Original Article

Study on the Thicknesses and the Girths of Tendoachilles of Human Cadavers: Study in a Medical College

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Abstract

Study on the Thicknesses and the Girths of Tendoachilles of Human Cadavers.

Background: *Tendoachilles is the chief planter flexor of the ankle joint. It provides elastic energy storage in walking and running. The present study was planned to collect data to find out possible variations of thickness and girth between right and left leg of both male and female.*

Materials and methods: *A cross sectional analytical type of study was conducted in the department of Anatomy, Dhaka Medical College, Dhaka, from July 2013 to June 2014. The data was collected from both right and left tendoachilles of 60 human cadaver taken from Anatomy Department of different Government and Nongovernment Medical Colleges in Dhaka city. After dissection thickness and girth of tendoachilles was measured and recorded.*

Results: *Among 60 human cadaver, 30 are male and 30 are female. The mean thickness of tendoachilles was greater in right leg than in left leg at its junction with gastrocnemius in male, (P<0.001) at the level of 4 cm above its junction with calcaneus and at the level of its junction with calcaneus in both male and female. No significant difference was observed in the measurement of thickness of right and left tendoachilles at the level of its junction with gastrocnemius in female. Mean girth of tendoachilles was greater in right leg than in left leg at its junction with gastrocnemius, at the level of 4 cm above its junction with calcaneus and at the level of its junction with calcaneus in both male and female.*

Conclusions: *The present study revealed that thickness and girth of tendoachilles was greater in right leg than in left leg which were statistically significant. The difference in thickness and girth can be useful during repair of rupture tendon by orthopaedic and plastic surgeon.*

Key Words:
Tendoachilles; Thickness; Girth.

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Introduction

Tendoachilles is the largest, thickest and strongest tendon in the human body. It lies in the lower part of the posterior portion of the leg. It is about 15 cm long[1] formed by the conjoint tendon of insertion of gastrocnemius and soleus. It originates close to the middle of the calf, and fuses with the gastrocnemius proximally.[2,3] The medial and lateral heads fuse in a single muscle belly occupying the posterior superficial compartment of the lower leg. Its anterior surface receives muscle fibres from soleus almost at its distal end.[4] It inserts into the posterior surface of calcaneus at its mid level, a bursa separating it from bones proximal area.[5]

Tendoachilles is the prime mediator of plantarflexion of the foot at the ankle joint. Gastrocnemius provides the force for propulsion in walking and running. Soleus acting from below is said to be more concerned with steadying the leg on the foot in standing[6]. It provides elastic energy storage in walking and running. It has been suggested that the absence of a well-developed Achilles tendon would preclude them from effective running, both at high speeds and over extended distances.[7]

Some of the commonest pathologies of Achilles tendon are rupture, degenerative changes and inflammation.[8] Rupture

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of Achilles tendon is common in young active people. It occurs at its narrowest point, usually about 5 cm above the point it is inserted into the calcaneum.[9,10] Following rupture patient usually presents with the complaints of inability to walk and run effectively. Knowledge of exact anatomy of the musculotendinous junction of Tendoachilles is essential for the surgeon to treat these patients. There is a wide anatomical variation in the exact location of the musculotendinous junction of tendoachilles, which can lead to confusions amongst surgeons while identifying the location of a rupture and devising a treatment plan. Precise knowledge of tendoachilles anatomy would help the surgeon in such situations.[11]

In the Indian subcontinent, a fairly common crime pattern is seen where terrorists cut various tendons of the body, including the tendoachilles, as a form of revenge.

Tendoachilles undergo unique changes in some general diseases and even in the normal ageing process. Ultrasonic measurements of the tendon thickness has been proposed as a useful non invasive tool for detection and monitoring cholesterol accumulation in hemodialysis related amyloidosis.[12]

This study will be of help for sports medicine physicians, orthopaedic and plastic surgeons, radiologists and will upgrade the knowledge in surgical procedure.

Materials and methods

A total 120 tendoachilles of 60 human cadavers of different medical colleges in Dhaka city were studied. There are 60 tendoachilles (30 male and 30 female) of right leg and 60 tendoachilles (30 male and 30.female) of left leg of 60 human cadaver.

The body was placed on the dissection table in a supine position. At first the height of cadaver was measured from the top of vertex up to heel. Then the body was turned upside down. Back of thigh, leg and sole was cleaned. Then with the help of a scalpel, skin incision was given. Skin, superficial fascia and deep fascia were incised and reflected. After removing the deep fascia, the contents of the most superficial compartment of the posterior portion of the leg was exposed. The contents were 2 heads of gastrocnemius, soleus and tendon of plantaris. The muscles were cleaned from its superficial and deeper structure. Then following the lower end of gastrocnemius tendoachilles were identified and exposed. The thickness of tendoachilles were measured with digital slide calipers. Girth of tendoachilles was measured with the help of a measuring tape. After collecting the data the findings of this study was analyzed by SPSS version 17. Comparison of values between right and left leg was done by paired students t test.

