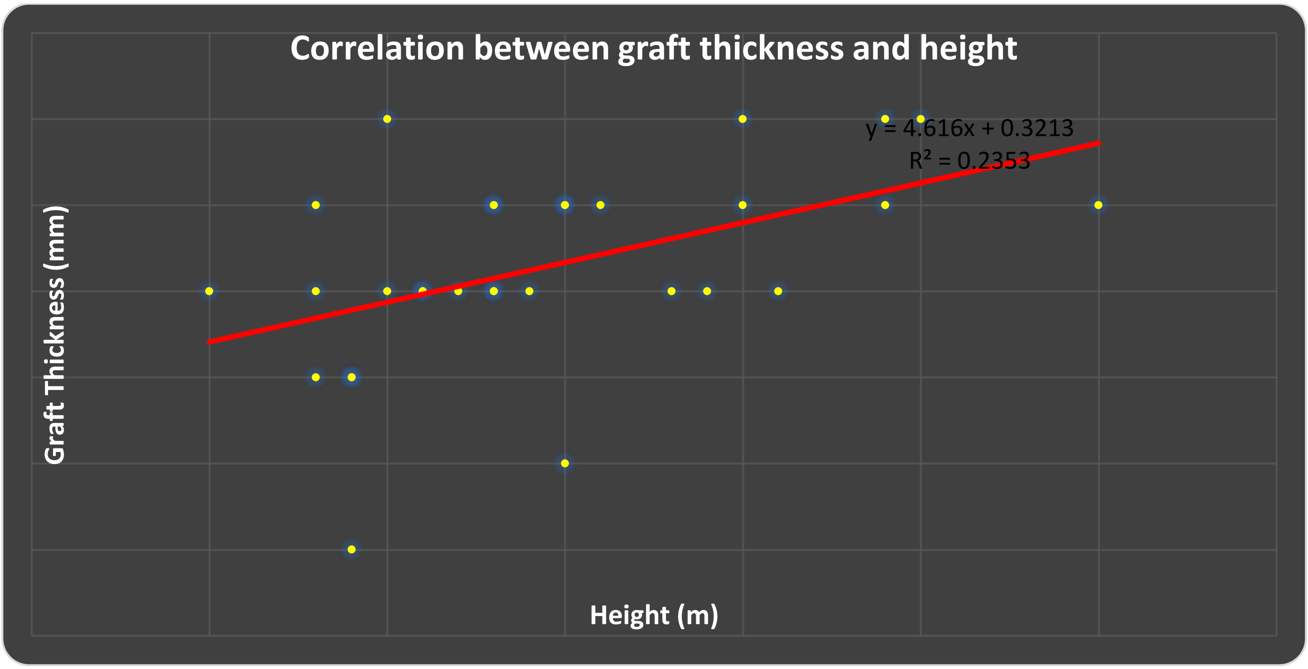

Figure 28: Correlation between graft thickness and height

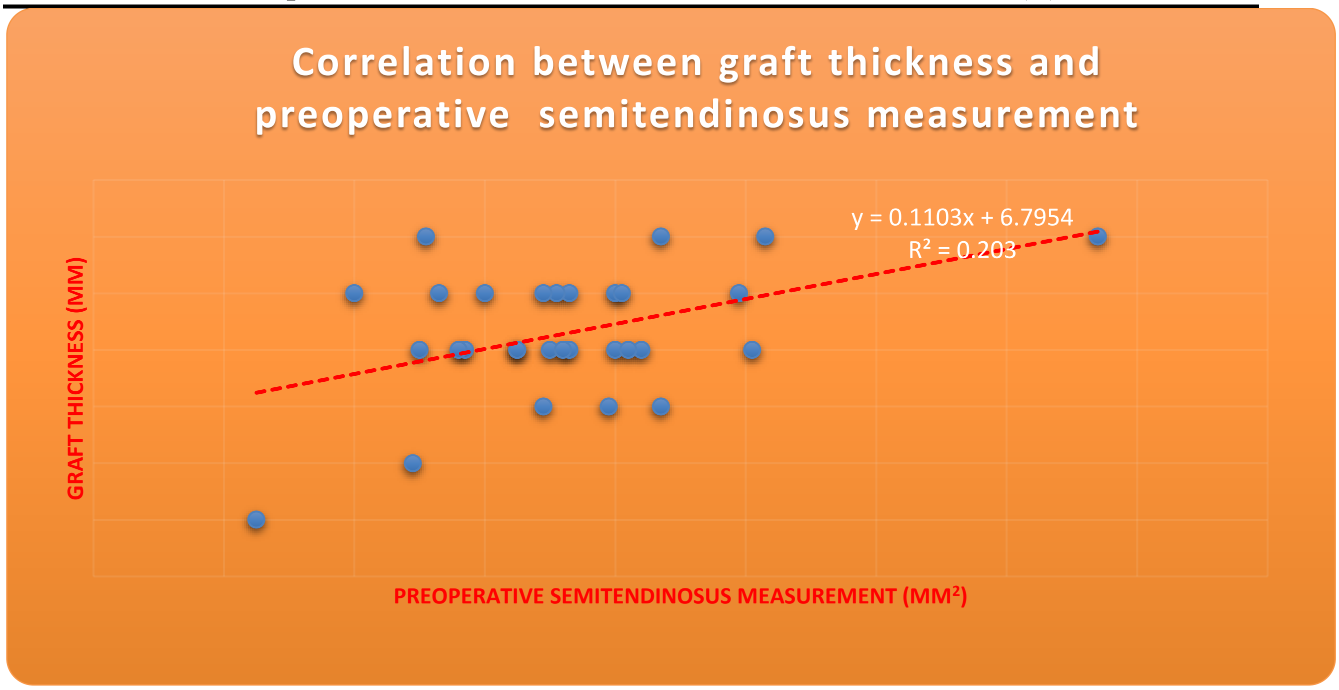

Figure 29: Correlation between graft