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RESEARCH ARTICLE

MORPHOMETRIC STUDY OF DISTAL END OF FEMUR IN INDIAN POPULATION.

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Abstract

Introduction: Knee joint is one of the most important joint needed for locomotion but unfortunately it's commonly affected by degenerative diseases, which ultimately lead to joint replacement surgery. Anthropometric measurements of distal femur will help in appropriate designing of knee joint replacement prosthesis.

Methods: In this study eighty adult dry femurs were taken for distal anthropometric measurements in department of anatomy, government medical college Jammu. Bicondylar Width and transverse diameter of femur shaft were measured using vernier caliper.

Results: The mean Bicondylar width of 80 femurs studied was 74.96 ± 5.35 millimeters (mms), of which 42 right sided femurs had mean Bicondylar width of 74.98 ± 5.91 mms and in 38 left sided femurs it was 74.94 ± 4.74 mms. The mean transverse shaft diameter of studied femurs was 24.88 ± 2.07 mms of which right sided femurs had mean transverse diameter of 25.07 ± 2.19 mms and in left sided femurs it was 24.67 ± 1.94 mms.

Conclusion: The measurements obtained will help biomedical engineers in designing the knee replacement prosthesis of appropriate size for Indian patients undergoing knee replacement surgeries.

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Introduction:-

The femur is longest weight bearing bone of human skeleton. It measures around 45 centimeters in length in an average adult man that constitutes approximately one-fourth of the height of an individual. The femur consists of upper and lower ends with intervening shaft. The shaft is aligned obliquely as two femora are widely separated above by pelvis but lie closer at the knee joint. Shaft is almost cylindrical throughout its length and is bowed forward. The proximal end is rounded represented by articular head which projects medially from its short neck. The distal extremity of femur consists of widely expanded double condyles which partly bear articular surface for transmission of weight to the distally placed bone tibia. Anteriorly the two condyles are confluent and continue into the shaft but posteriorly they are separated from each other by a deep intercondylar fossa, projecting beyond the plane of the popliteal surface. In distal end of femur the articular surface for the patella and the tibia is a broad area in the shape of inverted U.^(1,2,3,4,5,6,7)

The knee joint replacement surgery is one of the most commonly performed procedures these days, that requires accurate placement of well- fitted implants with adequate balancing of the surrounding soft tissues. For achieving normal functional range of motion in prosthetic knee it is important to use an appropriate sized femoral component. In addition, any mismatch in size between native bone and prosthesis may lead to several complications. Placement of undersized femoral component will result in implant loosening, while an oversized component may lead to impingement of soft tissues surrounding the knee joint. Hence the use of appropriate sized prosthesis is crucial for successful total knee arthroplasty procedure. ⁽⁸⁾ This makes knowledge of anthropometric measurements of distal femur highly important for designing appropriate knee joint replacement prosthesis.

Aims & Objectives:-

1. To study Bicondylar width and shaft transverse diameter of available dry femora in medical college Jammu.
2. To generate anthropometric data of lower end of femur for designing appropriate knee prosthesis.
3. To compare the generated data with the previous works in the field.

Material & Methods:-

Total 80 dry adult sized femurs of undetermined sex available in the Anatomy department of Government Medical Colleges, Jammu were taken for the study. Bones that on gross inspection had any evidence of fracture, deformity or post-mortem damage were excluded from the study. In order to measure bi-condylar width and transverse diameter of distal shaft each femur was placed on the smooth horizontal surface of a Physical Anthropometry table, with their posterior surface of condyles and greater trochanter touching the table surface. Bone holding clamps were used to keep femur in place, while taking measurements.

Vernier caliper was used for measuring maximum Bicondylar width (Fig.1).⁽⁹⁾ Transverse diameter of each bone was measured at midpoint of femoral length using vernier Caliper (Fig. 2) and recorded for computation. All measurements were taken by single author for consistency. The measurements taken were rounded up to two decimal places.⁽¹⁰⁾

Observation & Results:-

Out of 80 femurs taken for the study 42 were of right side and 38 belonged to the left side. it was observed from the frequency distribution table that Bicondylar width of 10 (23.81%) right side femora fell between 65.00 mm and 69.99 mm, 15 (35.71%) had Bicondylar width between 70.00-74.99 mm and in 11 (26.19%) it measured in the range of 75.00 mm to 79.99 mm, so out of the 42 right sided femora 36 (85.71%) had Bicondylar width in the range of 65.00 –79.99 mm (Table I). Bicondylar width of 9 (23.68%) left sided femurs was observed to be between 65.00 mm and 69.99 mm, 14 (36.84%) had Bicondylar width in range of 70.00-74.99 mm and in 10 (26.32%) it was in the range of 75.00 mm to 79.99 mm. Thus out of 38 left sided femur 33 (86.84%) were between 65.00 mm and 79.99 mm (Table II).

