

Prediction of length and diameter of semitendinosus graft for anterior cruciate ligament reconstruction using anthropometric parameters, age, gender and physical activities

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Abstract

Background: The knee joint is one of the most commonly injured joint and the most commonly injured ligament in knee is the anterior cruciate ligament Multiple graft option exist for reconstruction of ACL of which semitendinosus graft is one of the favoured graft . Study aimed to correlate the anthropometric parameters, age, gender, physical activities with intraoperative length and diameter of semitendinosus graft to facilitate ligament reconstruction .

Methodology: It is a prospective study done at Mahatma Gandhi Medical College and Research Institute, Pondicherry between January 2020 and September 2021 where all patients with anterior cruciate ligament injury coming to the OPD and Emergency medical services department satisfying inclusion and exclusion criteria were selected and included in the study

Results: The present study included total of 35 patients after obtaining the informed consent. The mean age of patients in the study was found to be 33.18 ± 6.99 yrs of age. Among the included patients, majority were male patients (85.7%) compared to female patients (14.3%) with male to female ratio of 6:1. Side of involvement was majority with right side (71.4%) followed with left side of involvement (28.6%). There was a significant positive strength of association between the height and graft length ($r=0.602$, $p<0.01$). There was a significant positive strength of association between the thigh length and graft length ($r=0.556$, $p<0.01$). There was a significant positive strength of association between the thigh circumference and graft diameter ($r=0.346$, $p<0.05$). Similarly the physical activity was significantly positive strength of association with the graft diameter ($r=0.452$, $p<0.05$).

Conclusion: In present study height of the patients, thigh length, thigh circumference and the physical activity were strongly positively correlated with the requirement of graft diameter and the length of graft required.

Article

Introduction

The knee joint is one of the most commonly injured joint and the most commonly injured ligament in knee is anterior cruciate ligament (ACL)⁽¹⁾. Owing to the growing number of road accidents and increased involvement in athletic activities, injuries to ACL ligament is increasing. Acute ACL damage causes repeated episodes of instability, pain and diminished

motion and associated with early onset of osteoarthritis. Arthroscopic reconstruction of the ACL tear has become the treatment of choice⁽²⁾.

Multiple options for graft choice exist for reconstruction of ACL including bone-patellar tendon bone (BPTB) autograft, quadriceps tendon autograft, hamstring tendon autograft and multiple allograft sources. The arthroscopic ACL reconstruction with hamstring autograft and fixation in the femoral tunnel with an endobutton and in the tibial tunnel with an bio interference screw is a well-proven literature technique.⁽³⁾

Pre-operative parameters such as age, gender, physical activities, height, weight, BMI, leg length, thigh circumference have been reported to be of predictive value in a variety of studies. Therefore estimation of the semitendinosus graft size could guide the surgeons in preoperative planning for the graft choice.⁽⁴⁾

AIM

To correlate the anthropometric parameters, age, gender, physical activities with intraoperative length and diameter of semitendinosus graft to facilitate ligament reconstruction

OBJECTIVES

1. To find a co-relation between the semitendinosus graft length, thickness and anthropometric parameters such as height, weight , body mass index, thigh length, circumference of thigh
2. To find a co-relation between the semitendinosus graft length, thickness and age
3. To find a co-relation between the semitendinosus graft length, thickness with gender and physical activities

4. MATERIAL & METHOD

A prospective study done at Mahatma Gandhi Medical College and Research Institute, Pondicherry between January 2020 and September 2021 . 35 patients with Anterior cruciate ligament injury who satisfied predefined inclusion and exclusion criteria were selected and included in study

Inclusion criteria:

- Patients of age above 18 years (with closed growth plates).
- Patients with isolated cruciate injury.

