

To Study the Correlation Between the Height & the Quadruple Semitendinosus Graft Diameters

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Abstract :

Background: Diameter of hamstring graft is variable. Premature tendon amputation occurs because of inability to identify and release all accessory bands. Preoperative prediction of hamstring graft size, number and distance of accessory bands is useful for surgeon.

Methodology: This is cross-sectional study included 60 patients. Correlation coefficient (Pearson's r) was used. T-test was used to compare the variables in both genders.

Result: There were correlations between the mean semitendinosus tendon diameters- femoral side (FD) and tibial side (TB) with height of patient (Pearson correlation for FD = 0.442 and $P < 0.001$) (Pearson correlation for TD = 0.663 and $P < 0.001$). For the semitendinosus tendons, the mean number of accessory bands was 1.48. The average distance of the most distal band (D1) to the tibial crest insertion was 6.7 ± 2.04 cm (range 3- 11 cm). In our study, distance of most proximal band to the tibial crest insertion was 11.5 cm (mean 8.5 cm). **Conclusion:** In our study, positive correlation between the height and the quadruple semitendinosus graft diameters was present. Semitendinosus graft diameters were more in males as compare to females. Third accessory band was present only in males ($n=4$) in our study. As height of patient increases, distance of distal band (D1) increases from tibial crest. There was inverse correlation between number of accessory bands and distance of the most distal band (D1) insertion. As number of bands less, the more is distance of proximal band from tibial crest.

Keywords : ACL Tears, Hamstring Tendons, Arthroscopy.

Introduction :

Though various auto grafts are used for ACL reconstruction, the most common are bone-patellar

tendon-bone graft and the quadrupled hamstring tendon graft.⁽¹⁻⁴⁾ Hamstring tendon graft are used predominantly now a days because of low donor site morbidity.⁽⁴⁻⁶⁾ Surgeons used triple and quadruple stranded hamstring graft because single strand of either semitendinosus or gracilis cannot give enough strength.⁽⁴⁾ But still there is major disadvantage of hamstring graft. Diameter of hamstring graft is variable.^(6,7) So achieving minimum diameter of 7mm^(8,9) is not possible in every case. In such cases, surgeon must be ready with alternative graft option. That's why Preoperative estimation of hamstring graft size could help in identifying high risk patient, planning alternate treatment options and proper patient counseling regarding management. Gracilis and semitendinosus tendons are present between the sartorius fascia and the superficial medial collateral ligament.^(10,11) Distal ends of the tendons give rise to Single or multiple accessory bands, inserting to the fascia of the medial gastrocnemius or tibial crest.⁽¹¹⁻¹³⁾ Distance and number of these bands are highly variable. Premature tendon amputation occurs because of inability to identify and release all accessory bands during tendon harvest.⁽¹²⁻¹⁴⁾

Hence preoperative prediction of number and distance of these accessory bands is useful for surgeon. The aim of this study was to find a relationship between the quadruple semitendinosus tendon autograft diameters and anthropometric parameters such as age, gender, height and body mass index (BMI) and also to find correlation between number, distance of semitendinosus accessory bands and anthropometric parameters such as age, gender, height and body mass index (BMI).

Methodology:

This is cross-sectional study included 60 patients (45 males and 15 females) who underwent ACL reconstruction with quadruple semitendinosus tendon by single surgeon in single institute from October 2017 to October 2018. Exclusion criteria were patients who were treated using graft other than semitendinosus tendon, associated ipsilateral ligamentum injury and previous ligament surgery. Age, gender, height, weight and BMI of each patient were recorded preoperatively.

Vertical incision was taken over the pes anserinus attachment medial to the tibial tuberosity. Semitendinosus tendon was identified. Number of accessory bands were identified and counted. Accessory bands were cut 1cm away from main tendon to measure distance from tibial insertion.

After harvesting tendon, distance of each band was measured from tibial insertion end. Tendon was looped so as to form quadruple graft. Length of the graft was calculated. Cylindrical sizer with increments of 1mm was used to measure graft diameters.

Mean age, weight, height, BMI and a range of various variables were described. Correlation coefficient (Pearson's r) was used to measure the correlation between different variables. t-test was used to compare the variables in both genders. A P-value of less than 0.05 was considered to be statistically significant.

