

An Anatomical Study Of Femoral Sulcus Angle On Dry Bones

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Abstract: Background: The distal end of femur has immense importance from the anatomical, functional and clinical point of view. The femoral sulcus angle is formed by two lines joining the highest points on the medial and the lateral condyles which meet at the lowest point on the intracondylar groove of the femur. Aim: This study aims to determine the size of femoral sulcus angle in local population. Due to difficulty in the determination of the gender of the femur we have limited our study to left and right bones. Material and Methods: Attempts are made to measure the sulcus angle of the femora. Study was carried out in the anatomy department of Smt. NHL Municipal Medical College, Gujarat state. Total 150 dry femora were analyzed and statistical analysis was done by using appropriate software. The femora were placed in a supine position on a flat table and with a goniometer the measurement was performed. To avoid faulty measurement and error, all the femoral angles were calculated by a single researcher. Result: Our results show the mean value of sulcus angle in right femora is 143.625° and left is 143.39° . The standard deviation is 9.269° in right and 8.9919° in left femora. The result of unpaired t test is 0.7519. The p value is 0.98 which is insignificant. Conclusion: There is no significant difference in the value of sulcus angle between right and left femora. This study gives us an idea about the mean size of the femoral sulcus angle in population. [Kathayat P Natl J Integr Res Med, 2020; 11(2):60-63]

Key Words: sulcus angle, patello-femoral joint, femora.

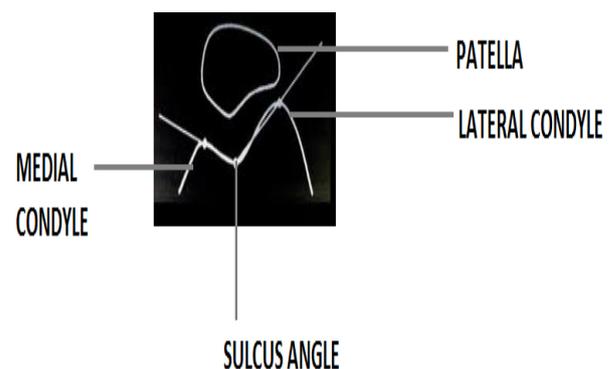
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Introduction: The femoral trochlear groove is formed by both the condyles on each side, is at situated at the end of the femur. The angle that is formed by joining two lines from the highest point on medial and lateral condyle that meet at lowest point of intercondylar groove is called the sulcus angle¹. The femoral sulcus angle forms an articular surface for patella and is very important for patellofemoral stability².

The femur not only forms the skeleton of thigh but also carries the body weight and supports movements and provides attachment of muscles of the leg³. The sulcus angle along with lateral to medial facet ratio of patellar groove can have an effect on patella tracking in patients with normal and stable knee joints⁴.

Though there have been evidences from the literature that the morphology of the femoral trochlear groove in fetuses is similar to that of adults, but the gender differences in the orientation have not been clearly delineated^{5,6}. During genesis, it has been seen that the medial condyle is originally larger than the lateral one³. It is believed that femoral dimensions and their characteristics might be population specific even within the same region and groups of different

ethnicity. It was because of this that this study was designed to obtain baseline morphometric data for this population to determine the size of femoral sulcus angles in local population using the skeletal collection in the department of Anatomy, Smt NHL Municipal Medical College. We have limited our research to left and right femoral sulcus angle analysis as gender differentiation in dry bones was not feasible.



Material and Methods: Total 150 femora of adults were studied from the skeletal collection in the Department of Anatomy, Smt NHL Municipal Medical College Gujarat. Bones were divided into left and right femora with all the deformed and broken bones excluded from the sample. The sample consists of all femora belonging to the local population of Gujarat. A goniometer was used to measure the sulcus

angle. To measure the sulcus angle, the femora was placed in a supine position on a flat table and, with a goniometer, the measurement of the sulcus angle was performed at 30° opposite and below the longitudinal axis of the femur. This is known as Merchant radiological view. The goniometer is placed on femur with the fulcrum on the lowest point of the intercondylar groove and then measured with joining the highest points on the medial and lateral condyles of the femur. All femora were measured by the same researcher to avoid misgauging and to reduce the rate of error. As it is difficult to determine individual's sex from a single femur so we confined our study to the evaluation of the sulcus angle in the right and left bones. Total 74 right femora and 76 left femora were analyzed.

The data obtained were summarized as means ± standard deviations; mean value, median and average range. SPSS for Windows 10.0 was used for the statistical analysis. Student's t test was used for left and right dry bone measurements. The p value is also calculated for research purpose.

Results: The sample we have studied had 150 bones 74 right femora and 76 left femora. The right femora were analyzed together left femora were separately studied (Table 1). Combined analysis is given in table below (Table 1).

Table 1: Profile Of Study Population

Values Of Femoralsulcus Angles	Right Femora	Left Femora	Combine d Analysis
121-130	5%	7%	6%
131-140	32%	32%	32%
141-150	42%	46%	44%
151-160	16%	14%	15%
161-170	4%	1%	3%

The pie charts representing the total data analysis of right and left femora is presented below(Chart 1 and 2). The combined analysis is also done and represented after it(Chart 3).

