

MORPHOMETRIC STUDY OF FEMORAL CONDYLES IN DRY ADULT HUMAN FEMUR BONE

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Abstract

Background: Femur is the thigh bone which is longest and strongest bone of the lower limb. Distal end of femur which has medial and lateral condyles in conjunction with the proximal end of tibia and patella, functions as a knee joint. Knowledge of different parameters of Femoral condyles can be useful for total knee replacement surgeries because of common occurrence of knee osteoarthritis. It facilitates orthopedician to select appropriate size knee prosthesis based on the morphometric data obtained. **Materials and Methods:** 40(20 on each side) Dry Human Femur of adult age and unknown sex were collected from Department of Anatomy of Government medical college, Bhavnagar. Different parameters like Anteroposterior and Transverse diameter of both Femoral condyles and Bicondylar width of Each Femur bone is measured using Vernier calliper and Statistical analysis of the parameters was done. **Results:** Average Anteroposterior diameter of right and left medial condyle is 54.81 ± 3.30 and 55.88 ± 5.19 respectively. Average Anteroposterior diameter of right and left Lateral condyle is 56.01 ± 3.22 and 55.85 ± 3.94 respectively. Average Transverse diameter of right and left medial condyle is 22.50 ± 1.65 and 23.71 ± 2.87 respectively. Average Transverse diameter of right and left Lateral condyle is 22.63 ± 1.81 and 22.45 ± 1.54 respectively. Average Bicondylar width of right and left femur is 71.35 ± 3.56 and 71.18 ± 4.65 respectively. **Conclusion:** Knowledge about different parameters of Femoral Condyles are essential for manufacturing the knee implants which are suitable for Indian population, Particularly for Gujarat state. So appropriate selection of implant will decrease the chances of mismatch and complications of surgery and will provide good Clinical outcome.

INTRODUCTION

The femur, the strongest and longest bone in the body, is located in the thigh. It has two ends and one shaft. Its upper end articulates with the hip bone to form the hip joint, while its lower end features two condyles—the medial and lateral condyles—separated posteriorly by an intercondylar notch. The lower end of the femur connects with the upper end of the tibia and patella, forming the knee joint. The knee joint is a complex, modified hinge joint. Osteoarthritis of the knee is now common, particularly among the elderly and obese. This chronic condition causes pain, stiffness, tenderness, and swelling in the knee joint, making knee replacement surgery a beneficial option for patients. However, complications can arise from inappropriate implant and prosthesis selection. Therefore, choosing the correct size and type of implants and prostheses is crucial for successful knee replacement surgery. Morphometric measurements are often taken using indirect methods such as magnetic resonance

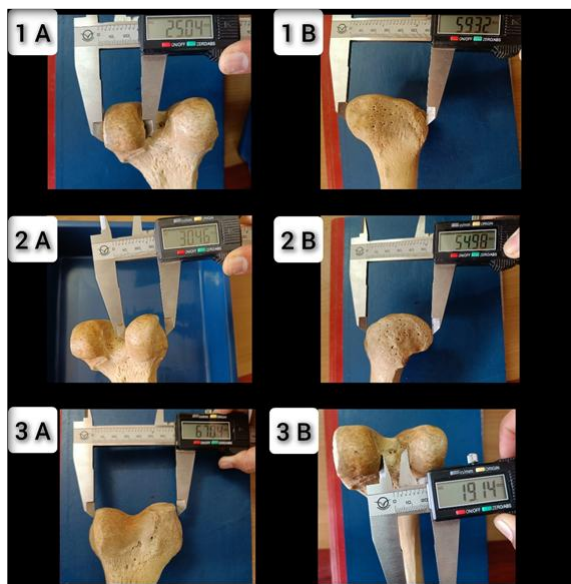
imaging (MRI) and computed tomography (CT). However, these methods can sometimes yield inaccurate results. Direct morphometric measurement of the femoral condyles may be more reliable. In this study, we conducted a morphometric analysis of both femoral condyles in the state of Gujarat.

MATERIALS AND METHODS

This prospective observational study was carried out in the Department of Anatomy at Government Medical College, Bhavnagar. A total of 40 dry adult human femur bones of indeterminate sex were examined, sourced from the department. The sample comprised 20 bones from the right side and 20 from the left. Bones selected for the study had completely ossified epiphyses and were intact. Bones that were fractured, damaged, or deformed were excluded.

