Morphometric Analysis of Lower End of Femur and Its Clinical Significance

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ABSTRACT

BACKGROUND

We wanted to study the morphometry of lower end of adult dried femur in Coimbatore region of Tamilnadu, India and evaluate its clinical significance.

METHODS

72 adult ossified femoral dry bones (both right and left), which were available in our Department of Anatomy were studied. This is a prospective observational study, conducted over a period of three months. Using digital vernier caliper with millimeter adjustment, the measurements were taken from lower end of femur and the parameters were studied.

RESULTS

The mean bicondylar width R: 74.85 mm ± 5.14, L: 73.37 mm ± 5.04; AP diameter of medial condyle, R: 53.50 mm ± 8.49, L: 50.96 mm ± 7.28; lateral condyle, R: 52.91 mm ± 7.92, L: 52.83 mm ± 6.80; Transverse diameter of medial condyle, R: 32.20 mm ± 2.20, L: 31.29 mm ± 2.71; Lateral condyle, R: 32.30 mm ± 2.27, L: 31.89 ± 2.38; Inter condylar width, R: 21.98 mm ± 2.52, L: 21.01 mm ± 2.06.

CONCLUSIONS

This study gives the detailed analysis of morphometry of lower end of femur as a sample from south Indian population in Coimbatore region of Tamilnadu.

KEYWORDS

Bicondylar Width, Femur, Inter Condylar Width

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BACKGROUND

Femur, the thigh bone is the largest and one of the strongest bones in the body. It transmits the body weight and gives stability to the human, as its lower end is widely expanded, providing good weight bearing surface over the superior surface of the tibia.[1] The lower end of femur is enlarged to form the medial and lateral condyles and forms the knee joint by articulating with patella in front and corresponding condyles of tibia below and behind.[2] Both condyles project backwards separated by the intercondylar fossa. Outer surface of both condyles are rough and convex and most prominent point on the convexity known as epicondyles. During development the secondary ossification centre for the lower end of femur appears at 9th month of intrauterine life and it fuses with the shaft between 16th and 18th yrs. of post-natal life.[3]

Primary osteoarthritis of knee joint is due to constant wear and tear, as it is a degenerative joint disease,[4] particularly seen in old age. For advanced damage to the joint and in crippling condition, total joint replacement operation, provides remarkable rehabilitation in life of affected individual. The design feature of the ideal prostheses should allow more than 100^0 of stable flexion, permit rotational laxity in the transverse plane, poses inherent stability in both mediolateral and anteroposterior planes, and have a low co-efficient of friction between sliding surfaces.[5] For the above said condition to prevail the detailed morphometric analysis of medial and lateral femoral condyles needed, that prevails over the population in particular area, for making ideal prosthesis in knee replacement. Present study is done to evaluate the morphometry of femoral condyles among Tamilnadu state population in India as a sample.

METHODS

72 Adult ossified femoral dry bones (both right and left) were taken, which were available from our Department of Anatomy, Government Medical College and ESI Hospital Coimbatore, Tamilnadu. This is a prospective observational study, conducted over a period of three months.

Using digital vernier caliper with millimeter adjustments the measurements were taken from lower end of femur and the following parameters were studied-

1. The maximum transverse diameter (bicondylar width),
2. Anteroposterior diameter of both medial and lateral femoral condyles,
3. Transverse diameter (width) of both medial and lateral condyles,
4. Intercondylar width of femur.

Only adult, dried femur bones available in Dept. of Anatomy. Fractured bones, unossified and osteoporotic bones were excluded from the study.

RESULTS

The parameters obtained were analysed. Quantitative data were expressed as mean and standard deviation. The difference between two groups with respect to continuous variables were analysed using unpaired T test. The p-value of less than 0.05 was considered as statistically significant.