thickness and preoperative semitendinosus measurement

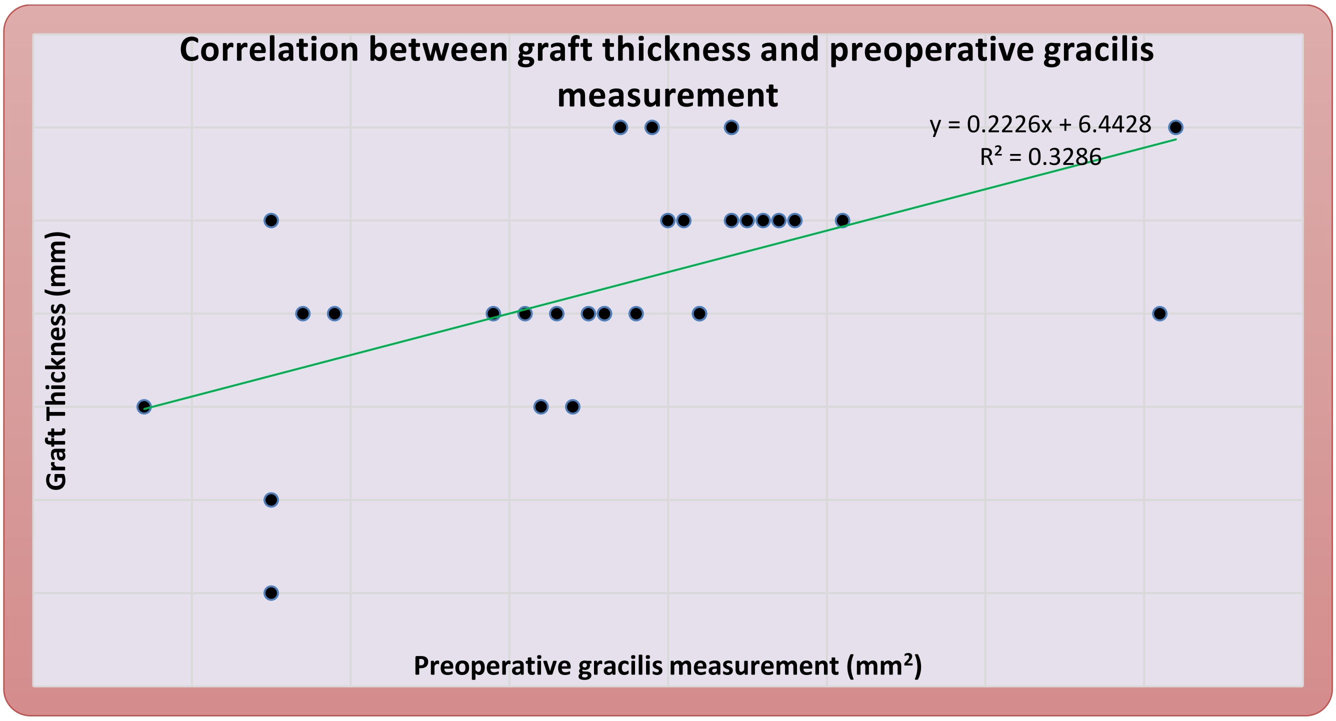

Figure 30: Correlation between graft thickness and preoperative gracilis measurement

