

Original Article

Semitendinosus Tendon Autograft Length and its Correlation with Anthropometric Measurements in Patients Undergoing Arthroscopic Anterior Cruciate Ligament Reconstruction using Hamstring Tendon Autograft in a Tertiary Care Centre

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ABSTRACT

Introduction: There is limited data available regarding semitendinosus tendon length and its correlation with anthropometric parameters in Nepalese population. This study aims to find out mean semitendinosus tendon length in patients undergoing arthroscopic anterior cruciate ligament reconstruction and its correlation with patient's height, femur length, and thigh girth.

Methodology: An observational study was conducted following institutional review committee (IRC) approval (reference number: B&BIRC-23-04). All Patients undergoing arthroscopic anterior cruciate ligament reconstruction using hamstring tendon autograft between January 1, 2021, and December 31, 2022, were included. Those who had premature rupture of semitendinosus tendon during graft harvest were excluded. Semitendinosus tendon autograft was harvested, and length was measured. Then, triplicated graft diameter was measured. If harvested gracilis, quadrupled or pentapled, combined semitendinosus and gracilis tendon autograft diameter was measured. Pearson's correlation coefficient was used to evaluate correlation and student t test was used to test the significance.

Results: Out of 102 included patients, 87(85.3%) were male and 15(14.7%) were female. Mean age of the patients was 30.5 ± 8.4 years. Semitendinosus tendon alone autograft was used in 26(25.5%) cases. and combined semitendinosus and gracilis tendon was used in 76(74.5%) cases. Mean semitendinosus tendon autograft length was 27.9 ± 2.8 cm. There was significant positive correlation between semitendinosus tendon autograft length and patients' height ($r = 0.594$, $p = .000$) and femur length ($r = 0.528$, $p = .000$).

Conclusion: Mean semitendinosus tendon autograft length in patients undergoing arthroscopic anterior cruciate ligament reconstruction is comparable to what reported in other international studies. Semitendinosus tendon length is significantly positively correlated with patients' height and femur length.

Keywords: arthroscopy, anterior cruciate ligament, hamstring tendon, reconstruction, semitendinosus tendon

INTRODUCTION

Hamstring tendon autograft is commonly preferred graft option for arthroscopic anterior cruciate ligament (ACL) reconstruction.¹ Usually, both semitendinosus and gracilis tendons are harvested to achieve larger diameter grafts.^{1,2} However, harvesting gracilis tendon may increase hamstring strength deficit.³ In addition, semitendinosus tendon alone and semitendinosus with gracilis tendon autografts have shown comparable functional outcomes.⁴

Studies have found that semitendinosus tendon alone autograft is effective in obtaining tripled or quadrupled graft diameter of 7mm or more, and in providing satisfactory functional

outcomes.^{5,6} However, anthropometric studies have suggested that the semitendinosus tendon autograft diameter is positively correlated with tendon length, patient's height, and thigh length.^{7,8} In addition, studies conducted in Asian population have found smaller tendon length compared to that of Caucasians.^{9,10} There is limited data available regarding semitendinosus tendon length and its correlation with anthropometric parameters in Nepalese population. Hence, this study aims to find out mean semitendinosus tendon length in patients undergoing arthroscopic ACL reconstruction using hamstring tendon autograft. In addition, this study aims to find out the correlation of semitendinosus tendon length with patient's height, femur length, and thigh girth.

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METHODS

An observational study was conducted among patients undergoing arthroscopic ACL reconstruction using hamstring tendon autograft following institutional review committee

(IRC) approval (reference number: B&BIRC-23-04). All Patients undergoing arthroscopic ACL reconstruction using hamstring tendon autograft between January 1, 2021, and December 31, 2022, were included. Those who had premature rupture of semitendinosus tendon during graft harvest were excluded. Convenient sampling method was used. Sample size was calculated using following formula.