Exclusion criteria:

- Patient with history of previous ipsilateral knee injury/surgery.
- Patients with history of any inflammatory joint disease (like synovitis, Rheumatoid arthritis, gouty arthritis, reactive arthritis, psoriatic arthritis, septic arthritis, etc.,)

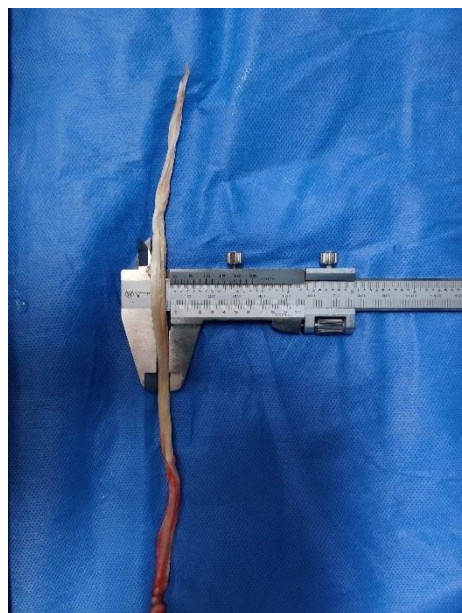
- Patients who are immuno compromised are excluded from the study.

The patient satisfying the inclusion criteria were assigned to a single group. An informed and written consent was obtained from the patient. ACL injury was assessed by arthroscopic examination. During procedure ACL is probed and its tension is examined under arthroscopic vision. Normal ACL feels stiff and tense when pulled with a probe, whereas a torn ACL feels soft without tension. Intra operatively, Anterior drawer test was performed under vision and anteroposterior stability was visualized.

Preoperatively Factors like age, gender, physical activities (Tegner score), height, weight, BMI, thigh length, thigh circumference were noted. Thigh length was measured from ASIS to Lateral joint line (LJL). Thigh circumferences was measured 15 cm proximal to the Medial Joint Line in all patients. Intraoperative measurements of semitendinosus tendon were made, including absolute length using scale and diameter using Vernier calliper. All measurements were obtained after blunt removal of attached muscle and fat but before any further postharvest alteration or trimming of the graft.

The technique for obtaining the graft during the ACL reconstruction surgery consisted of an oblique anteromedial incision in the proximal tibia, at the level of the insertion of the semitendinosus muscle. Following this, the tendon of the semitendinosus muscle was dissected and then de inserted against the bone and removed using a graft extractor. After the tendons had been prepared through removal of the muscle layer, the length (cm) and diameter (MM) of the semitendinosus graft was obtained using a ruler and Vernier calliper that had previously been sterilized. The measurements was made without suturing thread, which might have hindered obtaining the real dimensions of the tendon

Graft:

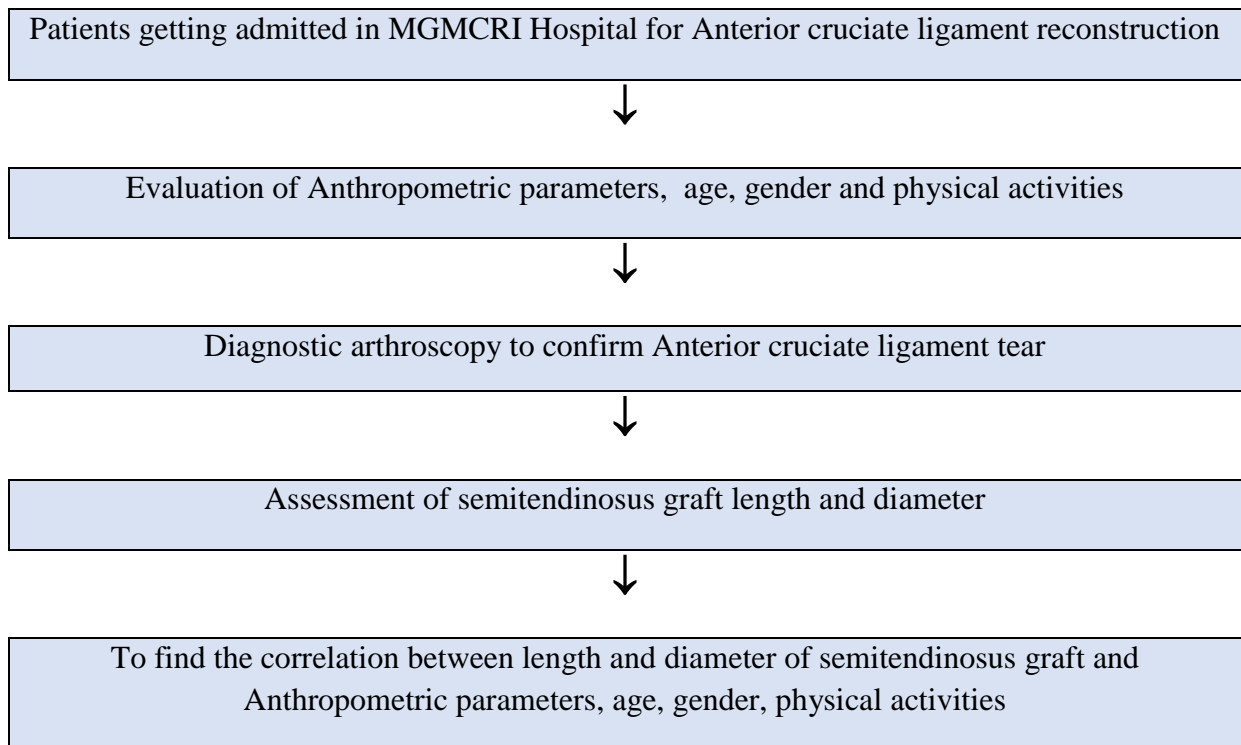


Graft diameter measured using Vernier caliper



Graft length measured using ruler

FLOW-CHART TO SUMMARIZE THE SEQUENCE OF EVENTS



STATISTICAL ANALYSIS

The correlation between the parameters were analysed using Pearson's correlation, and the linear logistic regression to assess the best fit model to predict. P-value of <0.05 was considered statistically significant.

RESULTS

The present study included total of 35 patients with ACL injury. The mean age of patients in the study was 33.18 ± 6.99 yrs, with male to female ratio of 6:1. Right side (71.4%) was majorly involved compared to left side (28.6%).

Height of patient varied from 142cm to 180cm, with average of 166cm. Weight of the patient varied from 53kg to 92 kg. Weight among the males patients was significantly higher compared to female patients.

On assessing physical activity among study participants, 6 participants(17.1%) were grade 3, 24 participants(68.6%) were grade 4, 5 participants(14.3%) were grade 5.

Table 1: Showing the mean level of physical parameters among the study participants

	Minimum	Maximum	Mean	SD
Height (cm)	142.0	180.0	166.41	9.57
Weight (kg)	53	92	70.11	9.41
BMI	16.5	38.3	25.14	4.48
Thigh length (cm)	36.0	60.0	49.32	4.60
Thigh circumference (cm)	32.0	53.0	44.19	5.03
Physical activity (Grade)	3	5	3.97	0.56
Graft diameter (mm)	3.58	5.62	4.73	0.52
Graft length (cm)	25.6	39.0	31.87	3.279

Table 2: Showing the Pearson's correlation of parameters with graft diameter and graft length

		Graft diameter	Graft length
Age	r	-.022	-.219
	Sig	.899	.206
Height	r	.248	0.602**
	Sig	.152	0.001
Weight	r	.191	.268

	Sig	.271	.120
BMI	r	-.050	-.194
	Sig	.776	.264
Thigh length	r	.191	.556**
	Sig	.273	.001
Thigh circumference	r	.346*	.312
	Sig	.042	.068
Physical activity	r	.452**	.230
	Sig	.006	.183

Age was found to have no correlation with graft length and graft diameter and is not a reliable parameter in predicting graft diameter and graft length.

On correlation of the weight, height, BMI with the graft diameter and graft length, no significant strength of association found between parameters. There was significant positive strength of association seen with height of the patient and graft length ($r=0.602$, $p<0.01$).

A significant positive strength of association seen with the thigh length of the patient and graft length ($r=0.556$, $p<0.01$).

