

# Correlation of patient's height, weight and BMI and sizing of autogenous hamstring graft with functional outcome in patients with arthroscopic ACL reconstruction

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## Abstract

**Background:** The Anterior cruciate ligament (ACL) is among most commonly affected ligaments, and surgical treatment is chosen for most patients who present pain and instability.

**Aims and objectives:** The aim of this study to assess the correlation of patient's height, weight and BMI with autologous harvested hamstring graft size.

**Material and method:** This study is Experimental study design. In this study a total of 50 patients, selected cases were operated for the primary ACL reconstruction utilizing hamstring tendon autograft at the Department of Orthopedics at Dr. Baba Saheb Ambedkar Medical College, Delhi, India from 15th August 2020 to 15th Jan 2022.

**Result:** The correlation and p-value of height and weight was with respect to harvested graft length (semitendinosus and gracilis) respectively. The other variables which include BMI do not correlate with harvested graft length (semitendinosus and gracilis).

**Conclusion:** We found that there was slight correlation between weight and height of male patient. We would suggest that: Height and weight could be successfully used as an anthropometric measurements for evaluating graft length.

**Keywords:** Anterior cruciate ligament (ACL), Harvested graft (gracilis and semitendinosus length) and Correlation.

## Introduction

The anterior cruciate ligament (ACL) is commonly injured and is the most frequently reconstructed ligament of the knee. Reconstructive techniques have evolved over time with variable results <sup>[1]</sup>. The anterior cruciate ligament (ACL) is among most commonly affected ligaments, and surgical treatment is chosen for most patients who present pain and instability <sup>[2]</sup>. The autologous grafts most frequently used in ACL reconstructions are the patellar, gracilis (G), semitendinosus (ST) and quadriceps tendons. Each technique has its adherents and indications, and selecting the graft depends on many factors, including the surgeon's preference and the patient's age and level of activity. The surgical technique using the tendons of the ST and G muscles as grafts presents results that are similar to those from the patellar tendon technique and enable smoother and less painful rehabilitation. The main disadvantages of this technique include the individual variability in length and thickness of the graft from

the tendons and the potential complications during graft harvesting [3, 4]. Worldwide estimate of the prevalence of ACL rupture has been estimated to be ranging from 37 to 70 per one lakh persons per year [5]. After the tendons have been removed from the semitendinosus and gracilis muscles, and before the graft has been constructed, surgeons are faced with many possibilities for the final configuration of the graft. The ACL runs through a special notch in the femur called the intercondylar notch and attaches to a special area of the tibia called the tibial spine. The effect of height, weight and body mass index (BMI) on long-term outcome for ACL reconstruction patients remained unclear [6]. Increased BMI has been associated with poorer functional outcomes following ACL reconstruction. Meanwhile, ACL reconstruction has also been suggested as an effective treatment irrespective of preoperative height, weight and BMI [7].

### Aims and objectives

The aim of this study to assess the correlation of patient's height, weight and BMI with autologous harvested hamstring graft size.

### Material and Method

This study is Experimental study design. In this study a total of 50 patients, selected cases were operated for the primary ACL reconstruction utilizing hamstring tendon autograft at the Department of Orthopedics at Dr. Baba Saheb Ambedkar Medical College, Delhi, India from 15th August 2020 to 15th Jan 2022, with the follow up 6 months in each patient.

### Inclusion criteria and Exclusion criteria

All cases who underwent primary arthroscopic ACL reconstruction using Hamstring tendon autograft. Some following case are excluded like immature skeleton, multi-ligament injury and any associated injury due to which post op-rehabilitation protocol needs to be changed.

### Study tools

Statistical analysis was performed using the latest version of SPSS Software Version 24.0. Continuous variables were analyzed using means, standard deviations and frequencies along with percentages for categorical variables. Correlation test for relation, Paired T-Test was applied to determine the statistical significance between groups, a p-value of less than 0.05 was considered to be statistically significant.

### Result

In this study a total of 50 patients were included who underwent arthroscopic assisted Single bundle primary ACL reconstructive surgery after taking proper written informed consent from the patient and ethical clearance from the institute.

**Table 1:** Demographic distribution of cases

Variables	Categories	Cases (%)
Age	<25	24(48%)
	>25	26(52%)
Sex	Male	40(80%)
	Female	10(20%)
Side injury	Left	10(20%)

	Right	40(80%)
Occupation	Office sedentary life style	6(12%)
	Businessman	9(18%)
	Labourer	10(20%)
	Housewives	6(12%)
	Professional sport men	5(10%)
	Student	14(28%)
	Mode of injury	Fall from height
	RTA	20(40%)
	Injury while playing	12(24%)

The above table illustrates the distribution of cases in different age groups in our study, out of which 40(80%) patients were males and 10(20%) patients were females. Out of 50 cases 24(48%) patients were less than 25years of age and 26(52%) belonged to the age group of more than 25years. The distribution of cases in different sides in 50 cases. Left knee was involved in 10(20%) cases whereas right knee was involved in 40(80%) cases. Our results revealed that majority of the patients were non-sports persons, accounting for 45 and only 5 of the patients belong to Professional sports category. Maximum number of patients sustained injury by falling from vehicle 20 (40%), while many of them injured their knee secondary to fall from height 15 (36%), while others got injured while playing sports 12 (24%).

