Morphometric Study of the Medial Meniscus of the Knee Joint in thirty Adult Male Cadavers

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Abstract

The objective of this study was to collect data and find morphometric variations in human beings meniscus. For this, 30 adult knees were studied to provide a baseline data of medial meniscus for morphometric parameters as this data was scarce in literature. The medial menisci form 60 knees of 30 adult male cadavers were properly dissected and dried. The parameters namely weight, inner circumference, outer circumference, width and thickness were tabulated, analyzed and comparison was made between meniscus of right and left side. Statistical analysis used was paired t-test. The average range of weight of medial menisci of both the knees is from 1.40-2.49 g. The average range of inner circumference of medial menisci of both the knees is from 6.5-11.6 cm. The average range of width of anterior segment of medial menisci of both the knees is from 0.5-1.5 cm. The average range of the width of middle segment of medial menisci of both the knees is from 0.7-1.6 cm. The average range of the width of posterior segment of medial menisci of both the knees is from 1.0-2.0 cm. On applying paired t-test between medial menisci of left and right knee, p value was found to be >0.05 which showed no significant difference in all these parameters.

Keywords: Morphometric variations, medial meniscus, adult male cadavers, knee joint, paired t-test.

Introduction

The average width of normal meniscus is 12-13. The medial meniscus is C-shaped and it is wider anteriorly than posteriorly (Moore and Dalley, 2001). Its anterior insertion is fan shaped and attached to the tibial plateau and to the intercondylar notch above, about 6-7 mm anterior to the fixation of the anterior cruciate ligament (Moreno, 1995). Its posterior insertion is on the intercondylar area of the tibia between the posterior insertion of the lateral meniscus and anterior to the fixation of the posterior cruciate ligament (Messner and Gao, 1998). Blood supply was identified in the peripheral third of the meniscus around the 22nd week of gestation (Petersen and Tillmann, 1995). At birth, almost the entire meniscus is vascularized. In the second year, a vascular area along the central margin of the meniscus is developed. Cohen et al. (1998) observed that there was also a relationship between the vascular indices in these regions and ages indicating that the values of the vascularization indices decreased with their increase.

In a study, conducted by Almeida et al. (2004), on 44 menisci of 22 knee of adult men corpses, the result obtained were as follows: related to the thickness of outer circumference of the meniscus, a statistically significant difference was not observed (p>0.05) among the lateral meniscus, the medium third was the thickest part (p<0.05). Comparing the average values of medial meniscus with the values of lateral meniscus, it was observed that in the anterior and posterior thirds, the medial meniscus was significantly thicker as compared to the lateral meniscus. Thickness of medial meniscus in anterior 3rd was 5.92±1.337 mm, in middle 3rd was 5.31±1.06 mm, in posterior 3rd was 5.91±1.13 mm that of lateral meniscus in anterior 3rd was 3.71±1.15 mm, in middle 3rd was 6.10±1.04 mm and in posterior 3rd was 5.29±0.78 mm.