Measurements were taken using a digital vernier caliper for the following parameters

1. Bicondylar Width: The widest horizontal distance between the two femoral epicondyles.
2. Medial Condylar Antero-Posterior Distance (MC-AP): The widest distance from the anterior to the posterior surface of the medial femoral condyle.
3. Medial Condylar Transverse Distance (MC-TD): The widest distance between the medial and lateral surfaces of the medial femoral condyle.
4. Lateral Condylar Antero-Posterior Distance (LC-AP): The widest distance from the anterior to the posterior surface of the lateral femoral condyle.
5. Lateral Condylar Transverse Distance (LC-TD): The widest distance between the medial and lateral surfaces of the lateral femoral condyle.
6. Width of Intercondylar Notch (W-ICN): The widest distance between the posterior parts of the medial and lateral surfaces of the intercondylar notch.



- 1A: illustrates the measurement of the MC-TD
 1B: illustrates the measurement of the MC-APD
 2A: illustrates the measurement of the LC-TD
 2B: illustrates the measurement of the LC-AP
 3A: illustrates the measurement of BCW
 3B: illustrates the measurement of the W-ICN

RESULTS

An investigation was conducted on 40 dry adult human femur bones, the sex of which was not specified. This sample comprised 20 femurs from the right side and 20 from the left side. The study focused on various morphometric parameters, including the mean bicondylar width, medial condylar anteroposterior distance, lateral condylar anteroposterior distance, medial condylar transverse distance, and lateral condylar transverse distance. For the right-sided femurs, the mean bicondylar width was found to be 71.35 ± 3.56 mm, with a medial condylar anteroposterior distance of 54.81 ± 3.30 mm, a lateral condylar anteroposterior distance of 56.01 ± 3.22 mm, a medial condylar transverse distance of 22.50 ± 1.65 mm, and a lateral condylar transverse distance of 22.63 ± 1.81 mm. In contrast, the left-sided femurs exhibited a mean bicondylar width of 71.18 ± 4.65 mm, a medial condylar anteroposterior distance of 55.88 ± 5.19 mm, a lateral condylar anteroposterior distance of 55.85 ± 3.94 mm, a medial condylar transverse distance of 23.71 ± 2.87 mm, and a lateral condylar transverse distance of 22.45 ± 1.54 mm. Detailed statistical analyses, including minimum, maximum, mean, and standard deviation values of right and left sided bones are presented in Tables 1, while Table 2 summarizes these parameters for all 40 femur bones.

Table 1

PARAMETERS	SIDE OF FEMUR							
	RIGHT SIDE				LEFT SIDE			
	MAX.	MIN.	MEAN	SD	MAX.	MIN.	MEAN	SD
BCW	77.4	65.03	71.35	3.56	77.75	62.26	71.18	4.65
MC APD	60.53	50.29	54.81	3.3	70.71	47.28	55.88	5.19
LC APD	62.34	50.82	56.01	3.22	61.36	49.7	55.85	3.94
MC TD	24.92	18.96	22.5	1.65	32.21	19.41	23.71	2.87
LC TD	30.46	19.1	22.86	2.43	25.86	19.05	22.45	1.54
W-ICN	24.69	16.05	21.16	2.17	25.76	15.17	20.6	2.99

Table 2

PARAMETERS	MIN.	MAX.	MEAN	SD
BCW	62.26	77.75	71.26	4.08
MC APD	47.28	70.71	55.51	4.33
LC APD	49.7	62.34	55.93	3.55
MC TD	18.96	32.21	23.1	2.39
LC TD	19.05	30.46	22.66	2.01
W-ICN	15.17	25.76	20.88	2.6