Ethical clearance

This study was approved by ethical review committee of Dhaka Medical College.

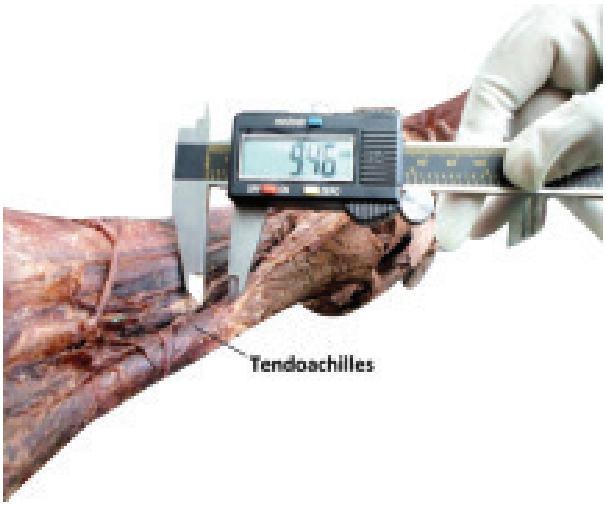

Fig.-1: *Method of measurements of thickness of tendoachilles*

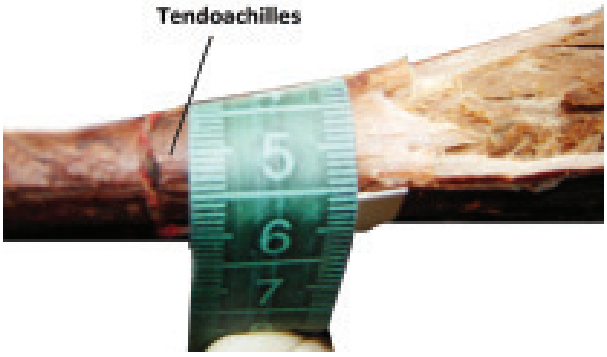

Fig.-2: *Method of measurements of girth of tendoachilles*

Results

Table-1

Thickness of tendoachilles at its musculotendinous junction with gastrocnemius of right and left leg in male and female cadavers

Sex	Thickness in cm		*P value*
	Right leg Mean±SD	Left leg Mean±SD	
Male (n=30)	1.76±0.21 (1.20 2.20)	1.67±0.16 (1.40 2.00)	0.009**
Female (n=30)	1.60±0.29 (1.20 2.20)	1.56±0.31 (1.20 2.20)	0.050ns
P value	0.017*		0.081ns

Figures in parentheses indicate range. Comparison between right and left leg done by paired Student's 't' test and comparison between male and female done by unpaired Student's 't' test, ns = not significant, * = significant at P<0.05, ** = significant at P<0.01.

60 right and 60 left tendoachilles from 60 human cadaver (30 male and 30 female)were included in this study. In male, thickness of tendoachilles at its musculotendinous junction with gastrocnemius of right and left leg was ranged from 1.20-2.20cm and 1.40-2.00cm respectively with a mean±SD of 1.76±0.21 cm and 1.67±0.61cm respectively. Statistically significant difference was observed between the thickness of tendoachilles of right leg and left leg in male. (P<0.01)Thickness of tendoachilles in female of right and left leg was ranged from 1.20-2.20cm and 1.20-2.20cm respectively with a mean of 1.60and 1.560.31respectively. The present study showed no statistically significant difference between the thickness of tendoachilles of right leg and left leg in female. (P>0.05)

Table - II

Thickness of tendoachilles at the level of 4 cm above its junction with calcaneus of right and left leg in male and female cadavers

Sex	Thickness in cm		*P value*
	Right leg Mean±SD	Left leg Mean±SD	
Male	1.16±0.11	1.10±0.16	0.001**
(n=30)	(1.00 1.40)	(0.70 1.30)	
Female	1.15±0.18	1.07±0.23	0.003**
(n=30)	(0.80 1.40)	(0.60 1.40)	
P value	0.808ns	0.629ns	

Figures in parentheses indicate range. Comparison between right and left leg done by paired Student's 't' test and comparison between male and female done by unpaired Student's 't' test, ns = not significant, ** = significant at P<0.01.

