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Variation of peroneus longus tendon dimensions (length and thickness) with anthropometric measures of patients (height, weight, age, and body mass index) in skeletally mature patients.

Dr. Mohamad Waseem Dar[1], Dr. Pallav Gupta[2], Dr. Manish Singh[3]*

[1]Postgraduate Scholar, Department of Orthopedics, Government Medical College Jammu, India.
[2]Senior Resident, Department of Orthopedics, Government Medical College Jammu, India.
[3*]Assistant Professor, Department of Orthopedics, Government Medical College Jammu, India.

***Corresponding Author:** Dr. Manish Singh
*Mail id: **docmanishsingh@gmail.com**

Abstract

Background: ACL reconstruction is the most common surgery to repair ruptured ACL. There are many graft choices in ACL reconstruction. Graft decision is the most important preoperative consideration in ACL reconstruction. It can minimize re-rupture incident and provide optimal knee stability after surgery.
Aim: This study aims to investigate the variation of peroneus longus tendon dimensions (length and thickness) with anthropometric measures of patients (height, weight, age, and body mass index) in skeletally mature patients. **Methods:** A profile of 34 patients (25 males, 9 females with mean age of 28.5±8.2 (Yrs) aged from 18 to 30 years who received PLT autograft for ACL reconstruction in this prospective observational study. Demographic characteristics of the patients and leg length, and proximal and distal leg diameters were recorded before the operation. The PLT autograft diameter and length were measured during the surgery.
Results: During the period of the study, 37 patients underwent ACL reconstruction. Three patients were excluded and 34 patients fulfilled the inclusion criteria. A statistically significant correlation was found between the graft diameter and length and weight, height, body mass index (BMI), leg length, and proximal and distal leg diameters ($p<0.01$). Distal leg diameter had the highest correlation coefficient for the PLT autograft diameter ($r=0.891$), while the height had the highest correlation coefficient for the PLT autograft length ($r=0.871$). In 75% of patients were peroneus longus tendon is sufficient to for ACL reconstruction.
Conclusion: Anthropometric parameters of height, weight, BMI, leg length, and proximal and distal leg diameters may be helpful for surgeons to predict the diameter and length of the PLT autograft before surgery. Among these parameters, we believe that distal leg diameter is a particularly important parameter in estimating the autograft diameter. Although the results of this study are promising, further large-scale, long-term, prospective studies are needed to reach more accurate results.

Keywords: ACL reconstruction, autograft, Anthropometric parameters, surgery

Introduction:

Anterior Cruciate Ligament (ACL) is one of many ligaments in the knee that is commonly injured in sports and accidents [1]. Recently, ACL reconstruction has become a common procedure to treat torn ACL in highly active person [2]. ACL reconstruction goals are to restore knee stability, relieve symptoms, particularly pain and instability, and return the patients to their daily activity as before injury [1]. [w1] To restore the knee stability, ACL reconstruction (ACLR) has been recognized as the most common procedure.[3] However, up to 4.0% to 15.3% of the operations are failed.[4] According to literatures, a series of factors could influence the outcomes of ACLR surgery, including age, sport activities, graft type, initial graft tension, graft diameter, and anatomic reconstruction .[5-7] Of those factors, the diameter of the graft play an important role.[8] Magnussen et al[9] considered 7mm as the minimum graft size to avoid the revision surgery. Recently, researchers argued that a graft diameter of no less than 8mm is the acceptable range.[10,11] A cohort study of 2240 patients performed by Snaebjornsson et a.[12] showed that, when graft diameter located at 7.0 to 10.0mm, per 0.5mm increase resulted in a 0.86 times lower likelihood of revision surgery. In addition, some studies have suggested that graft diameter is associated with postoperative complications such as knee joint instability.[13,14] Hence, predicting the graft diameter in ACLR is of vital clinical importance by helping surgeons make comprehensive preoperative plans and opt for alternative graft choices.

Graft diameter of greater than eight mm is also recommended to reduce the risk of graft failure. The size of preneous longus graft differs among individuals; hence, a pre-operative knowledge can help the surgeon to be prepared with other

graft options. Several studies have been done to predict the graft characteristics based on weight, height, body mass index, thigh circumference, and thigh length of the patient, of which, height is found be the most important predictor of graft length. [15,16] Here we intend to see the correlation of peroneus longus tendon with patient height and weight and derive a formula to predict the tendon length pre-operatively based on patient's height.

Materials and methods

This prospective observational study was conducted in the department of orthopaedic Government medical College Jammu. All patient attending causality and OPD for ACL reconstruction surgery were taken for study. Through examination and investigation was done. Consent was taken from each patient. Thirty seven patients underwent ACL reconstruction using peroneus longus tendon. Patient characteristics were recorded including body weight, height, Body Mass Index (BMI), leg length and gender.

Inclusion criteria:
Either sex
Patient who give consent for study

Exclusion criteria:
Patient not giving consent for study

Operation procedures

All patients received single bundle reconstruction under general anesthesia. All PLT grafts were harvested in the same fashion with a 2-cm longitudinal skin incision at the posterolateral side of the fibula just over the peroneus tendon, 2cm proximal to the posterior border of the lateral malleolus. After exposing the distal PLT, a stripper was used to harvest the tendon. The superficial fascia and fat of the PLT were removed, and the rough edge was trimmed carefully. Then, the PLT were doubled up at the middle to obtain a 4-strand graft and its ends were whip-stitched with a No. 2 polyester suture. The diameter of PLT graft was measured using the Smith and Nephew sizing cylinder in 0.5-mm increments. Finally, the prepared PLT was implanted and fixed using a bioabsorbable interference screw using an independent femoral approach as previously described.[17]

Statistical analysis
Statistical data were analyzed by an independent statistician, and were considered significant if $p < 0.05$. Statistical analysis was performed with the computer program SPSS, version 25.0 (IBM Corp., Chicago). We determined normalized data using Shapiro-Wilk test and analyzed them using Mann-Whitney, and Pearson correlation. Pearson correlation was used to find correlations between intraoperative graft diameter and patient's physical characteristics.