**Table 2:** Distribution of cases as per height, weight and BMI of patients

Variables	Categories	Cases (%)
Height	150-160 cm	13(26%)
	161-170 cm	20(40%)
	>170 cm	17(34%)
Weight	40-60 kgs	12(24%)
	61-80 kgs	32(64%)
	>80 kgs	6(12%)
BMI(Kg/Sq meter)	15-20 kg/sqmeter	7(14%)
	20-25 kg /sqmeter	25(50%)
	>25 kg/sqmeter	18(36%)

The above table illustrated the Estimation of Height parameters revealed that majority of patients (20 cases) were within the height range of 160-170cms, followed by the group with an estimated height of more than 170cms (17cases). Estimation of patient weight parameter suggest that majority of patients (32 cases) were between 60-80Kgs, followed by the weight range of 40-60 Kgs (12 cases). Whereas the Estimation of Patient distribution of the BMI indicated that the majority of patients (25 cases) possess BMI range between 20-25Kg per sq.metre, constituting about 50% of all the patients.

**Table 3:** Correlation of different variables with respect to Harvested Graft Length (Semitendinosus and Gracilis)

Variable/Categories		Height	Weight	BMI
Overall	HSL (r and p-value)	0.43(0.002)	0.42(0.002)	0.10(0.468)
	HGL (r and p-value)	0.37(0.008)	0.45(0.001)	0.14(0.302)
Female	HSL (r and p-value)	0.17(0.63)	0.34(0.33)	0.29(0.415)
	HGL (r and p-value)	0.11(0.75)	0.42(0.22)	0.41(0.23)
Male	HSL (r and p-value)	0.49(0.001)	0.48(0.002)	0.18(0.248)
	HGL (r and p-value)	0.44(0.004)	0.48(0.001)	0.15(0.347)
Age group <25	HSL (r and p-value)	0.49(0.01)	0.59(0.002)	0.28(0.17)
	HGL (r and p-value)	0.47(0.02)	0.61(0.001)	0.29(0.168)

Age group	HSL (r and p-value)	0.42(0.03)	0.31(0.11)	0.06 (0.75)
>25	HGL (r and p-value)	0.31(0.11)	0.32(0.10)	0.06(0.75)

On statistically analyzing, the coefficient of correlation (r) and p value between different variable with respect to harvested graft length (semitendinosus and gracilis), the r and p value was found to be significant. The correlation and p-value of height was 0.432(0.002), 0.373(0.008) and weight was 0.422(0.002), 0.452(0.001) with respect to harvested graft length (semitendinosus and gracilis) respectively. The other variables which include BMI and Thigh circumference do not correlate with harvested graft length (semitendinosus and gracilis). The gender shows the specific correlation of different variable with respect to harvested graft length (semitendinosus and gracilis). The correlation and p-value of height in male [0.491(p=0.001), 0.444(p=0.004)] and that of weight in male [0.48(p=0.002), 0.489(p=0.001)] are statistically significant which is  $p < 0.05$  with respect to harvested graft length (semitendinosus and gracilis). The gender specific analysis shows female height and weight are not statistically significantly correlated to harvested graft length (semitendinosus and gracilis) while in male gender, height and weight are significantly correlated. Whereas the age illustrated the specific correlation of different variable with respect to harvested graft length (semitendinosus and gracilis). On statistically analysis, the correlation coefficient and p-value of height in <25 age was [0.491(p=0.015), 0.47(p=0.02)] and of weight in <25 age was [0.48(p=0.002), 0.489 (p=0.001)].

These indicate that Height and Weight are statistically significant with respect to semitendinosus and gracilis length in age group less than 25 years.

## Discussion

The Anterior Cruciate Ligament is one of the most commonly reconstructed ligaments of the knee [8]. An injury to the anterior cruciate ligament ACL can result in significant functional impairment [9]. Strength and stiffness of the graft are important components in order to decide the kind of graft and the technique of tendon reconstruction. Anatomical studies have demonstrated that the mean diameter of the normal ACL is approximately 11 mm, with a range from 6 to 12 mm. Although the parameters for acceptable graft size that are necessary in order to achieve a satisfactory result after ACL reconstruction have not been clearly defined, a diameter of at least 7 mm has traditionally been recommended [10, 11]. In this investigation, we focused on the influence of graft size and patient height, weight and BMI on outcome in the early postoperative period. In our study the patients, we used two type of graft combinations, such as Harvested Graft Semitendinosus Length and Harvested Graft Gracilis Length. The aim of our study is to assess the correlation of patient's height, weight and BMI with autologous harvested hamstring graft size.