In the study conducted by Almeida et al. (2004), the individual analysis of each meniscus showed that the posterior 3rd was the widest part of the medial meniscus (p<0.05); while in the lateral meniscus, no statistically significant (p>0.05) difference was observed among the three examined points. Width of medial menisci in anterior 3rd was 9.02±1.59 mm, in middle 3rd was 12.16±2.58 mm, in posterior 3rd was 17.37±2.22 mm, that of lateral menisci in anterior 3rd was 11.86±1.81 mm, in middle 3rd was 11.97±.56 mm, in posterior 3rd was 11.44±1.07 mm, in the middle 3rd, there was no statistically significant difference when comparing the lateral and the medial menisci (p>0.05). However, the anterior and the posterior thirds showed a statistically significant difference between the two groups. The relation of area of meniscus/area of tibial plate showed a percentage average value of 54.70±7.32% in the medial part and 48.67±4.43% in the lateral part (p<0.01). The distance between the anterior and posterior cornua of medial meniscus (29.70±4.12 mm) was significantly higher than (p<0.05) lateral meniscus (12.71±1.84 mm).
In another study conducted by Braz and Silva (2010) on 40 menisci from 20 knees, it was observed that there was no statistically significant difference in the length of the outer circumference (p>0.05) between the medial (91.85±5.66 mm) and lateral meniscus (92.80±7.52 mm). The distance between the anterior and posterior horn of the medial meniscus (25.88±3.33 mm) was significantly higher than that of the lateral meniscus (12.55±1.98 mm). With regard to the width of the lateral meniscus, there was no significant difference between the anterior (11.32±1.46 mm), medium (11.16±1.64 mm) and posterior third (11.67±1.54 mm). However in the medial meniscus, the posterior 3rd was the widest part (14.96±2.66 mm) followed by the mid (9.32±2.24 mm) and anterior 3rd (7.68±1.36 mm). Comparing the width of the medial and lateral menisci, a statistically significant difference (p<0.05) in three points was found. With regard to the thickness of the meniscus, which was also measured at three points, the posterior 3rd of the medial meniscus was the smallest (5.18 mm) followed by anterior (6.17 mm) and medium (6.31 mm) showing an average of 5.88 mm. On the other hand, in the lateral meniscus, the anterior third was the smallest (4.40 mm) followed by the posterior (5.46 mm) and medium (6.52 mm) thirds and their average value was 5.46 mm. It can be said that the width and thickness were inversely related, the greater the width of one of the thirds, the smaller the thickness, while the opposite was also true.

In a morphometric analysis of the menisci of the knee joint in south Indian human fetuses by Murlimanju et al. (2010), the menisci were obtained from 106 knee joints of the formalin fixed South Indian fetuses. There were some statistically significant morphometrical differences found between the right and left side joints and also between the two sexes. The peripheral and inner border lengths of medial meniscus (26.66±4.69 mm and 14.72±4.05 mm) were significantly more than (p<0.00, p<0.00) the lateral meniscus (25.14±4.05 mm and 12.59±3.22 mm). Related to the thickness of outer circumference of meniscus, anterior third (1.61±0.39 mm) of the medial meniscus was the thickest part (p<0.003, p<0.003) compared to posterior (1.48±0.36 mm) and middle thirds (1.47±0.35 mm). There was no statistically significant difference found between the posterior and middle thirds (p=1). Statistically significant difference was not observed (p=0.36, p=0.06 and p=0.66) among the anterior, middle and posterior thirds of lateral meniscus. Comparing the average values of medial meniscus with the values of lateral meniscus, a statistically significant difference (p<0.05) was not observed relating to the thickness. The average thicknesses of the medial and lateral menisci were 1.52±0.37 mm and 1.53±0.38 mm respectively. In the study conducted by Murlimanju et al. (2010), the individual analysis of each meniscus showed that the posterior third (3.28±0.62 mm) was the widest part of the medial meniscus (p<0.00, p<0.00) than the anterior (2.94±0.61 mm) and middle thirds (2.88±0.61 mm). There was no statistically significant difference found between the anterior and middle thirds (p=0.72). In the lateral meniscus, the middle third parts (3.53±0.75) was the widest (p<0.00, p<0.008) compared to the posterior (3.44±0.63 mm) and the anterior third parts (3.26±0.60 mm). There, was no statistically significant difference found between the anterior and posterior thirds (p=0.34).

Comparing the average values of medial meniscus with the values of lateral meniscus, the lateral meniscus was wider than the medial meniscus (p<0.05). The average width of the medial and lateral menisci was 3.04±0.62 mm and 3.41±0.66 mm respectively. The distance between the anterior and posterior horns of the medial meniscus (3.79±0.89 mm) was significantly more than (p<0.00) the lateral meniscus (1.56±0.61 mm).

The objective of this study was to collect data and find morphometric variations in human beings meniscus and 30 adult knees were studied to provide a baseline data of medial meniscus for morphometric parameters.