Result:

In this study, 60 patients (45 males and 15 females) were included with Mean age of 34.05 ± 8.06 years (range 19 – 53 years), mean height of 165.12 ± 10.88 cm (range 140-190 cm), mean weight of 67.12 ± 13.5 kg (range 41 – 98 kg), mean BMI was 24.49 ± 3.59 (range 16.7-31.43 kg/m²).

Table 1: All parameters - mean and standard deviation(SD)

Sr. No.	Study Parameter	Mean	SD
1	Age (Yrs)	34.05	8.058
2	Height (cm)	165.12	10.879
3	Weight (kg)	67.12	13.50
4	BMI (kg/m ²)	24.50	3.60
5	Graft Length (mm)	291.42	20.40
6	Tibial diameter –TD (mm)	8.83	0.89
7	Femoral diameter – FD (mm)	7.90	0.92
8	Number of Bands	1.48	0.62
9	Distance of distal band from tibia crest- D1 (cm)	6.7	2.05
10	Distance of proximal band from tibia crest (cm)	8.47	2.19

The mean quadruple semitendinosus tendon femoral side diameter (FD) was 8.09 ± 0.94 mm for males and 7.33 ± 0.5 mm for females, and The mean quadruple semitendinosus tendon tibial side diameter (TD) was 9.11 ± 0.7 mm for males and 8.0 ± 0.75 mm for females and the differences were statistically significant in both femoral ($P < 0.001$) and tibial ($P < 0.001$) diameters.(Fig 1)

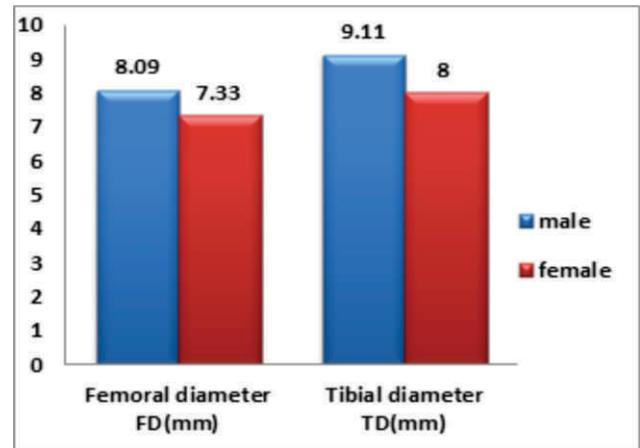


Figure 1: Mean femoral and tibial graft diameters in Male and female

There were no significant differences between the mean diameters of both side of semitendinosus tendon and patients' age, weight and BMI. There were significant correlations between the mean semitendinosus tendon diameters- femoral side (FD) and tibial side (TB) with height (Pearson correlation for FD =0.442 and $P < 0.001$) (Pearson correlation for TD =0.663 and $P < 0.001$). (Fig 2)

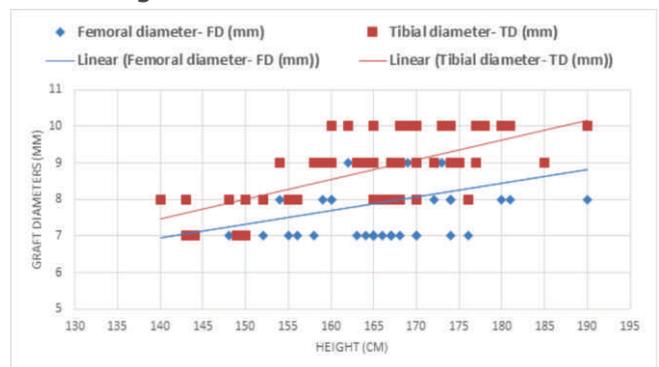


Figure 2: Scattered plot showing relationship between height and graft diameters. This shows significant correlation between height and graft diameters.

For the semitendinosus tendons, the mean number of accessory bands was 1.48 ± 0.62 (range 1-3). There was no significant difference in number of bands between males and females ($p > 0.05$). However third accessory band was present only in males ($n=4$) in our study. Maximum number of bands in females was two, present in 5 patients out of 15. The average distance of the most distal band (D1) to the tibial crest insertion was 6.7 ± 2.04 cm (range 3- 11 cm). In our study, distance of most proximal band to the tibial crest insertion was 11.5 cm (mean 8.5 cm).

There was no correlation between number of bands with height, weight and BMI. And there was no any correlation between the distance of most proximal band with height, weight and BMI.