Sample size calculation:

$$N = Z^2 \sigma^2 / E^2$$

$$= 1.96^2 \times 3.1^2 / 12$$

$$= 36.91$$

Where,

Z = 1.96, constant for 95% confidence interval (CI)

σ = 3.1, standard deviation of semitendinosus tendon length obtained from previous study¹¹

E = 1, Error rate

Calculated minimal sample size was 37. However, a total of 102 patients were included.

Demographic data recorded were age, gender, mechanism of injury. Semitendinosus tendon autograft was harvested using standard technique and length was measured using regular scale. Then, tripled or quadrupled diameter was measured. If needed, gracilis was harvested using standard technique. Then, combined semitendinosus and gracilis tendon quadrupled or pentapled diameter was measured using standard diameter measurement tool. Then, ACL reconstruction was performed using standard technique.²

Continuous data were reported as mean $\pm$ standard deviation (SD) and categorical data were reported as number (percentage). Pearson's correlation coefficient was used to evaluate correlation and student t test was used to test the significance. Level of significance was set on 0.05. Statistical analysis was done using statistical package for social sciences (SPSS) software version 26.

RESULTS

Out of 102 included patients, 87 (85.3%) were male and 15 (14.7%) were female. Mean age of the patients was 30.5 ± 8.4 years. The mechanisms of injury were sports injury 55 (53.9%), fall injury 26 (25.5%), road traffic accidents 20 (19.6%), and others 1 (0.9%). Semitendinosus tendon alone autograft was used in 26 (25.5%) cases and combined semitendinosus and gracilis tendon was used in 76 (74.5%) cases. Mean semitendinosus tendon autograft length was 27.9 ± 2.8 cm. Mean triplicated semitendinosus tendon autograft diameter was 7.8 ± 0.6 mm and mean combined semitendinosus and gracilis tendon autograft diameter was 8.3 ± 0.8 mm. Graft folds were: triplicated in 26 (25.5%) cases, quadrupled in 27 (26.46%) cases, and pentapled in 49 (48.03%) cases. Table 1 showed the gender specific distribution of hamstring tendon length and graft diameter.

Table 1. gender specific distribution of hamstring tendon length and graft diameter.

Parameters	Male	Female
SemiT length (cm)	28.31 ± 2.82	26.00 ± 1.93
SemiT [triplicated diameter (mm)]	7.869 ± 0.66	7.67 ± 0.289
SemiT with gracilis diameter (mm)	8.41 ± 0.73	7.58 ± 0.51

SemiT-Semitendinosus Tendon

Table 2 showed the correlation between semitendinosus tendon length and patient's height, femur length, and thigh girth.

Parameters		Mean $\pm$ SD	Correlation with SemiT length
Height (In cm)	male	169.4 ± 6.6	$r = .594, p = .000^*$
	female	158.2 ± 5.3	
Femur Length (In cm)	male	42.8 ± 3.1	$r = .528, p = .000^*$
	female	39.9 ± 2.7	
Thigh Girth (In cm)	male	50.7 ± 5.5	$r = -.031, p = .759^*$
	female	48.6 ± 5.2	

SemiT Semitendinosus Tendon; r Correlation coefficient; SD standard deviation; (*) Student t test, level of significance 0.05.

DISCUSSION

This study identified that the mean semitendinosus tendon autograft length in patients undergoing arthroscopic ACL reconstruction was 27.9 ± 2.8 cm. The findings were comparable to that reported in other international studies, which was around 27.7-30.9 cm.^{7-9,11} Goyal et al. (2020) conducted a study in India including 95 patients undergoing arthroscopic ACL reconstruction where they observed that mean semitendinosus tendon autograft length was 27.7 ± 2.6 cm.⁸ Similarly, another study conducted by Xie et al. (2012) in China including 235 Han Chinese patients undergoing arthroscopic double bundle ACL reconstruction found that the mean semitendinosus tendon autograft length was 27.9 ± 2.1 cm.⁹ This suggests that semitendinosus tendon length is similar among Nepalese, Indian, and Han Chinese population.