	Right (36) (In Millimeters)				Left (36) (In Millimeters)			
Parameter	Min	Max	Mean	Sd	Min	Max	Mean	Sd
BCW	62.20	83.57	74.85	5.04	64.30	83.40	73.37	5.14
MCAP	40.10	66.05	53.50	8.49	38.40	66.05	50.96	7.28
LCAP	40.14	65.24	52.91	7.92	40.60	65.24	52.83	6.80
MCT	27.54	36.40	32.20	2.20	28.30	36.41	31.29	2.71
LCT	26.20	37.43	32.30	2.27	27.58	37.44	31.89	2.38
ICW	15.81	27.23	21.98	2.52	13.96	25.58	21.01	2.56

Table 1. Parameter Results in Millimeters

Parameter	Right & Left Difference (p-value)	Statistically Significant (ss) Not Significant (ns)
Bicondylar width	0.2215	Ns
Lat condyle ap	0.9635	Ns
Med condyle ap	0.1774	Ns
Med condyle tran	0.1223	Ns
Lat condyle tran	0.4570	Ns
Intercondylar w	0.1097	Ns

Table 2. Right and Left Comparison

Above data shows statistically no significance difference between the values of all parameters, compared to the right and left side.

DISCUSSION

Previous studies done at national and international levels are compared. Bicondylar width (BCW) and intercondylar width (ICW) comparative table is shown below-

Sl. No.	Population, Number of Bones and Year of Study	BCW		ICW	
		R	L	R	L
1	Terzidis I et al[6] Greekbones n= 360 (2012)	84.10 ± 00.62	83.70 ± 00.63	20.05 ± 02.30	20.50 ± 02.20
2	Ravichandaran et al[7] South India n=200 (2010)	74.58 ± 00.57	73.97 ± 00.61	18.89 ± 00.29	18.65 ± 00.27
3	Ameet KJ et al[8] North India n=97 (2014)	72.50 ± 05.30	73.30 ± 05.30	18.00 ± 03.00	17.90 ± 02.50
4	Mistri et al[9] West Bengal n=127 (2015)	74.43 ± 06.10	73.98 ± 05.99	19.12 ± 02.50	18.65 ± 02.80
5	Biswas et al West Bengal n=70(2017)	71.71 ± 04.50	70.71 ± 05.25	20.86 ± 02.52	19.45 ± 02.57 ±
6	Hiren s Chavda et al[10] Gujarat N=74 (2019	69.60 ± 05.04	69.80 ± 04.96	20.40 ± 03.17	18.70 ± 02.52
7	Present Study n=72 (2020)	74.85 ± 05.04	73.17 ± 05.14	21.98 ± 02.52	21.01 ± 02.56

Table 3. Results of Previous Studies Done in Various Geographical Areas

On comparison with previous studies done, the bicondylar width measurement shows significant difference with study done by Hiren S Schavda et al, Biswas et al of north Indian population. And Terzidis et al, of Greek population. No significance difference seen in the studies done by Mistri et al, Ammer KJ et al and Ravidharan et al (of south Indian population).

Regarding the intercondylar width, the present study has no significance with all previous studies except Ravidharan et al of south Indian population with measurement of 18.0 mm $\pm$ 3.0 on Right and 17.9 mm $\pm$ 2.5 on left.

Study	MC AP	LC AP	MCT	LCT	MC AP	LC AP	MCT	LCT
Biswas et al 2017	52.97 ± 03.77	56.20 ± 03.36	25.48 ± 02.05	27.80 ± 02.91	54.74 ± 03.85	56.05 ± 04.29	27.28 ± 02.29	28.03 ± 02.56
Hiren et al 2019	52.90 ± 04.99	54.07 ± 04.01	26.70 ± 02.03	30.30 ± 03.05	53.50 ± 04.15	55.00 ± 04.31	26.90 ± 02.23	29.60 ± 02.03
Present Study 2020	53.50 ± 08.49	52.91 ± 07.92	32.20 ± 02.20	33.30 ± 02.27	50.96 ± 07.28	52.83 ± 06.80	31.29 ± 02.71	31.89 ± 02.38

Table 4. Studies with All Parameters

Based on the above data the medial and lateral femoral condyle anteroposterior diameter, shows significant difference with Biswas et al and Hiren S Chavda et al, where the lateral condyle measurements are more in both right and left side.