In male, thickness of tendoachilles at level of 4 cm above its junction with calcaneus of right and left leg was ranged from 1.00-1.40cm and 0.70-1.30cm respectively with a mean of 1.16 cmand 1.10cm respectively. Statistically significant difference was observed between the thickness of tendoachilles of right leg and left leg in male. (P<0.01) Thickness of tendoachilles in female of right and left leg was ranged from 0.80-1.40cm and 0.60-1.40cm respectively with a mean of 1.15and 1.070.23respectively. The present study showed statistically significant difference between the thickness of tendoachilles of right leg and left leg in female. (P<0.01)

Table - III

Thickness of tendoachilles at the level of its junction with calcaneus of right and left leg in male and female cadavers

Sex	Thickness in cm		*P value*
	Right leg Mean±SD	Left leg Mean±SD	
Male	1.60±0.18	1.51±0.25	0.0001***
(n=30)	(1.20 2.00)	(1.00 2.00)	
Female	1.56±0.17	1.41±0.22	0.0001***
(n=30)	(1.30 2.00)	(1.20 2.00)	
P value	0.388ns	0.106ns	

Figures in parentheses indicate range. Comparison between right and left leg done by paired Student's 't' test and comparison between male and female done by unpaired Student's 't' test, ns = not significant, *** = significant at P<0.001

In male, thickness of tendoachilles at the level of its junction with calcaneus of right and left leg was ranged from 1.20-2.00cm and 1.00-2.00cm respectively with a mean of 1.60and 1.51cm respectively. The present study showed statistically significant difference between the thickness of tendoachilles of right leg and left leg in male. (P<0.001) In female, thickness of tendoachilles of right and left leg was ranged from 1.30-2.00cm and 1.20-2.00cm respectively with a mean of 1.56 cmand 1.410.22 respectively. Statistically significant difference was observed between the thickness of tendoachilles of right leg and left leg in female. (P<0.001)

Table - IV

Girth of tendoachilles at its musculotendinous junction with gastrocnemius of right and left leg in male and female cadavers

Sex	Girth in cm		*P value*
	Right leg Mean±SD	Left leg Mean±SD	
Male	10.97±1.85	10.81±2.01	0.013*
(n=30)	(8.00 14.00)	(7.20 14.00)	
Female	8.70±2.04	8.51±1.85	0.019*
(n=30)	(6.00 12.00)	(6.00 11.50)	
P value	0.0001***	0.0001***	

Figures in parentheses indicate range. Comparison between right and left leg done by paired Student's 't' test and comparison between male and female done by unpaired Student's 't' test, * = significant at P<0.05, *** = significant at P<0.001

In male, girth of tendoachilles at its musculotendinous junction with gastrocnemius of right and left leg was ranged from 8.00-14.00cm and 7.20-14.00cm respectively with a mean of 10.97and 10.81cm respectively. Statistically significant difference was observed between the girth of tendoachilles of right leg and left leg in male. (P<0.05) Girth of tendoachilles in female of right and left leg was ranged from 6.00-12.00cm and 6.00-11.50cm respectively with a mean of 8.70and 8.511.85respectively. The present study showed statistically significant difference between the girth of tendoachilles of right leg and left leg in female. (P<0.05)

Table -V

Girth of tendoachilles at the level of 4 cm above its junction with calcaneus of right and left leg in male and female cadavers

Sex	Girth in cm		*P value*
	Right leg Mean±SD	Left leg Mean±SD	
Male	3.75±0.73	3.67±0.70	0.0001***
(n=30)	(3.00 6.80)	(3.00 6.60)	
Female	3.48±0.34	3.32±0.31	0.002**
(n=30)	(2.60 4.30)	(2.50 4.00)	
P value	0.064ns	0.016*	

Figures in parentheses indicate range. Comparison between right and left leg done by paired Student's 't' test and comparison between male and female done by unpaired Student's 't' test, ns = not significant, * = significant at P<0.05, ** = significant at P<0.01, *** = significant at P<0.001

In male, girth of tendoachilles at the level of 4 cm above its junction with calcaneus of right and left leg was ranged from 3.00-6.80cm and 3.00-6.60cm respectively with a mean of 3.75and 3.67cm respectively. Statistically significant difference was observed between the girth of tendoachilles of right leg and left leg in male. (P<0.001) Girth of tendoachilles in female of right and left leg was ranged from 2.60-4.30cm and 2.50-4.00cm respectively with a mean of 3.48 and 3.320.31 respectively. The present study showed statistically significant difference between the girth of tendoachilles of right leg and left leg in female. (P<0.01)

Table - VI

Girth of tendoachilles at the level of its junction with calcaneus of right and left leg in male and female cadavers

Sex	Girth in cm		*P value*
	Right leg Mean±SD	Left leg Mean±SD	
Male	6.02±0.87	5.90±0.91	0.004**
(n=30)	(4.00 6.80)	(4.00 6.80)	
Female	5.70±0.70	5.54±0.71	0.0001***
(n=30)	(3.80 8.00)	(3.50 8.00)	
P value	0.127ns	0.093ns	

Figures in parentheses indicate range. Comparison between right and left leg done by paired Student's 't' test and comparison between male and female done by unpaired Student's 't' test, ns = not significant, ** = significant at P<0.01, *** = significant at P<0.001

In male, girth of tendoachilles at the level of its junction with calcaneus of right and left leg was ranged from 4.00-6.80cm and 4.00-6.80cm respectively with a mean of 6.02and 5.90cm respectively. Statistically significant difference was observed between the girth of tendoachilles of right leg and left leg in male. (P<0.01) In female, girth of tendoachilles of right and left leg was ranged from 3.80-8.00cm and 3.50-8.00cm respectively with a mean of 5.70and 5.540.71respectively. There was statistically significant difference observed between the girth of tendoachilles of right leg and left leg in female. (P<0.001)

Discussion

Thickness of tendoachilles at its musculotendinous junction with gastrocnemius.