Conflict of interest: Nil

Funding: Nil

Results:

A total of 34 patients (25 males, 9 females with mean age, weight, BMI, Leg length, tendon diameter and tendon length among the males and females were of 28.5±8.2 (Yrs), 27.3±7.5 (Yrs), 1.9 (m), 1.6 (m), 25.4, 24.3, 34 (cm), 32 (cm), 8.4 (mm), 7.6 (mm), 14 (cm) and 13.6 (cm) respectively [Table 1] .

Table. 1: Patient characteristics

Variables	Male	Female
Age (years)	28.5±7.3	27.3±8.5
Weight (kgs)	80.4±7.9	62.1±6.2
Height (m)	1.9	1.6
BMI	25.4	24.3
Leg length (cm)	34	32
Tendon diameter (mm)	8.4	7.6
Tendon length (cm)	28	26.5

Correlation between intraoperative peroneus longus diameter with patient's gender was statistically significant with p=0.012 ($p < 0.05$) and coefficient correlation was −0.612. Correlation between intraoperative peroneus longus diameter with patient's body weight was statistically significant with p=0.013 ($p < 0.05$) and coefficient correlation was 0.410.

Correlation between intraoperative peroneus longus diameter with patient's body height was statistically significant with p=0.007 ($p < 0.05$) and coefficient correlation was 0.402. Also, correlation between intraoperative peroneus longus diameter with patient's BMI was statistically significant with p=0.021 ($p < 0.05$) and coefficient correlation was 0.298 [Table 2].

Table 2: Pre-operative and intra-operative correlation

Pre-operative measurement	Coefficient correlation	P Value
Gender	**-0.612**	**<0.05**
Age	**-0.210**	**>0.05**
Weight	**0.421**	**<0.05**
Height	**0.421**	**<0.05**
Body mass index (BMI)	**0.338**	**<0.05**

Discussion:

Anterior cruciate ligament (ACL) injury is a common knee injury with an incidence of up to 78 per 100,000 person years [18]. Surgical treatment is often required to restore knee biomechanics and function. Several autograft options are available for ACL reconstruction, such as bone-patellar tendon-bone (BTB), hamstring tendon (HT), quadriceps tendon (QUAD) and peroneus longus tendon (PLT) [19,20], while the popularity of hamstring tendon grafts has risen due to their biomechanical stability, low donor-site morbidity and improved fixation methods [21,22], however, the success of the surgery is closely related to graft size, and inadequate graft size is associated with high failure and re-rupture rates.
Consequently, identifying patients with inadequate graft size has become essential for appropriate pre-operative decision making and arrangement of alternative grafts source. Anthropometric measurements related to demographic and radiological parameters have been proposed to predict hamstring tendon graft size [23--26]. Several studies investigated the correlation between these measurements and graft size, but the results have been inconsistent [27-29].
Our study hypothesis was that patients' physical characteristics can influence the graft size in ACL reconstruction. We found significant correlation between peroneus longus graft diameter with patient's gender, height, body weight, and BMI. A previous study showed that height is the most influential measurement for the graft size diameter [30]. Theme et al. reported a correlation between patient's BMI and hamstring graft size diameter [31].
Xiaoxiao et al., in 2018 explained that weight, height, and duration of injury were variables which could determine the diameter of peroneus longus graft and could be used as important information before ACL reconstruction [32].
Gender is a controversial factor. Some authors regarded female gender as a predicting factor of small graft size [33], however, others did not find significant difference between gender and graft diameter.[34] In our study, we also did not find statically significant differences with regard to gender among the study population. However, other anthropometric data such as the age, height, BMI, and weight were all statistically significant among the study population.
Pereira et al. found that body weight, age, and BMI had no effect on the diameter of the hamstring tendon. Meanwhile, height was the main predictor of tendon length and diameter [35].
Body weight was found to affect the diameter of the hamstring and peroneus longus. Song et al. stated that the graft diameter of the hamstring tendon could be predicted from body height, weight, and duration of injury with regression coefficient of 0.225. This indicated 22.5% of the variance in the diameter of the hamstring tendon graft could be predicted by these three predictors.
According to the study of Ho et al., determination of preoperative factors in the form of anthropometric weight data showed a strong and significant relationship with r=0.24, $p < 0.01$ in the male group and r=0.51, $p < 0.01$ in the female group [36]. Another study by Goyal et al. did not show consistent results and did not include the variable of body height. Body weight was significantly associated with the diameter of gracilis tendon grafts and quadrupled tendons but was not significantly associated with the diameter of the semitendinosus tendon graft [37].
Research for predictors on the peroneus longus diameter has not been widely performed. However, based on one study which used peroneus longus diameter to look for preoperative predictors, results showed that the predictors were body weight, height, and duration of injury [38].

Conclusion:

Anthropometric parameters of height, weight, BMI, leg length, and proximal and distal leg diameters may be helpful for surgeons to predict the diameter and length of the PLT autograft before surgery. Among these parameters, we believe that distal leg diameter is a particularly important parameter in estimating the autograft diameter. Although the results of this study are promising, further large-scale, long-term, prospective studies are needed to reach more accurate results.

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