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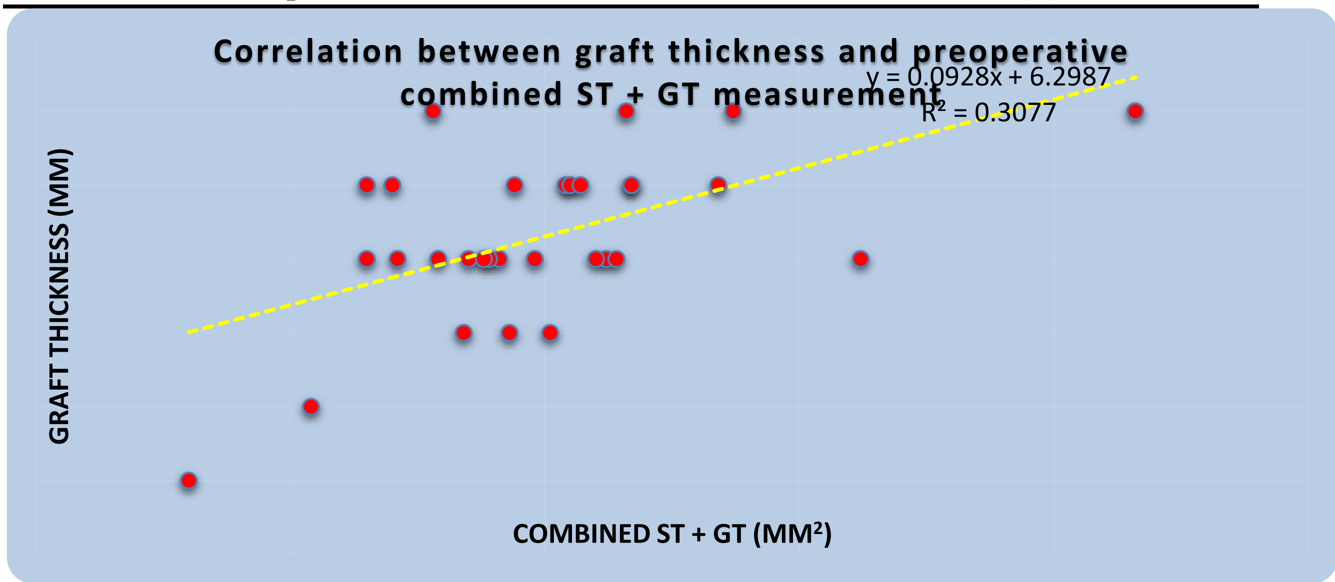

Figure 31: Correlation between graft thickness and preoperative combined ST + GT measurement

Discussion

The diagnosis and management of anterior cruciate ligament (ACL) injuries often include the use of magnetic resonance imaging (MRI). With the continuous improvement of MRI technology, higher resolution images are now possible, making MRI an ideal imaging modality for qualitative characterization of soft tissue anatomy. This ability can be utilized to measure the preoperative cross-sectional area of the hamstring tendon. For improved knee stability, it is essential to harvest a graft of the right size, as graft diameter is currently one of the most critical factors in deciding the success of ACL reconstruction.two (2) .While the clinical examination, the patient's activity objectives, and the doctor's personal taste are the usual factors in determining the best graft, it might be helpful to have an idea of the expected graft size before surgery. In this study, we want to determine the relevance of the semitendinosus and gracilis cross-sectional areas evaluated on preoperative MRI for graft size prediction. Additionally, we will explore the association between graft size and patient characteristics such as age, height, weight, BMI, thigh circumference, and activity level. We used a diameter of 8.5 mm as our cutoff for the various predictors in this study because new evidence is showing that soft tissue grafts should be at least 8 mm in diameter, and that as the diameter increases, the biomechanical properties, resistance, and stiffness of the graft tendon improve significantly, leading to a decreased revision rate.

Our research shows that the semitendinosus (p=0.045), gracilis (p=0.017), and total CSA (p=0.022) all show statistically significant correlations with graft diameter. Consequently, the proper intraoperative diameters of quadruple hamstring graft diameter may be predicted by evaluating the CSA of the semitendinosus and gracilis tendons using MRI. These findings are consistent with those of Tahsin Beyzadeoglu et al., who investigated the relationship between graft size and magnetic resonance imaging (MRI). two (2) Intraoperative graft sizes were shown to be highly correlated with cross-sectional areas of semitendinosus tendons as determined by magnetic resonance imaging (MRI), according to Bickel et al. (7). Tahsin Beyzadeoglu et al. found that MRI can be used as a useful clinical tool to predict hamstring graft sizes preoperatively without adding extra costs, which changes the original conclusion of Hamada et al. that MRI was impractical for