The mean Bicondylar width on statistical analysis for right sided femur was 74.98 mm with standard deviation of 5.91. Similarly, the mean Bicondylar width for left sided femora was found to be 74.94 mm with standard deviation of 4.74. When total 82 femora considered, the mean Bicondylar width of 74.96 ± 5.35 mm was obtained (Table III). The mean Bicondylar width on right side femurs was observed to be higher than that of left side. The measurements obtained were statistically analyzed to determine whether the differences were statistically significant or not. The SPSS software student's t-test was used to analyze values. The results obtained were $t = 0.398$ in $df = 78$ had a $P > 0.05$. Thus the difference in mean Bicondylar width between right and left sided femurs observed in present study was statistically insignificant.

Transverse diameter of shaft was measured at the midpoint of each femur length. The shaft width measured at that level of 37 (88.10%) femurs out of total 42 right sided study sample fell between 22.50 and 29.99 millimeters (Table IV). The shaft width of 34 (89.47%) out of 38 left sided femur was found to be between 20.00 and 27.49 millimeters (Table V). The mean shaft width of right sided femurs was 25.07 millimeters while as of left sided femurs it was 24.67 millimeters with standard deviations of 2.19 and 1.94 respectively. The mean shaft width for total 80 femora was 24.88 millimeters with standard deviation of 2.07 (Table VI). When student's t-test was applied, $t = 0.267$ with $df = 78$ had $P > 0.05$, thus variation in mid-shaft width between the two sides was found to be statistically insignificant.

Discussion:-

One of the important factors which govern long-term success of total knee prosthesis is their appropriate matching to size and width of femoral condyles.⁽⁸⁾ Several research works have been done to generate anthropometric data for designing knee prosthesis.^(11,12,13,14 15,16,17,18) In many of these researches the Bicondylar width was measured as sole or a part of some other Parameter of lower femora. In our present study left vs. right bi-condylar width variation was found to be statistically insignificant (Table III). in Caucasian (Greek) population the mean Bicondylar width has been found to be 83.90 mm±6.3 mm by Terzidis et al.⁽⁷⁾ In comparison, our study had mean Bicondylar width of 74.96 ± 5.35 mm, this difference is supposed to be due to short stature of indian population as compared to Caucasians. Mean shaft width in right sided femurs was 25.07± 2.19 mm. while of left side femurs it came to be 24.67 ± 1.94 mm, However student's t-test showed difference between left and right mean shaft widths statistically insignificant with P > 0.05.

Conclusion:-

Knee Replacement surgery these days is one of the commonest procedures performed for the treatment of various pathological conditions related to knee joint. The data collected in this study regarding Bicondylar femoral width in Indian group of population will help biomedical engineers in designing appropriate knee replacement prosthesis, which will fit better in Indian group of patients undergoing knee replacement surgeries that will in turn result in better post-operative outcome as well as better long term sustainability of such implants.

Table I:-Frequency distribution of bicondylar width in right sided femora (n = 42)

Bicondylar width (mm)	Frequency in numbers	Percentage of total
60.0 – 64.9	2	4.76
65.0 – 69.9	10	23.81
70.0 – 74.9	15	35.71
75.0 – 79.9	11	26.19
80.0 – 84.9	4	9.52
TOTAL	42	100

Table II:-Frequency distribution of bicondylar width in left sided femora (n = 38)

Bicondylar width (mm)	Frequency in numbers	Percentage of total
60.0 – 64.9	2	5.26
65.0 – 69.9	9	23.68
70.0 – 74.9	14	36.84
75.0 – 79.9	10	26.32
80.0 – 84.9	3	7.89
TOTAL	38	100

Table III:-Comparison between bicondylar widths of left and right side. n = 80

Sidedness	Number of femora studied	Mean Bicondylar width (mm)	Standard Deviation
Right	42	74.98	5.91
Left	38	74.94	4.74
TOTAL	80	74.96	5.35

t = 0.398 d f = 78 P > 0.05

Table IV:-Frequency distribution of shaft widths in right sided femora (n =42)

Shaft width (mm)	Frequency in numbers	Percentage of total
20.00 – 22.49	5	11.90
22.50 – 24.99	10	23.81
25.00 – 27.49	20	47.62
27.50 – 29.99	7	16.67
TOTAL	42	100.00%

Table V:-Frequency distribution of shaft widths in left sided femora (n=38)

Shaft width (mm)	Frequency in numbers	Percentage of total
20.00 – 22.49	8	21.05
22.50 – 24.99	18	47.37
25.00 – 27.49	8	21.05
27.50 – 29.99	4	10.53
TOTAL	38	100.00%

Table VI: Comparison between shaft widths of left and right side. n=80

Sidedness	Number of femora studied	Mean shaft width (mm)	Standard Deviation
Right	42	25.07	2.19
Left	38	24.67	1.94
TOTAL	80	24.88	2.07

$t = 0.267$ $df = 78$ $P > 0.05$

**Figure 1:**-Bi-codylar width measurement



Figure 2:-Measurement of Femoral shaft width

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