



MORPHOMETRIC STUDY OF FEMORAL CONDYLES IN VISAKHAPATNAM ZONE OF ANDHRA PRADESH REGION

Anatomy

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ABSTRACT

Knee joint is a very important joint in lower limb . In this joint lower end of femur is having a more significance because ,knee replacement surgeries are very commonly performed surgeries in now a days as osteoarthritis of knee is a common disorder in old people. Implants /prosthesis of knee are commonly placed in replacement surgeries .Proper measurement of femoral condyles is having a more advantage in minimizing the complications of surgery ,faster healing after surgery. Total 100 dry femurs of unknown sex belongs to right ,left side are observed for present study.the following measurements are taken during the study : bicondylar width ,AP Diameter & transverse diameter of medial condyle , AP Diameter & transverse diameter of lateral condyle ,length & width of inter condylar notch .The present study provides very important morphometric data of femoral condyles ,so it is very helpful in designing ,manufacture of knee implants and further helps in better results of knee replacement surgeries.

KEYWORDS

Morphometric Data ,femoral Condyles , Bicondylar Width , Knee Implants

INTRODUCTION

The knee joint is a hinge type of synovial joint , it is very complex joint having a articulation of lower end of femur ,upper end of tibia & patella and forming femoro tibial ,femoro patellar components.Usually on anterior aspect of lower end of femur both condyles are continued ,but on posterior aspect both are separated by intercondylar notch (1).

Morphometric measurements of femoral condyles are very important for designing the knee implants & prosthesis (2).Direct method of measuring the femoral condyles plays a beneficial role in proper designing the implants ,which minimizes the complications of surgery (3) . Indirect methods like magnetic resonance imaging(MRI) ,Computerised tomography (CT) , Radiography are used for designing the implants (4-7),which were mostly inaccurate (8-10) .

In the knee implant ,femoral component is very important .So,morphometric assessment of femoral condyles is crucial in selection of proper sized implant(11,12). Now a days degenerative arthritis of knee is becoming more common in old age people & obese people. As it is a very painful condition ,knee replacement surgery is becoming very popular (13) .Total beneficial outcome of surgery is completely depends on proper selection and placement of implant .Usually for asian population small sized knee implants more suitable than big sized implants(14).

MATERIALS AND METHODS

This is a prospective study conducted in the department of Anatomy, Andhra medical college ,Visakhapatnam , Andhra Pradesh ,india , during the year 2019 &2020. In this present study ,totally 100 dry femur bones of unknown sex are used .Complete & clean femur bones are used for the study ,damaged & old bones are excluded from the study. With the help of vernier calipers ,the following parameters were measured.

- 1) Bicondylar width : Distance in between the ends of medial & femoral condyles
- 2) AP-MC : Antero posterior diameter of medial femoral condyle

- 3) AP-LC : Antero posterior diameter of lateral femoral condyle
- 4) T-MC : Transverse diameter of medial femoral condyle
- 5) T-LC : Transverse diameter of lateral femoral condyle
- 6) L-ICN : Length of inter condylar notch
- 7) W-ICN : Width of inter condylar notch

Quantitative data of the following study is usually expressed as mean and standard deviation .Difference in between 2 groups with respect to continuous variables are analysed using unpaired T Test. Most of the statistical tests are performed with SPSS VERSION 2.0 software .The p value <0.05 is considered as highly statistically significant.