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evaluating tendon sizes due to extra cost and examination time (54). two (2) Reducing the total CSA of the semitendinosus and gracilis tendon on MRI is linked to a reduced graft size in ACL restoration, according to Willem M.P. Heijboer. Preoperative magnetic resonance imaging (MRI) can reliably estimate the anticipated ACL autograft size and detect those that fall short of the target diameter cutoff, according to research by Andrew Hanna et al. eight (8) For a graft larger than 8 mm, the study requires a total CSA greater than or equal to 18.6 mm2. For the semitendinosus tendon, a CSA greater than 11 mm2 is required (Sensitivity 84.6%, Specificity 58.8%, PPV 61.1%, NPV 83.3%, Accuracy 70%). For the gracilis tendon, a CSA greater than 7.6 mm2 is required (Sensitivity 92.3%, Specificity 76.5, PPV 75%, NPV 92.9%, Accuracy 83.3%). In order to forecast precise graft sizes, the cutoff CSA values were established by Brian M. Grawe et al. . The expected graft diameters of 8 and 9 mm, respectively, were determined using CSA values of 21.64 and 22.25.Dissimilar measurement techniques explain why Tahsin Beyzadeoglu et al. (2) arrived at a total CSA of 18.4 mm2 for a 7 mm graft, which differs from our findings. According to Juan Ignacio Erquicia et al. , a total CSA larger than 17 mm2 was associated with a true graft diameter of 8 mm or smaller in 15 out of 21 patients, yielding a sensitivity of 76.9%. However, it is possible that these variations are due to differences in the MRI measurement levels used in our study, which could be the physis, physeal scar, or joint line level. There was an 88% chance of getting a large enough graft (≥7 mm) during surgery if the total cross-sectional area was more than 18 mm2, according to research by Brent A. Bickel and colleagues. (7) Our study demonstrated a statistically significant correlation between height and graft diameter (P = 0.007), meaning that a patient's graft size is directly proportional to their height.

Additionally, we found a weak negative connection (r= -0.38, P= 0.038) between graft diameter and age.

Weight, body mass index (BMI), and thigh circumference were not correlated with graft thickness in a statistically significant way (P > 0.05). Statistical analysis has shown no statistically significant relationship between activity level and graft size intraoperatively; this might be attributable to the limited sample size. Similarly, the length of injury has an inverse effect on graft diameter. While other anthropometric measures such as body weight, BMI, and thigh circumference do not have any predictive value for graft diameter, Dr. Dinesh Manni et al. finds that height is the most dependable single predictor criterion for graft diameter. He came to the same conclusion as us: graft diameter was unrelated to activity level.

In a research conducted by Willem M.P. Heijboer et al. it was shown that HT autograft diameter was substantially linked with weight, height, gender, and thigh circumference, although these variables were examined at a different level than ours. Rafael Noschang Pereira et al. discovered that only height is connected with graft size, however, age, weight and body mass index had not exhibited any association with the overall diameter of the quadruple hamstring graft. Height and age were shown to be connected with Hamstring quadruple graft diameter, according to Jeffrey M. Tuman et al. , although body mass index was not.

To counter this, researchers Brian M. Grawe et al. (56) found that patients' weight and height were good predictors of larger grafts. While our study did have certain drawbacks, such as a small sample size, it may have benefited from the participation of more than one reading radiologist to ensure the region of interest tool's interobserver validity.

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Conclusion:

1. Summary: We can say with confidence that: 1-Preoperative MRI is a great tool for predicting the size of the hamstring tendon autograft in ACL repair. If the axial MRI of the tendons shows a cross-sectional area greater than 18.6 mm2 at the level of the largest width of the distal femur, then the graft, when made of four strands, will be more than 8 mm in diameter.

2-When predicting whether patients may have grafts that are too small, a constellation of anthropometric parameters might be helpful. Factors increasing the likelihood of an inadequate transplant include being underweight, having a lengthy time between injury and operation, and being small in stature.

Recommendations:

1-MRI requests for patients suspected of having an ACL damage should include a measurement of the hamstring tendons' cross-sectional area, so that the operating surgeon can use this information.

2- Performing the same or a comparable study at a different facility with a bigger sample size and a different surgeon or radiologist to ensure the measures can be reliably repeated.

3. A research examining the use of magnetic resonance imaging (MRI) for graft size prediction in alternative hamstring tendon preparation methods (5 strands, 6 strands, or all within) might be beneficial.

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