

Morphometric measurement of adductor longus and its clinical application: A cadaveric study

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Abstract

Objectives: A profound knowledge of the anatomical organization of adductor muscle compartment is necessary to understand their functions, and to assist in the development of accurate clinical and biomechanical models. This study aims at providing appropriate morphometric measurements of adductor longus muscle.

Materials and Methods: The present study was conducted on 50 lower limbs. All limbs were fully dissected and measurements were taken with help of a steel tape.

Results: We found Adductor longus muscle in all the 50 dissected lower limbs (100%). The range of length and width of proximal aponeurosis varied from 4.1- 6.8cm and 0.8 -2.5cm respectively. The range of length of fleshy part (muscular belly) varied from 14.4 – 20.7cm. The range of length and width of distal aponeurosis varied from 9.8 – 13.9cm and 2.1 – 4.8cm respectively.

Conclusion: Our results would aid educational anatomy dissections, surgical interventions and help in management of many ailments.

Keywords: Cadaver, Adductor longus, Morphometry.

Introduction

A profound knowledge of the anatomical organization of adductor muscle compartment is necessary to understand their functions, and to assist in the development of accurate clinical and biomechanical models.¹

The adductors (adductor longus, adductor brevis and adductor magnus) originate proximally from the inferior aspect of the body and ramus of the pubis all three muscles insert distally on the femur, from a point beginning on the posterior aspect of the femur proximal to the linea aspera, along the linea aspera, to the adductor tubercle.²

The adductor longus is long triangular and relatively thin muscle. Its fibres are narrow proximally and straggle more distally. The anterior branch of the obturator nerve innervates the muscle. It is involved in adduction, external rotation, and anteflexion of the hip joint.³ Morphometry of muscles of lower limb has been attempted in the past.⁴⁻⁸ Muscle morphometry has helped researchers to improve understanding of muscle anatomy and function, in addition to studying the mechanics of human movement. For example, a direct relationship between a muscle's cross-sectional area (CSA) and its ability to generate force has been a fundamental hypothesis for numerous biomechanical studies.⁹

Elucidation of muscle architecture may provide useful information for selection of muscles used in tendon transfers. To substitute a lost muscle function,

the distal tendons of muscles often are transferred from one position to another.^{10,11} Muscle architecture has been studied regarding weight, number and size of muscle fibres.¹²

Reviewing the literature we found an extreme paucity of data pertaining to the details mentioning anatomical characteristics of adductor longus muscle taking into account the length, width of tendon/aponeurosis of origin, the length of its fleshy part (muscle belly), the length, and width of the tendon /aponeurosis of insertion. The present work attempts to provide a detailed morphometric profile of the adductor longus muscle.

Materials and Methods

Fifty lower limbs from 25 phenol embalmed adult cadavers were dissected in the Department of Anatomy. Out the fifty, forty –six were male limbs (23 cadavers) and four were female limbs (two cadavers). The cadavers were labelled from 1 to 25 with suffix R (Right) or L (Left). The adductor longus muscle was exposed and its origin and insertion were traced on the hip bone and femur as per the dissection steps provided by Cunningham's Manual of Practical Anatomy (Romanes, 1986). Each measurement was taken using a standard measuring tape.

The origin of muscle from the front of body of the pubis immediately below the pubic crest to the start of fleshy part was traced. The length of proximal aponeurosis/tendon was considered from origin of the

tendon upto the point where fleshy muscle fibres commenced (Fig. 1). The width of proximal aponeurosis of muscle on the body of pubis was also measured (Fig. 2). The muscle was then divided transversely near its origin. The proximal part of muscle was turned towards the distal part of femur. The aponeurotic insertion of the muscle onto the linea aspera of the femur was finally traced. The length of distal aponeurosis on the linea aspera was measured from the point where fleshy fibres ceased (Fig. 3). The width of distal aponeurosis was measured transversely from the linea aspera (Fig. 4). The length of the fleshy part of the muscle was also measured (Fig. 5).

Means and standard deviations of these measurements were calculated. All statistical analysis was done using SPSS.



AL: Adductor longus
Distance ab: length of proximal aponeurosis of adductor longus

Fig.1: Measurement of length of proximal aponeurosis of Adductor Longus (left limb)



AL: Adductor longus
Distance ab: Width of proximal aponeurosis of adductor longus

Fig. 2: Measurement of width of proximal aponeurosis of Adductor Longus (left limb)



AL: Adductor longus
Distance ab: length of distal aponeurosis of adductor longus

Fig. 3: Measurement of length of distal aponeurosis of the Adductor Longus (Right limb)



AL: Adductor Longus
Distance ab: width of distal aponeurosis of adductor longus

Fig. 4: Measurement of width of distal aponeurosis of the Adductor Longus (Right Limb)



AL: Adductor longus
Distance ab: length of fleshy part of adductor longus

Fig.5: Measurement of fleshy part of Adductor Longus (Right limb)

Table 1: Mean values (in cms) and standard deviation of various parameters of Adductor Longus (50 limbs)

S. N.	Parameters	Mean values	Standard deviation
1	Fleshy part	17.19	1.734788
2	Length of the proximal aponeurosis	5.246	0.715773
3	Width of the proximal aponeurosis	1.354	0.356405
4	Length of the distal aponeurosis	12.582	1.221022
5	Width of the distal aponeurosis	3.018	0.538209

Table depicting the values for the total sample i.e. 50 limbs from 25 cadavers.