RESULTS

Method of the measurement of several morphometric measurements of femoral condyles are showed in figures from fig no:1- 6. In our study 100 femur bones were assessed for morphometric study.In these 50 bones are right , 50 are left bones. Out of all bones ,mean bicondylar width was 73.26 ± 5.521 mm on right side , 73.70 ± 5.549 mm on left side ($p > 0.05$) .Mean antero posterior diameter of medial condyle on right side is 56.64 ± 4.848 mm , On left side is 58.02 ± 5.313 mm ($p > 0.05$) . Mean antero posterior diameter of lateral condyle on right side is 57.40 ± 4.499 mm, on left side is 59.30 ± 4.200 mm ($p < 0.05$) (p value is 0.031).Mean transverse diameter of medial condyle on right side is 29.74 ± 4.746 mm , On left side is 28.90 ± 3.131 mm ($p > 0.05$) .Mean transverse diameter of lateral condyle on right side is 30.26 ± 4.009 mm ,on left side is 30.72 ± 2.914 mm ($p > 0.05$) .Mean intercondylar notch length on right side is 25.32 ± 3.513 mm ,on left side is 27.76 ± 3.099 mm ($p < 0.05$) (p value is 0.000).Mean intercondylar notch width on right side is 20.16 ± 3.559 mm ,On left side is 22.54 ± 3.903 mm ($p < 0.05$) (p value is 0.002). Maximum & minimum values of various morphometric measurements of right ,left sided femurs (50 right ,50 left) and mean & SD values of those bones are depicted in table no : 1. Where as mean & SD and p values of several parameters of right ,left sided femur bones (50 right ,50 left) are showed in table no:2 .Maximum ,minimum values of various morphometric measurements & Mean ,SD of those values among all femur bones (100 bones – 50 right ,50 left) are showed in table no:3.

Table 1: Showing Maximum ,minimum ,mean And Standard Deviation For Various Parameters Of Right & Left Sided Femur Bones

PARAMETER (mm)	RIGHT (50)				LEFT (50)			
	MAXIMUM	MINIMUM	MEAN	SD	MAXIMUM	MINIMUM	MEAN	SD
BCW	81.96	61.88	73.26	5.521	84.42	62.38	73.70	5.549
AP MC	66.32	50.01	56.64	4.848	67.79	46.08	58.02	5.313
AP LC	66.92	50.11	57.40	4.499	67.67	51.88	59.30	4.200
T MC	39.29	22.48	29.74	4.746	33.64	22.06	28.90	3.131
T LC	37.60	22.59	30.26	4.009	35.15	24.56	30.72	2.914
L ICN	29.69	18.27	25.32	3.513	32.43	16.00	27.76	3.099
W ICN	27.23	12.94	20.16	3.559	33.67	9.70	22.54	3.903

Table 2 : Showing Mean,standard Deviation And P Values Of Various Parameters Of Right & Left Sided Femur Bones :

Parameter	Side of femur (mean $\pm$ SD) mm		P - value
	Right (N=50)	Left (N=50)	
BCW	73.26 $\pm$ 5.521	73.70 $\pm$ 5.549	0.690
AP MC	56.64 $\pm$ 4.848	58.02 $\pm$ 5.313	0.178
AP LC	57.40 $\pm$ 4.499	59.30 $\pm$ 4.200	0.031
T MC	29.74 $\pm$ 4.746	28.90 $\pm$ 3.131	0.299
T LC	30.26 $\pm$ 4.009	30.72 $\pm$ 2.914	0.513
L ICN	25.32 $\pm$ 3.513	27.76 $\pm$ 3.099	0.000
W ICN	20.16 $\pm$ 3.559	22.54 $\pm$ 3.903	0.002

Table 3 : Showing Maximum, minimum, mean And Standard Deviation For Various Parameters Of All Femur Bones :

Parameter (N=100)	Maximum	Minimum	Mean	Standard deviation
BCW	84.42	61.88	73.48	5.467

Table 4 : Showing Comparison Of Several Parameters Of Femoral Condyles In Studies By Various Authors