Materials and methods

Experimental design and parameters studied: The medial menisci from 60 knees of 30 adult male cadavers were properly dissected and dried. The following parameters were taken:
1. weight
2. Inner circumference
3. Outer circumference
4. Width
5. Thickness

Weight was taken by electronic balance and three readings were taken in grams by three different individuals and average of three readings was calculated and recorded. For parameters 2, 3 and 4 the following method was applied. Three points were marked on the meniscus. 1st point on anterior cornu (horn) called anterior apical point and 2nd point on posterior cornu on convex side called posterior apical point of outer circumference point and 3rd point on posterior cornu on concave side called posterior apical point of inner circumference. The concave length of the inner circumference from anterior apical point to posterior apical point on the inner circumference was measured by silk thread and was divided by 3 points A, B, C into 4 equal parts. The convex length of the outer circumference from anterior apical point to posterior apical point on the outer circumference was measured and similarly this was divided by 3 points A’, B’, C’ into 4 equal parts. Points were transferred from inner circumference to outer circumference. The width of the meniscus at these points was measured i.e. A-A’, B-B’, C-C’ as shown in Fig. 1. Average width at each point was calculated. The thickness of the meniscus was determined using the same width points and then the thread was placed between the top and bottom edge in the outer circumference only (Fig. 2 and 3). The data so obtained was collected, recorded, tabulated and analyzed.
Statistical analysis: Data were analyzed statistically using the student t-test for independent samples and the level of significance was 0.05.

Results and discussion
In the present study, the weight range of medial menisci of left knee is from 1.44-2.49 g with mean weight of 1.87. The weight range of medial menisci of right knee is from 1.40-2.21 g with mean weight of 1.84. On applying the statistical analysis (paired t-test) between weight of medial menisci of left and right knee, p value was found to be >0.05 which shows that there is no significant difference between weight of left and right medial menisci. In the present study, the range of inner circumference of medial menisci of left knee is from 4.2-9.8 cm with mean inner circumference of 6.4 cm. The range of inner circumference of medial menisci of right knee is from 4.6-8.8 cm with mean inner circumference of 6.2 cm. On applying the statistical analysis (paired t-test) between inner circumference of medial menisci of left and right knee, p value was found to be >0.05 which shows no significant difference between the inner circumference to left and right medial menisci.

In the present study, the range of outer circumference of medial menisci of left knee is from 6.08-11.6 cm with mean outer circumference of 9.7 cm. The range of outer circumference of medial menisci of right knee is from 6.5-11.5 cm with mean outer circumference of 9.2 cm. On applying the statistical analysis (paired t-test) between outer circumference of medial menisci of left and right knee, p value was found to be >0.05 which shows no significant difference between the outer circumference of left and right medial menisci. The width range of anterior segment of medial menisci of left knee is from 0.5-1.5 cm with mean width of 1.00 cm. The width range of anterior segment of the medial menisci of right knee is from 0.5-1.5 cm with mean width of 0.9 cm. On applying the statistical analysis (paired t-test) between the two, p value was found to be >0.05 which shows no significant difference between them. The width range of middle segment of medial menisci of left knee is from 0.7-1.6 cm with mean width of 1.10 cm. The width range of anterior segment of the medial menisci of right knee is from 0.7-1.6 cm with mean width of 1.0 cm. On applying the statistical analysis (paired t-test) between the two, p value was found to be >0.05 which shows no significant difference between them. The width range of posterior segment of medial menisci of left knee is from 1.0-2.0 cm with mean width of 1.50 cm. The width range of posterior segment of the medial menisci of right knee is from 1.1-1.8 cm with mean width of 1.40 cm (Fig. 4). On applying the statistical analysis (paired t-test) between the two, p value was found to be >0.05 which shows no significant difference between them.
When analyzing the thickness of the outer circumference of the medial meniscus, the posterior third (5.18±1.55 mm) appeared thinner compared to the anterior (6.17±1.68 mm) and medium thirds (6.31±1.73 mm). There was no significant difference between these anterior and medium third.

**Conclusion**

Following are the conclusive points derived at the end of the study:

1. No statistically significant difference was found between outer circumference of right and left knee medial meniscus.
2. No statistically significant difference was found between weight of right and left knee medial meniscus.
3. No statistically significant difference was found between inner circumference, width of anterior, middle segment between right and left knee medial meniscus.
4. Width of posterior segment of both sides was significantly higher than anterior and middle segment.

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**References**