In contrast, Moghamis et al. (2020) conducted a study in Qatar including 50 male patients undergoing arthroscopic ACL reconstruction where they found that mean semitendinosus tendon length was 30.8 ± 3.2 cm.⁷ Similarly, another study conducted by Janssen et al. (2017) in Netherlands including 725 Caucasians undergoing ACL reconstruction observed that the mean semitendinosus tendon autograft length was 28.9 ± 3.1 cm.¹¹ This suggests that semitendinosus tendon lengths are higher among Arabs and Caucasians compared to Nepalese population.

This study also identified that there was significant positive correlation between semitendinosus tendon autograft length and patients' height ($r = 0.594$, $p = .000$) and femur length ($r = 0.528$, $p = .000$). This suggests that the tendon length increases with increase in height and femur length. These findings were also supported by several international studies.^{7,8,11} Moghamis et al. (2020) observed strong positive correlation between semitendinosus tendon autograft length and patients' height ($r = 0.541$, $p = .000$) and thigh length ($r = 0.578$, $p = .000$) among Arabs.⁷ Similarly, Goyal et al. (2020) found significant positive correlation between semitendinosus tendon autograft length and patients' height ($r = 0.41$, $p < 0.001$) and thigh length ($r = 0.43$, $p < 0.001$) among Indians.⁸ Furthermore, Janssen et al. (2017) observed that semitendinosus tendon autograft length among Caucasians was independently related to patients' height and thigh length.¹¹ This suggests that semitendinosus tendon length is positively correlated with patients' height and thigh length irrespective of geographical and ethnic variation.

This study also identified that the mean triplicated semitendinosus tendon autograft diameter was 7.8 ± 0.6 mm. Most of the studies have concluded that the ACL reconstruction performed with graft size more than 8 mm has less re-tear rate.^{5,6} This suggests that semitendinosus tendon alone can also be used for arthroscopic ACL reconstruction. However, these studies used all-inside ACL reconstruction using quadrupled graft. In contrast, newer studies including demanding young individuals have advocated that a quadrupled graft with diameter of >8 mm is required to avoid complications.^{7,8,11} Although there is a risk of hamstring strength deficit after harvesting gracilis, the difference was not clinically significant.^{3,4}

In this study, the mean combined semitendinosus and gracilis graft diameter was 8.3 ± 0.8 mm. This suggests that it is always advisable to harvest gracilis to achieve adequate graft diameter. However, the mean combined semitendinosus and gracilis tendon autograft diameter among females was 7.58 ± 0.51 mm, which is not adequate. Thus, for females, other graft options, such as peroneus tendon graft, need to be chosen.¹

This study has several limitations. It is a single center observational study which has potential risk of selection and reporting bias and lacks external validity. The correlation of semitendinosus tendon autograft length with gender and body mass index was not established. Many previous studies have suggested that there is significant negative correlation with female gender.^{8,9} The correlation between graft diameter and anthropometric parameters were also not evaluated. Furthermore, Correlation between the mean diameter with anthropometric variables with cut-off values, for e.g., females shorter than 160 cm have combined ST-G diameter less than 7.5 mm, were not evaluated. However, to the best of our knowledge, this kind of studies were not conducted before in our population. The findings of the study further

strengthen the understanding that semitendinosus tendon alone autograft can effectively achieve triplicated graft diameter of 7mm or more, and gracilis tendon may not be always needed. This may prevent more liberal harvesting of gracilis tendon.

CONCLUSION

Mean semitendinosus tendon autograft length is comparable to what reported in other international studies. Semitendinosus tendon length is significantly positively correlated with patients' height and femur length. Semitendinosus tendon autograft alone can effectively achieve triplicated diameter of 7mm or more. However, to achieve quadrupled diameter of 8 mm or more, gracilis needs to be harvested. Future studies with randomized sampling and blinding measurements could provide better evidence on semitendinosus tendon autograft lengths and its correlation with anthropometric measurements.

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