Year of study & population studied	BCW		AP-MC		AP-LC		T-MC		T-LC		L-ICN		W- ICN	
	R	L	R	L	R	L	R	L	R	L	R	L	R	L
Ravichandran D Et al (19) (2010), south india 200 bones ,106 R,94 L.	74.58 $\pm$ 0.57	73.97 $\pm$ 0.61	-	-	-	-	-	-	-	-	-	-	18.89 $\pm$ 0.29	18.68 $\pm$ 0.27
Terzidis et al (3) (2012) greek 360 bones (180 R,180 L)	84.1 $\pm$ 0.62	83.7 $\pm$ 0.63	58.6 $\pm$ 4.1	58.7 $\pm$ 4.1	58.4 $\pm$ 4.0	58.5 $\pm$ 4.0	-	-	-	-	-	-	20.5 $\pm$ 2.3	20.5 $\pm$ 2.2
Ameet KJ et al(20) 2014, 97 bones (45R, 52 L)	72.5 $\pm$ 5.3	73.3 $\pm$ 5.3	-	-	-	-	-	-	-	-	-	-	18.0 $\pm$ 3.0	17.9 $\pm$ 2.5
Mistri S et al., (21) 2015, West Bengal 127 bones (65 R, 62 L)	74.43 $\pm$ 6.10	73.98 $\pm$ 5.99	-	-	-	-	-	-	-	-	-	-	19.12 $\pm$ 2.5	18.65 $\pm$ 2.8
Shweta J et al., (15) 2017, North India 100 bones (51R, 49 L)	73.1 $\pm$ 6.14	72.16 $\pm$ 6.58	-	-	-	-	-	-	-	-	-	-	20.82 $\pm$ 2.57	21.03 $\pm$ 3.13
Biswas A et al.,(18), 2017, West Bengal 70 bones (35R, 35L)	71.71 $\pm$ 4.50	70.71 $\pm$ 5.25	52.97 $\pm$ 3.77	54.74 $\pm$ 3.85	56.20 $\pm$ 3.36	56.05 $\pm$ 4.29	25.48 $\pm$ 2.05	27.28 $\pm$ 2.29	27.80 $\pm$ 2.91	28.03 $\pm$ 2.56	-	-	20.86 $\pm$ 2.52	19.45 $\pm$ 2.57
Hiren s .chavada et al (16), 2019, Gurajat ,74 bones (37 R ,37 L)	69.6 $\pm$ 5.04	69.8 $\pm$ 4.96	52.9 $\pm$ 4.99	53.5 $\pm$ 4.15	54.7 $\pm$ 4.01	55.0 $\pm$ 4.31	26.7 $\pm$ 2.03	26.9 $\pm$ 2.23	30.3 $\pm$ 3.05	29.6 $\pm$ 2.03	-	-	20.4 $\pm$ 3.17	18.7 $\pm$ 2.52
Present study 2020,,Andhra Pradesh ,100 bones (50 R ,50 L)	73.26 $\pm$ 5.521	73.70 $\pm$ 5.549	56.64 $\pm$ 4.848	58.02 $\pm$ 5.313	57.40 $\pm$ 4.499	59.30 $\pm$ 4.200	29.74 $\pm$ 4.746	28.90 $\pm$ 3.131	30.26 $\pm$ 4.009	30.72 $\pm$ 2.914	25.32 $\pm$ 3.513	27.76 $\pm$ 3.099	20.16 $\pm$ 3.559	22.54 $\pm$ 3.903

In the present study , average bicondylar width was 73.48 $\pm$ 5.467 mm (on right side 73.26 $\pm$ 5.521 mm , on left side 73.70 $\pm$ 5.549 mm) ,the present findings are as similar as study by the shweta J Et al (15) in north india people ,higher than the study conducted by Hiren S Chavda et al(16) in Gujarath people.

In this study average antero posterior diameter of medial condyle was 57.33 $\pm$ 5.107 mm (56.64 $\pm$ 4.848 mm on right side , 58.02 $\pm$ 5.313 mm on left side) ,these findings are very close to study conducted by the Terzidis I Et al (3) in Greek people and Neelima P et al (17) in Andhra pradesh population (average AP diameter of medial condyle in their study is 57.83 $\pm$ 0.697 mm).

In my study ,average antero posterior diameter of lateral condyle was 58.35 $\pm$ 4.434 mm (on right side 57.40 $\pm$ 4.499 mm ,on left side 59.30 $\pm$ 4.200 mm) it is of statistically significant (p<0.05) ,these findings are lying in between the studies conducted by the Terzidis I Et al (3) in greek population ,Biswas A et al (18) in west Bengal population ,higher than the study conducted By Hiren S Chavda et al(16) in gujarath population (average AP Diameter of lateral condyle was 54.87 $\pm$ 4.13 mm ,on right side was 54.7 $\pm$ 4.01 mm ,on left side was 55.0 $\pm$ 4.31 mm) .In the study conducted by Neelima et al (17), the AP Diameter of lateral condyle was 58 $\pm$ 0.514 mm ,which is mostly close to my observation In my present study ,average transverse diameter of

AP MC	67.79	46.08	57.33	5.107
AP LC	67.67	50.11	58.35	4.434
T MC	39.29	22.06	29.32	4.022
T LC	37.60	22.59	30.49	3.495
L ICN	32.43	16.00	26.49	3.518
W ICN	33.67	9.70	21.35	3.904