Table 2: Mean values and standard deviation of various parameters of Adductor Longus in males (46 limbs)

S. N.	Parameters	Mean values	Standard deviation
1	Fleshy part length	17.3	1.726782
2	Length of the distal aponeurosis	5.308696	0.692444
3	Width of the distal aponeurosis	1.373913	0.362359
4	Length of the proximal aponeurosis	12.66522	1.137095
5	Width of the proximal aponeurosis	3.030435	0.55812

Table 3: Mean values and standard deviation of various parameters of Adductor Longus in females (4 limbs)

S. N.	Parameters	Mean values	Standard deviation
1	Fleshy part	15.925	1.452297
2	Length of the distal aponeurosis	4.525	0.65
3	Width of the distal aponeurosis	1.125	0.170783
4	Length of the proximal aponeurosis	11.625	1.905037
5	Width of the proximal aponeurosis	2.875	0.170783

Observations

We found Adductor longus muscle in all the 50 dissected lower limbs (100%). In all the 50 limbs the origin and the insertion of the muscle was according to the typical anatomical pattern. All these were recorded as shown in table 1. The range of length of proximal aponeurosis varied from 4.1- 6.8cm and the range of width of proximal aponeurosis varied from 0.8 -2.5cm. The range of length of fleshy part (muscular belly) varied from 14.4 – 20.7cm. The range of length of distal aponeurosis varied from 9.8 – 13.9cm and the range of width of distal aponeurosis varied from 2.1 – 4.8cm. The results of the mean values in both males and females are depicted in tables 2-4.

Discussion

Human bipedalism is an exclusive character with which we are able to stand and walk with trunk upright and knees nearly straight.¹³ The adductor muscles of medial compartment of thigh have an important role in balancing and stabilizing the trunk on the lower limb during walking.² These muscles adduct the femur and counteract the rotation of the pelvis, especially during the double support phase of gait, when the anterior

lower extremity is flexed and the posterior lower extremity is extended at hip.¹⁴

We could come across very few studies wherein research work has been done regarding morphometric analysis of adductor muscles of the thigh.¹⁵⁻¹⁸ The observations in these studies were based on non invasive techniques such as MRI and CT. Reviewing the literature we found that very few studies have been conducted on cadavers giving details of morphometry of these muscles.^{19,20} This gave us an impetus to concentrate our research on cadavers restricting to measurements pertaining to Adductor Longus.

After having dissected the region carefully, the morphometric and statistical analysis of the muscle was done. It was observed that both the origin and the insertion of the muscle was not exactly tendinous but the fibres formed an aponeurosis. The mean lengths of the fleshy part (muscle belly) was 17.3cms and the distal aponeurotic part (contractile part) was 5.3 cms. Not much could be assessed from the findings of female patients due to the paucity of female cadavers. These observations of ours are different from what has been mentioned in standard textbooks of anatomy.

Adductor longus injuries are serious and can be missed many a times. The muscle is known to tear from its insertion.²¹ Adductor longus tendon tear and strains have been found to occur in athletes.^{22,23} Subtotal or

total ruptures of the adductor longus muscle are rare.²⁴⁻²⁹

Insertional tendinopathy of the adductor longus is a common and problematic condition in elite athletes and may lead to rupture.²² Treatment of these would include transfer of tendon wherein a profound knowledge of muscle and tendon length is important.

Tendon transfer and tendon repair surgeries are being attempted by surgeons.^{9,10} It is here that Aponeurotic attachments especially the insertions can pose difficulties. Thus our detailed accounts of measurements can prove to be useful.

Athletes diagnosed with rupture of adductor longus tendon, acute repair with suture anchors is the treatment of choice. Gracilis and adductor longus are located in the same region of the human thigh, and the two are supplied by the same vascular source and nerve. Both are long strap muscles with good excursion. Overall, these characteristics make the two muscles candidates for the development of surgical procedures for double functioning free muscle transplantation (DFFMT) based on single vascular anastomosis.²³ A detailed morphometric analysis would certainly be of help to the surgeons doing such work.

Sport surgeons resort to adductor release and tenotomy only if other rehabilitative procedures fail to cure the patient of pain and debility.²⁰

Conclusion

Findings of the present study shall assist in understanding the muscle functions. Also as morphological features are in direct correlation with their function and this data might prove useful in further research in the field of myology and kinesiology. The knowledge of such morphometric analysis may be helpful to general surgeons and orthopaedic surgeons in the management of adductor longus injuries, tendon transfers and muscle transdisposition.

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