Chart 1, 2: Pie Charts Of Femoral Sulcus Angle Distribution In Right (Topmost) And Left Femora (Below)

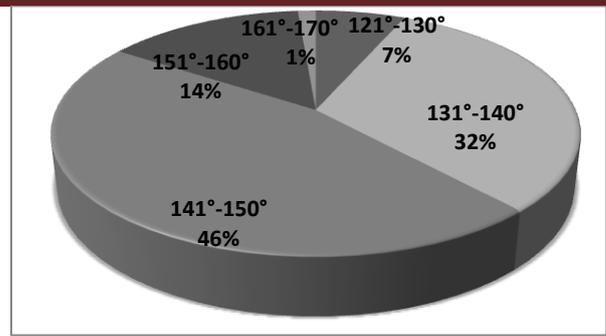
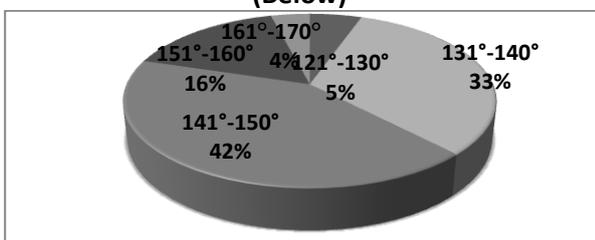
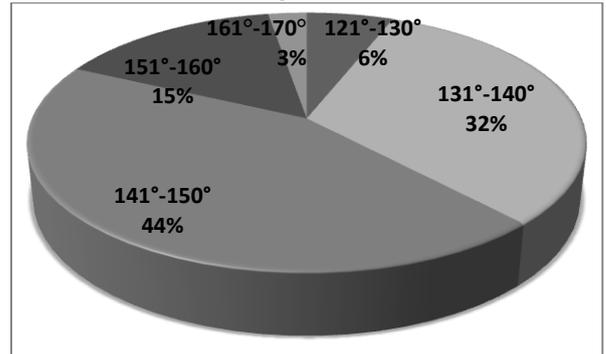


Chart 3: Combined Analysis Of All The Femora (Both Right And Left)



In our study, the sulcus angles in the right and left dry bones were 121°-166° (mean 143.625° ± SD 9.269°) and 124°-164° (mean 143.9° ± SD 8.991°), respectively (Table 2). In the femoral bones measurements, no statistically significant differences were found between the right and left angle (P =0.98) (Table 2).

Table 2: Femoral Sulcus Angle And Its Comparative Result In Right And Left

Findings	Right Femora	Left Femora
Total No. (Out Of 150 Femora)	74	76
Maximum	166	164
Minimum	121	124
Mean Value (Average Value)	143.625	143.39
Standard Deviation	9.269	8.9919
Median	144	145
T TEST	0.7519	
P VALUE	0.98	

Discussion: In this study, we didn't find any significant difference in the mean femoral sulcus angles in left and right femora. Murshed et al conducted a similar study in Turkey on 80 human dry femora and 100 magnetic resonance images (MRI) - 50 females, 50 males and no significant differences in the mean femoral sulcus angles between left and right femora was seen⁷.

Nietosvaara also stated that no significant difference in the mean sulcus angle was noted between left and right femur of 100 knees of 25 boys and 25 girls after conducting a similar research⁸.

Also according to research by Mwakikunga⁹ there was no difference in the mean values of left and right femur was noted in study of 196 femur bones. For this reason, observation of present study suggest that there is no difference between left and right femoral sulcus angle giving a mean value and a range of sulcus angle for the population we conducted research on. This supports the earlier reported population specific studies. Brattström¹⁰ provided us with the value of the mean osseous intercondylar angle of 142° in normal knees with his research. According to Merchant¹¹, the normal sulcus angle has been defined as 138°. On measuring 100 human adult cadaver knees, the mean femoral sulcus angle was 144°¹² by Buard Jean. So comparing are research with previously performed research we get no significant difference.

We do not find significant difference comparing our research with another similar research such as Murshed et al (2003) reported to have right and left mean value as 142.3 and 142.5 respectively with standard deviation of 9.7 and 7.9 in right and left respectively. The t test value result was 0.517 in their research with p value of 0.987. In our results, if the right and left dry femurs are considered together, the mean sulcus angle is 142.4°. Thus, our results are in agreement with those obtained by Brattström¹⁰ and, compared with those of Merchant¹¹, our results were several degrees larger.

Another research Mwakikunga et al (2016) reported almost similar result of 142.2 and 141.2 for mean value of right and left femoral sulcus angle individually analyzed. Standard deviation in their study was 9.7 and 7.9 in right and left respectively. But the result of the combined femora is result of t test is 0.517 with p value of 0.02609 is contradicting our result (p value=0.98). Our research does provide the idea about the difference in sulcus angle and other parameters amongst different genders. Also radiological findings are not considered in the study.

Previously conducted studies show us the relation between sulcus angle, groove size and

posture or gait of the person¹³. Even the dysplasia of this area leads to recurrent patellar luxation¹⁰. The shape of the condyles of the femur modify and affect the stability of the patella and changes in them may lead to change in the groove size leading to patellar lateralization and other problems^{14,5,15}.

Conclusion: Our study has calculated and then provided the mean size, standard deviation and a normal range of the femoral sulcus angle of adult local population. There are no significant differences in the size of the femoral sulcus angles in left and right. This study is conducted in different parts of the world and they all give us different result of groove size and angle. Even after doing a population specific research still we found a lot of difference in groove size and angle.

This difference and asymmetric dimensions of the femoral sulcus angle in the population may suggest the genetic, nutrition, racial and life style variations prevalent in the population. Clinical importance of our study is in determining the stability of patellofemoral joints. Clinicians dealing with cases of pathologic alterations in the sulcus angle and misalignments of the patellofemoral joint will find the finding of our study important to rule out the diagnosis and it is also useful in forensic medicine.

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