The values of transverse diameter of both medial and lateral femoral condyles compared to the Biswas et al and Hiren S Chavda et al shows significant difference with increased values in present study.

Sl. No	Previous Study	Parameter	Right	Left
1	Terzidis I et al	BCW	< 0.05 Significant	<0.05 Significant
		ICW	<0.05 Significant	<0.05 Significant
2	Ravichandaran et al	BCW	0.456 Not significant	0.152 Not significant
		ICW	<0.05 Significant	<0.05 Significant
3	Ameet KJ et al	BCW	<0.05 Significant	<0.05 Significant
		ICW	<0.05 Significant	<0.05 Significant
4	Mistri et al	BCW	0.452 Not significant	0.524 Not significant
		ICW	<0.05 Significant	<0.05 Significant
5	Biswas et al	BCW	<0.05 Significant	<0.05 Significant
		ICW	<0.05 Significant	<0.05 Significant
6.5	Hiren s chavda et al	BCW	<0.05 Significant	<0.05 Significant
		ICW	<0.05 Significant	<0.05 Significant

Table 5. Comparison with Previous Studies

Study	MC AP	LC AP	MCT	LCT	MC AP	LC AP	MCT	LCT
1.Biswas et al	0.633 NS	<0.05 SS	<0.05 SS	<0.05 SS	<0.05 SS	56.05 ± 04.29	<0.05 SS	<0.05 SS
2.Hiren et al	0.602 NS	0.264 NS	<0.05 SS	<0.05 SS	<0.05 SS	<0.05 SS	<0.05 SS	<0.05 SS

Table 6. Comparison with Studies of All Parameters

In addition other previous studies done related to morphometry of lower end of femur were also analysed and it's salient features are presented here: The difference in mean bicondylar width in Indian population is due to short stature as compared to caucausians.[11] There is age related differences in dimensions of distal femur, patients under 40 yrs. of age need different knee implant design compared to the older people.[12]

Selection of appropriate implant according to different ethnic specifications will minimise mismatch and increase in clinical outcome.[13] Morphometric evaluation of Korean femurs shows most of the parameters were larger in males than in females.[14] The proximal - distal condylar length (PDCL) can be measured from most proximal condylar margin which is useful in surgical settings.[15] There is a statistically significant incremental reduction in AP and ML dimension of lower end of femur with an increase in age.[16]

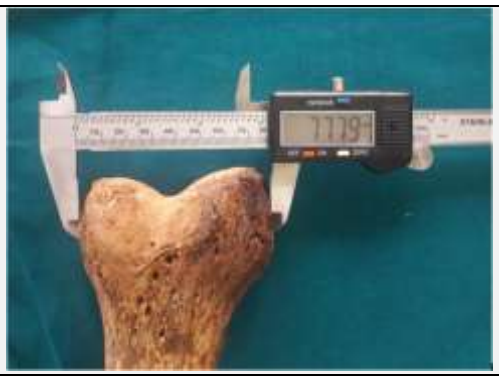

Figure 1. Bicondylar Width Measured in mm.

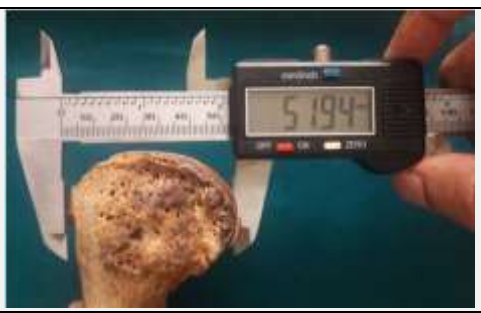

Figure 2. Lateral Condyle AP Diameter in mm

CONCLUSIONS

The above study gives detailed analysis of morphometry of lower end of femur as a sample from south Indian population in Coimbatore region of Tamilnadu. Morphometry of the bone varies among different races, and populations. The present study gives additional information for making an ideal prosthesis.

Financial or Other Competing Interests: None.

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