There was correlation between height of patient and distance of the most distal band (D1) to the tibial crest insertion (Pearson correlation for D1 = 0.327 and $P=0.011$). There was inverse correlation between number of accessory bands and distance of the most distal band (D1) from tibial crest (Pearson correlation = -0.382 and $P=0.003$). (Fig 3)

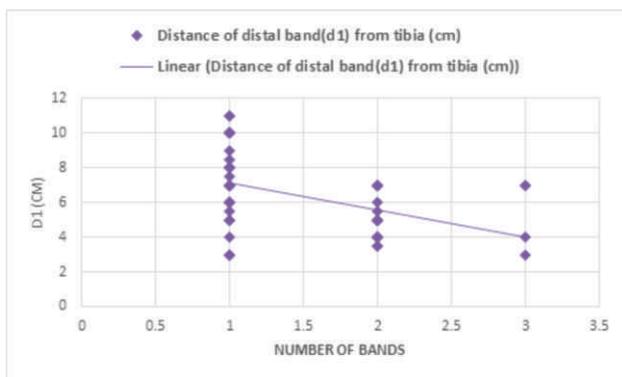


Figure 3: Scattered plot showing inverse relationship between number of bands and distance of distal accessory band from tibia. This shows inverse correlation between number of bands and distance of distal accessory band from tibia.

Discussion :

We included 60 patients with ACL tear underwent primary ACL reconstruction. We found correlation between the height and the quadruple semitendinosus graft diameters. There are other studies like Asif et al (2016)⁽¹⁾, Treme et al (2008)⁽²⁾, Gupta et al (2017)⁽⁸⁾, Goyal et al (2015)⁽⁹⁾ in which they also found correlation between the height and hamstring graft diameter. Treme et al⁽²⁾, Schwartzberg et al⁽¹⁶⁾ and Gupta et al⁽⁸⁾ observed positive correlation between leg length and graft diameter. Moderate association was found between thigh length and graft diameter by Goyal et al.⁽⁹⁾ In the study of Asif et al⁽¹⁾, they obtained positive correlation between the thigh circumference and graft diameter. We did not study any relation between graft diameter and leg length, thigh length, thigh circumference.

We have not observed any correlation between weight and graft diameter. Treme et al⁽²⁾ and Schwartzberg et al⁽¹⁶⁾ found contrast result to our study. They found

association between weight and graft diameter. In our study similar to the study of Ma et al⁽⁷⁾, Semitendinosus graft diameters were more in males as compare to females. Similar to the studies of Asif et al⁽¹⁾, Ma et al⁽⁷⁾, we have found no effect of BMI on graft diameter.

There are few cadaveric studies available regarding accessory bands of hamstring tendons but only one in vivo study⁽¹²⁾ present in literature. In vivo soft tissue conditions may be different from cadaver due to embalming process.⁽¹²⁾ To avoid the failure of releasing all accessory bands before tendon stripper insertion, more information should available on accessory bands of hamstring tendons though in vivo studies.

We only studied accessory bands of semitendinosus tendon and found bands in 100 % patient. Pagnani et al⁽¹⁷⁾ found band to semitendinosus tendon in only 77 % cadavers. Candal-Couto et al⁽¹³⁾ observed band in all 100 % cadavers. In our study, distance of most proximal band to the tibial crest insertion was 11.5 cm (mean 8.5 cm). The average distance of the most distal band (D1) to the tibial crest insertion was 6.7 cm (range 3- 11 cm). In the cadaveric study of Tuncay et al⁽¹¹⁾, The band started within 6–8 cm and ended within 8–12 cm of the insertion point of pes anserinus. Yasin et al⁽¹²⁾ found in their in vivo study that the average distance of the most proximal band from the tibial crest insertion being 8.1 cm and the median number of accessory bands for the semitendinosus tendons was 3 (range 1–4). In our study, the mean number of accessory bands was 1.48 (range 1-3).

Conclusion :

In our study, positive correlation between the height and the quadruple semitendinosus graft diameters was present. Semitendinosus graft diameters were more in males as compare to females. There was no correlation between number of bands with height, weight and BMI. Third accessory band was present only in males ($n=4$) in our study. There was correlation between height of patient and distance of the most distal band (D1). As height of patient increases, distance of distal band increases from tibial crest. There was inverse correlation between number of accessory bands and distance of the most distal band (D1) insertion. As number of bands less, the more is distance of distal band from tibial crest.

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