There was a significant positive strength of association between the thigh circumference and graft diameter ($r=0.346$, $p<0.05$). Similarly the physical activity was significantly positive strength of association with the graft diameter ($r=0.452$, $p<0.05$).

Discussion.

Arthroscopic ACL reconstruction is performed to restore the functional stability in ACL deficient knees and restore the normal kinetics of the knee. Increasing number of ACL reconstruction surgeries have been performed and there is an increasing expectation of patients to speedy recovery and more rapid return to activities of daily living, work and study.

Long term outcomes and post-op morbidity following arthroscopic ACL reconstruction depends on graft selection, surgical technique, experience of the surgeon and rehabilitation protocol.

In our study we found that males were more commonly involved than the females. There were 85.7% males whereas the females involved were 14.3% with male to female ratio of 6:1. This may be due to male predominance in RTA and sports and more time spent in outdoor activities than females.

The Mean age involved in our study was 33.18 ± 6.99 yrs of age with more patients in age group between 20-30 years. Our study found that age had negative strength of association with graft diameter and graft length which were similar to study done by

Sakti et al⁽⁵⁾ . **However Jansen et al⁽⁶⁾** in their study found that that age had negative strength of association with graft length and positive strength of association with graft diameter.

Our study found that the graft diameter had no strength of association with height, weight, BMI, thigh length with P-value more than 0.05. Regression analysis indicated that height, weight, BMI, thigh length are not a statistically significant predictor of semitendinosus graft diameter. In a study done by **Sakti et al⁽⁵⁾**, found that weight, BMI, thigh length had no correlation with graft diameter with no significant p-value. Therefore height, weight, BMI, thigh length have no correlation with graft diameter and are not a reliable parameters in predicting graft diameter.

Our study found that the graft diameter had positive strength of association with thigh circumference and physical activity using tegner score with p value less the 0.05. Regression analysis indicated that thigh circumference and physical activity evaluated using tegner score are statistically significant predictor of semitendinosus graft diameter. In a study done by **TremeG et al⁽⁷⁾** a strong association between thigh circumference and graft diameter noted, but association of graft diameter with physical activity using tegner score was found to be insignificant. In a study done by **Asif et al⁽⁸⁾** found that there was a strong association between thigh circumference and graft diameter. Therefore thigh circumference, physical activity have significant correlation with graft diameter and are a reliable parameters in predicting graft diameter.

Our study found that the graft length had positive strength of association with height ($r=0.602$, $p=0001$) and thigh length ($r= 0.556$, $p=0.001$) of the patient. Regression analysis indicated that height and thigh length are statistically significant predictor of semitendinosus graft length .In a study by **Goyal et al⁽⁹⁾** found that patients height and thigh length correlated strongly with graftlength.In a study by **Pereire R et⁽⁴⁾** al showed positive relationship between height and total length of semitendinosus tendon . In a study by **Treme G et al⁽⁷⁾** showed height has significant positive correlation with length of the graft and leg length has significant positive correlation with length of the graft. Hence height and thigh length can be used in predicting the graft length.

Our study found that the graft length had no strength of association with weight ,BMI, thigh circumference, physical activity of the patient. Regression analysis indicated that weight, BMI, thigh circumference, physical activity are statistically significant predictor of semitendinosus graft length had no correlation with graft length with no significant p-value . In a study by **Goyal T et al⁽⁹⁾** and **Pereira et al⁽⁴⁾** weight, had no significant correlation with graft length. Therefore weight, BMI, thigh circumference, physical activity have no correlation with graft length and are not a reliable parameters in predicting graft length.

9. LIMITATION

This study is with some limitation, first being a single centric study, with small sample size. The study need to be conducted extensively at various locations with varied demographic details of the patients including the height, weight, BMI with larger population size to generalize the findings of this present study

Conclusion: In present study height of the patients, thigh length, thigh circumference and the physical activity were strongly positively correlated with the requirement of graft diameter and the length of graft required.

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