



QUADRICEPS TENDON AND PATELLAR LIGAMENT; A MORPHOMETRIC STUDY

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Article received on:
09/01/2015
Accepted for publication:
22/07/2015
Received after proof reading:
09/09/2015

INTRODUCTION

The most common injury involving ligaments of the knee joint especially in sportsmen is a tear of the anterior cruciate ligament (ACL) which demands efforts at its reconstruction to restore functional stability.^{1,2} Such reconstructive surgery however remains controversial.³ Several sources of graft tissue have been sought for this purpose. Use of autografts from various sources has been made: these include fascia lata, hamstring tendon, semitendinosus tendon, gracilis tendon, iliotibial band, tensor fascia lata, the Achilles tendon, and quadriceps tendon and patellar ligament. Varying degrees of results with their use have been reported.^{4,5} Injury to ACL can result not only in significant functional impairment but a failure to reconstruct the ligament may lead to repeated bouts of laxity and instability and damage to the meniscus and articular cartilage; it may

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ABSTRACT... Background: Anterior cruciate ligament (ACL) is commonly injured especially in sportsmen. Autografts using tissue from various sources including the quadriceps tendon and patellar ligament are popular but still controversial due to varying degree of success. The morphological characteristics of the quadriceps tendon and the patellar ligament are of prime importance for this purpose. **Objectives:** This cadaveric study was undertaken to evaluate the morphometric characteristics of the quadriceps tendon and patellar ligament as an autograft for ACL reconstructive surgery. **Study design:** Qualitative cadaveric study. **Material and methods:** The morphometric observations of the quadriceps tendon and patellar ligament on 36 (18 male and 18 female) adult formalin fixed cadavers were recorded by dissection. The observations included the length, breadth and thickness of the quadriceps tendon and the patellar ligament and were recorded on both sides separately in the male and female subjects. The data were tabulated, compared and statistically analyzed. **Results:** There was no significant difference in measurements on the right and left sides both in the male and in the female specimens. However the length and width of the quadriceps tendon was more in the males as compared to the females. The patellar ligament was significantly longer in the male specimens as was its width. Thickness of the patellar ligament, however, was not significantly different in the two genders. **Conclusion:** Both the quadriceps tendon and the patellar ligament are safe and convenient sources of autograft tissue for reconstruction of the ACL.

Keywords: Quadriceps tendon, patellar ligament, anterior cruciate ligament, morphometry

Article Citation: Hijazi MM, Khan MA, Altaf FMN, Ahmed MR, Alkhusi AG, Sakran AMEA. Quadriceps tendon and patellar ligament; a morphometric study. Professional Med J 2015;22(9):1192-1195. DOI: 10.17957/TPMJ/15.2759

also accelerate osteoarthritis in a predisposed subject.^{6,7}

With varying techniques employed by surgeons the source of the graft tissue to replace the damaged ACL is of critical importance. To ensure the best outcome, it is essential to understand the surgical options. Despite the availability of numerous manuscripts, there is no agreement in the literature on the most suitable choice for the graft source.^{8,9,10} The quadriceps tendon and the patellar ligament are favored choices; each one having its advantages and disadvantages. While the quadriceps tendon is thicker and wider providing a plentiful source it is avascular and harvesting the graft tissue for ACL construction is more demanding.¹¹ The patellar tendon autograft has not only the advantage that it has a greater tensile strength, it may be vascular having the

inferior lateral or medial genicular artery branches and can have some bony part with it providing better chances for the graft.^{12,13}The source of tissue for graft has to have not only similarity of structure but should be large and thick enough so that removal of a part sufficient as an ACL implant should not significantly hamper its normal physiological role.

The quadriceps tendon and the patellar ligaments being a common choice by surgeons for ACL reconstructive implant, this cadaveric study was undertaken to evaluate the morphometric characteristics of the same as an autograft for ACL reconstructive knee surgery.

MATERIAL AND METHODS

Ethical approval was obtained from the ethical committee of the Umm al Qura University to carry out the study. The anatomical features and morphometric observations of the quadriceps tendon and patellar ligament on 36 (18 male and

18 female) adult formalin fixed cadavers were recorded by dissection. It was checked from the record that the subjects had no history of surgery or extensive disease involving the area under study. Measurements were taken by a sliding vernier caliper (General Tools Mfg. Co. LLC New York, NY 10013) to the nearest millimeter. The observations included the length, breadth and thickness of the quadriceps tendon and the patellar ligament and were recorded on both sides separately in the male and female subjects. The data were tabulated, compared and statistically analyzed.

RESULTS

The values (mean± SE) of morphometric observations on the length, width and thickness of the quadriceps tendon and patellar ligament on the right and left side and in the male and female specimens are shown in table I and II. The significance was considered at *P* < 0.05.