DISCUSSION

Comparison of present study with other Studies

Author and region of the study	MC APD		LC APD		MC TD		LC TD		BCW		W-ICN	
	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left
Mistri S et al.,[2],2015,West Bengal 127 bones(65 R,62 L)	-	-	-	-	-	-	-	-	74.43 ± 6.1	73.98 ± 5.99	19.12 ± 2.5	18.65 ± 2.8
Terzidis I et al.,[5],2012,Greek 360 bones(180R,180L)	58.6 ± 4.1	58.7 ± 4.1	58.4 ± 4	58.5 ± 4	-	-	-	-	84.1 ± 0.62	83.7 ± 0.63	20.5 ± 2.3	20.5 ± 2.2
Ravichandran D et al.,[20]2010,South India (200 bones,106R,94L)	-	-	-	-	-	-	-	-	74.58 ± 0.57	73.97 ± 0.61	18.89 ± 0.29	18.65 ± 0.27
Shweta J et al.,[22],2017,North India 100 bones (51R,49L)	-	-	-	-	-	-	-	-	73.1 ± 6.14	72.16 ± 6.58	20.82 ± 2.57	21.03 ± 3.13
Biswas A et al.,[23],2017,West Bengal 70 bones(35R,35L)	52.97 ± 3.77	54.74 ± 3.85	56.2 ± 3.36	56.05 ± 4.29	25.48 ± 2.05	27.28 ± 2.29	27.8 ± 2.91	28.03 ± 2.56	71.71 ± 4.5	70.71 ± 5.25	20.86 ± 2.52	19.45± 2.57
Present study	54.81 ± 3.3	55.88 ± 5.19	56.01 ± 3.22	55.85 ± 3.94	22.5 ± 1.65	23.71 ± 2.87	22.86 ± 2.43	22.45 ± 1.54	71.35 ± 3.56	71.18 ± 4.65	21.16 ± 2.17	20.60± 2.99

This study's results have been compared with those from similar research, as illustrated in the table above.

In this study, the average anteroposterior diameter of the medial condyle is 54.81±3.30 mm on the right and 55.88±5.19 mm on the left. These values are smaller than those reported by Terzidis et al. (58.6±4.1 mm right, 58.7±4.1 mm left) but larger than those reported by Biswas et al. (52.97±3.77 mm right, 54.74±3.85 mm left).

For the lateral condyle, our study shows an anteroposterior diameter of 56.01±3.22 mm on the right and 55.85±3.94 mm on the left, closely matching Biswas et al.'s results (56.20±3.36 mm right, 56.05±4.29 mm left) but smaller than Terzidis et al.'s findings (58.4±4.0 mm right, 58.5±4.0 mm left).

The transverse diameter of the medial condyle in our study measures 22.50±1.65 mm on the right and 23.71±2.87 mm on the left, which are smaller than Biswas et al.'s measurements (25.48±2.05 mm right, 27.28±2.29 mm left). Similarly, the transverse diameter of the lateral condyle in our study is 22.86±2.43 mm (right) and 22.45±1.54 mm (left), smaller than Biswas et al.'s findings (27.80±2.91 mm right, 28.03±2.56 mm left).

Our study reports a bicondylar width of 71.35±3.56 mm on the right and 71.18±4.65 mm on the left,

which is similar to Ravichandran et al.'s measurements (74.58±0.57 mm right, 73.97±0.61 mm left) but smaller than those reported by Mistri et al., Terzidis et al., Shweta et al., and Biswas et al. (74.43±6.10 mm right, 73.98±5.99 mm left; 84.1±0.62 mm right, 83.7±0.63 mm left; 73.1±6.14 mm right, 72.16±6.58 mm left; 71.71±4.50 mm right, 70.71±5.25 mm left).

Finally, the intercondylar notch width in our study is 21.16±2.17 mm on the right and 20.60±2.99 mm on the left, similar to Shweta et al.'s findings (20.82±2.57 mm right, 21.03±3.13 mm left), but smaller than those reported by Mistri et al., Terzidis et al., Ravichandran et al., and Biswas et al. (19.12±2.5 mm right, 18.65±2.8 mm left; 20.5±2.3 mm right, 20.5±2.2 mm left; 18.89±0.29 mm right, 18.65±0.27 mm left; 20.86±2.52 mm right, 19.45±2.57 mm left).

CONCLUSION

This study employed a direct method in conjunction with a digital vernier caliper to meticulously measure a variety of morphometric parameters. These parameters are pivotal in the development and production of prostheses and knee implants essential for knee replacement surgeries. The detailed dataset generated from these measurements can provide

orthopedic surgeons with invaluable information to accurately select the optimal prosthesis size for individual patients. This precise selection process has the potential to significantly reduce post-operative complications and improve the overall surgical outcome for patients undergoing knee replacement procedures.

Abbreviation

MC-TD: Medial condyle transverse diameter
MC-APD: Medial condyle anteroposterior diameter
LC-TD: Lateral condyle transverse diameter
LC-APD: Lateral condyle anteroposterior diameter
BCW; Bicondylar width
W-ICN: Intercondylar notch width
MAX.: Maximum
MIN.: Minimum
SD: Standard deviation.

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