In our study, a total of 50 patients were included who underwent arthroscopic assisted ACL reconstructive procedure. The age group ranged from young adult group to middle age group were selected for the study. Maximum number of patients were found to be in above 25 years age group. Duncan E Meuffels *et al.* in 2011 also reported that most of the patients belonged to the same age group with the mean age of 27 years [12], while E.S. Abebe reported a mean age of 31 years [13]. In our study, 40 males and 10 females sustained the injury and were operated. This emphasizes the fact that mostly males are the affected victims probably because males are more actively involved in sports and other physical activities. Ranjan R, Kumar R and Singh A in 2018 also reported that out of 20 patients, 17 patients were male and 3 were Female [14]. The study conducted by Mohan L *et al.* in 2017 also noted the injury was common in the male cases, however the injury side did not seem to have influence on the outcome [15].

The surgery was performed on the Right knee in 40 and left knee in 10 probably due to the fact that the Right knee is more commonly the dominant side in the Indian population.

According to the study by Kwang W L *et al.* in 2014, there was no significant difference between the affected sides <sup>[16]</sup>.

Amongst the patients operated, 14 were Students, 10 were Workers, and 5 were Sports men. Most of the patients operated i.e. 20 of them sustained injury to the knee by Road Traffic accidents that is due to fall from their two wheeler vehicles, while many of them i.e. 15 of the patients injured it secondary to fall from height. 12 of them sustained the injury while playing. By these findings it is very evident that ACL injuries most commonly occurs in physically active people. This reference is in direct agreement with Nikolaos Davarinos, Barry James O'Neill and William Curtin in their study performed in 2014, who stated that the rupture of Anterior Cruciate Ligament is one of the commonest ligament to be injured in those population who are actively involved in sports activity <sup>[17]</sup>. This significant difference may be due to the fact that less number of people take Sports activity as their professional carrier in our country as compared to Western countries.

(Table 3) Shows that out of 50 patients, overall correlation of different variable with respect to length of semitendinosus and gracilis. The correlation and p-value of height 0.432(0.002), 0.373(0.008) and weight 0.422(0.002), 0.452(0.001) are statistically significant in two variable with respect to length of semitendinosus and gracilis. The gender specific analysis shows female height as well as weight is statistically insignificantly to Graft length while in Male gender, there is significant correlation between Height and Weight to graft length.

Chiang *et al.* in 2012 evaluated a total of 100 patients, who underwent surgical intervention with double bundle Anterior Cruciate Ligament reconstruction by using autologous semitendinosus and gracilis tendons. In this study, author has observed that both the height and thigh length were significantly correlated with the gracilis and semitendinosus lengths <sup>[18]</sup>. Though, authors have observed a slight but significant difference in the graft diameter among male and female patients. Their results suggest that males preferentially possess larger grafts than females. This may be due to the fact than men generally possess longer tendon as compared to female. Additionally, authors have also observed that there is a linear relationship between the graft diameter and the height of the male patients. Predictive estimations revealed that females with smaller and thin graft size are comparatively associated with poor outcomes. On gender and age specific analysis of correlation of anthropometric data with hamstring graft length, we noticed that the male patients less than 25 years of age had the best correlation with hamstring graft length. This could be due to males having better musculature secondary to male hormonal factors. Due to which the ligament harvest has a better strength and size. The better correlation in age less than 25 years of age could be explained as in this age, the obesity and flabby musculature is minimal and young active lifestyle could be a reason for well-maintained musculature in the body.

## Conclusion

The present study was done to evaluate the Correlation of Anthropometric measurements with Hamstring graft diameter and length using semitendinosus Autograft in patients with ACL tear. Standard arthroscopic technique was used for ACL reconstruction. Based on this study, on analyzing correlation of anthropometric variable with harvested graft length, we could observe that height and weight are significantly correlated with anthropometric variables. This correlation is more profound in male patients less than 25 years of age. Further our result shows that BMI and thigh circumference have no correlation with harvested graft length. We found that there was slight correlation between weight and height of male patient. The capacity to precisely predict the length and diameter of the hamstring tendons (ST and G) used in ACL reconstructions continues to be an important factor in decision-making and in choosing the best surgical technique and the appropriate graft.

**Authors Contribution:**

1. **Dr. Amar Singh:** Drafting of manuscript
2. **Dr. Shaswat Agrawal:** Implementing Statistical Analysis
3. **Dr. Apoorv Dua:** Data Collection

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