Quadriceps tendon						Patellar ligament					
Length QT-L		Width QT-W		Thickness QT-T		Length PT-L		Width PT-W		Thickness PT-T	
R	L	R	L	R	L	R	L	R	L	R	L
61.4±3.2	62.1±2.8	29±2.5	28±1.9	7.1±0.9	8.3±1.1	46±1.7	45±0.8	25±1.2	26±2.2	4.1±0.6	3.8±0.8

Table-I. Showing the measurements of the Quadriceps tendon and Patellar ligaments in male subjects (mean ± S.E.) in millimeters.

There was no significant difference in the right and left sides both in the male and in the female specimens in all observations. However the length of the quadriceps tendon was more in the males as compared to the females; a similar significant difference was observed in the width of the

ligament. The patellar ligament was found to be significantly longer in the male specimen as was the width of this ligament in the male specimens. Thickness of the patellar ligament, however, was not significantly different in the two groups.

Quadriceps tendon						Patellar ligament					
Length QT-L		Width QT-W		Thickness QT-T		Length PT-L		Width PT-W		Thickness PT-T	
R	L	R	L	R	L	R	L	R	L	R	L
56.3±2.7	55.6±3.1	26.2±2.9	27.2±1.7	6.4±0.8	6.6±0.9	42.1±2.3	43.2±3.2	22.5±0.9	23.2±1.4	3.7±0.6	3.5±0.8

Table-II. Showing the measurements of the Quadriceps tendon and Patellar ligaments in female subjects (mean ± S.E.) in millimeters.

DISCUSSION

Injury to the ACL usually in the form of a tear is common and requires repair to restore function; failure to repair may lead to recurrent instability, damage to menisci and articular cartilage, and may proceed to osteoarthritis. Several options

have been tried in the past for reconstruction of the torn ligament e.g., bone-patellar tendon-bone composites, combined semitendinosus and gracilis hamstring tendons, and quadriceps tendon both as autografts and allografts. The allografts also include the Achilles tendon. The

degree of success considering clinical results has been variable; favored solution, though still controversial, remains autografts. The most common choices lie between the quadriceps tendon and the patellar ligament each having their advantages and disadvantages.¹⁴The reasons for making such choice are strength of the tissue, ease of harvesting the graft tissue and bone to bone healing after a secure fixation. The morphological characteristics of the quadriceps tendon and the patellar ligament are of prime importance for this purpose. The present study has addressed the same issue.

The study has provided useful morphometric data on the length, width and thickness of the quadriceps tendon and the patellar ligament both in the adult male and female subjects. The results indicated that measurements when compared were not significantly different on the right and left sides in the male and female groups. All measurements in the male group, however, were higher than those in the female group.

The length of the ACL is 31-38mm and the width is 11mm, on average.⁹The quadriceps tendon is sufficiently thick and wide and provides a plentiful source of tissue whereas the patellar ligament is not just as thick but is more dense and has greater tensile strength as already described by.²⁰Removal of one third of either of these structures does not have any effect on the stabilization of the knee joint.^{10,11}Both of these are therefore good source of useful tissue for reconstruction with patellar ligament having the added advantage of having more tensile strength and the possibility of vascularization by the inferior lateral or medial genicular artery branches. Our study has provided data to support the possible harvesting of tissue for ACL graft from the quadriceps tendon and patellar ligaments both in the adult male as well as in the female subjects.

Several factors need to be considered in selecting a graft material: it should be easily accessible, should rapidly ligamentize once implanted and be comparable to the strength of ACL. The central quadriceps tendon has the advantage of

being thicker and wider than the patellar ligament and therefore provides plenty of tissue for ACL reconstruction; the graft however is largely avascular and it takes long time to be taken by the surrounding tissues.¹⁶It has been shown in detailed vascular studies that the patellar ligament can be a good source for reconstruction tissue because a vascularized graft can be obtained using either the inferior lateral genicular artery or inferior medial genicular artery with the patellar tendon.¹⁷ Another novel type is a triangular graft involving one third of central patellar ligament, superficial part of the patella bone and part from the quadriceps tendon. The graft traverses through a tunnel in the lateral condyle of the femur and is sutured to distal end of femur.^{18,19}The choice of graft and the technique employed however remain the domain of the operating surgeon.

The quadriceps tendons and patellar ligaments have been tested for strength and load bearing capacity and have been found to be comparable in this regard¹⁹ the patellar ligament being stronger and tougher than the quadriceps tendon.²¹

CONCLUSION

It may be said in conclusion that both the quadriceps tendon and the patellar ligament are safe and convenient sources of autograft tissue for reconstruction of the ACL.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

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