In the present study, the thickness of tendoachilles at its junction with gastrocnemius was found more in right leg in both male and female. (In male P<0.01 and in female P>0.05). The thickness of tendoachilles was more in right leg of male than in female (P<0.05). The thickness of left tendoachilles in male was found more than the corresponding value in female. (P>0.05).

The findings of the present study could not be compared with the findings of other study due to lack of relevant data.

Thickness of tendoachilles at the level of 4cm above its junction with calcaneus

In the present study, the thickness of tendoachilles at the level of 4cm above its junction with calcaneus was found more in right leg in both male and female which was statistically significant.. Between male and female the thickness of tendoachilles of right leg was statistically not

different. The thickness of left tendoachilles in male was found more than the corresponding value in female (P<0.01) . The study findings could not be compared with the findings of others due to lack of relevant literature.

Thickness of tendoachilles at the level of its junction with calcaneus

In the present study, the thickness of tendoachilles at the level of its junction with calcaneus was found more in right leg in both male and female which was statistically significant. Between male and female the thickness of tendoachilles of right leg was statistically not different (P>0.05). The thickness of left tendoachilles in male was found more than the corresponding value in female which was statically not significant.

In Hong Kong, Pang and Ying[14] conducted of 40 subjects by ultrasonography (2006, p.1295). They reported 0thickness of tendoachilles in right leg and 0.509 thickness in left leg. Statistically significant difference was observed when the thickness of tendoachilles recorded by Pang and Ying compared with the thickness of right and left tendoachilles of both male and female of the present study. The difference in thickness may be due to difference in ethnicity and difference in method of measurement. In 2014 Egwu *et al.*[15] conducted a study in Nigeria by ultrasound method. They recorded 0.62 thickness of tendoachilles in right leg and 0.63 thickness in left leg. Both the values for right leg and left leg were smaller than the values in both male [(right leg, P<0.0001) and (left leg, P<0.0001)] and female [(right leg, P<0.0001) and (left leg, P<0.0001)] of the present study. This difference may be due to the different ethnic groups and different method of measurements on which Egwu *et al.* carried out their studies.

Girth of tendoachilles at its musculotendinous junction with gastrocnemius

In the present study, the girth of tendoachilles at the level of its junction with gastrocnemius was found more in right leg in both male and female. (In male P<0.05 and female P<0.05). The girth of tendoachilles was more in right tendoachilles of male than in female (P<0.001). The girth of left tendoachilles in male was found more than the corresponding value in female which was statistically significant.. The findings of the present study could not be compared with the findings of other study due to lack of relevant data.

Girth of tendoachilles at the level of 4 cm above its junction with calcaneus

In the present study, the girth of tendoachilles at the level of 4cm above its junction with calcaneus was found more in right leg in both male and female which was statistically significant.. The girth of right tendoachilles was more in male than in female. (P>0.05). The girth of left tendoachilles in male was found more than the corresponding value in female. (P<0.05). The findings of the present study could not be compared with the findings of other study due to lack of relevant data.

Girth of tendoachilles at the level of its junction with calcaneus

In the present study, the girth of tendoachilles at the level of its junction with calcaneus was found more in right leg in both male and female which was statistically significant.. Between male and female the girth of tendoachilles of right leg was statistically not different. The girth of left tendoachilles in male was found more than the corresponding value in female. (P>0.05). The findings of the present study could not be compared with the findings of other study due to lack of relevant data.

Conclusion: The study revealed that, mean thickness of tendoachilles was greater in right leg than in left leg at its junction with gastrocnemius in male, (P<0.001) at the level of 4 cm above its junction with calcaneus and at the level of its junction with calcaneus in both male and female. No significant difference was observed in the measurement of thickness of right and left tendoachilles at the level of its junction with gastrocnemius in female. Mean girth of tendoachilles was greater in right leg than in left leg at its junction with gastrocnemius, at the level of 4 cm above its junction calcaneus and at the level of its junction with calcaneus in both male and female. Further ultrasound study of living tendoachilles and comparison of the ultrasound finding with the cadaveric thickness and girth of tendoachilles might be beneficial in this regard.

Conflicts of interest: No conflict of interest was declared.

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