DISCUSSION

Normal morphometry of femoral condyles ,intercondylar notch are important factors maintaining the stability of knee joint.In now a days ,knee replacement is become a very popular surgery ,as degenerative arthritis is very common in knee joint .Successful outcome of surgery is always based on properly matched knee implant.In this regard ,Proper selection & designing of implant is mandatory to manufacture the implant, usually direct methods of measurements are more beneficial than indirect method of measurements(3).Observations of various morphometric measurements by several authors are depicted in table no:4

medial condyle was 29.32 $\pm$ 4.022mm (29.74 $\pm$ 4.746 mm on right side , 28.90 $\pm$ 3.131 mm on left side) , findings of this study are higher than the studies by Biswas A Et al (18) ,Hiren s chavda et al(16) (average diameter is 26.79 $\pm$ 2.16 mm), Neelima et al (17) (average diameter is 21.33 $\pm$ 0.430 mm) .

In this study ,average transverse diameter of lateral condyle was 30.49 $\pm$ 3.495 mm (on right side 30.26 $\pm$ 4.009 mm , 30.72 $\pm$ 2.914 mm on left side) , findings of the present study are higher than the study conducted by Biswas A et al (18) (27.80 $\pm$ 2.91 mm on right side ,28.03 $\pm$ 2.56 mm on left side) , close to the study by the Hiren s chavda et al (16) (30.3 $\pm$ 3.05 mm on right side ,29.6 $\pm$ 2.03 mm on left side) ,less than the study by Neelima et al (17) (average transverse diameter of lateral conyle was 21.08 $\pm$ 0.442 mm) .

In my present study ,average length of intercondylar notch was 26.49 $\pm$ 3.518 mm (25.32 $\pm$ 3.513 mm on right side , 27.76 $\pm$ 3.099 mm on left side) .It is statistically significant finding (p<0.005) .In a studies by the various authors ,this measurement is not observed.

In this study ,average width of intercondylar notch was 21.35 $\pm$ 3.904 mm (on right side 20.16 $\pm$ 3.559 mm ,on left side is 22.54 $\pm$ 3.903 mm) .It is statistically significant finding (p<0.005) . Findings of this study are close to studies by the Biswas A et al (18) (20.86 $\pm$ 2.52 mm on right

side , 19.45 ± 2.57 mm on left side), Hiren s chavda et al (16) (20.4 ± 3.17 mm on right side , 18.7 ± 2.52 mm on left side) on right side ,but on left side the present study findings are higher than other studies .

Most of the previous authors are observe the morphometric data of femoral condyles with the MRI scan , X Ray ,CT scan (4-7) .These are indirect methods of measurement.where as in the present study all the data are measured directly.This is direct method of measurement.this is more accurate than the indirect methods (8-10).

Variations in the measurements among different populations are due to life style ,mode of work ,environmental and genetic factors. These are deciding the built ,composition ,stature of body.

CONCLUSION

The present study is providing morphometric information of condyles of femur which is assessed by direct method.Morphometric data of people is varied in between them.We thought ,this morphometric information is very useful to manufacturers of knee implants ,as this morphometry of femoral condyles is very essential and it also prevents the minimizing the chances of mismatch , post -operative complications.

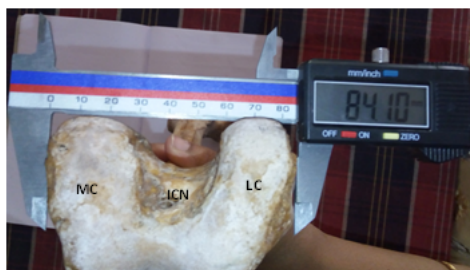


Fig 1: Showing Measurement Of Bicondylar Width

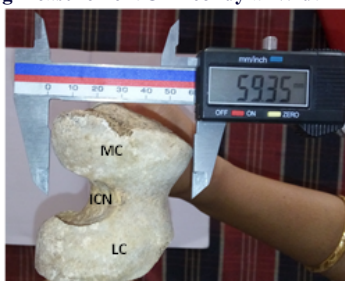


Fig 2: Showing Measurement Of Ap (anteroposterior) Diameter Of Medial Condyle

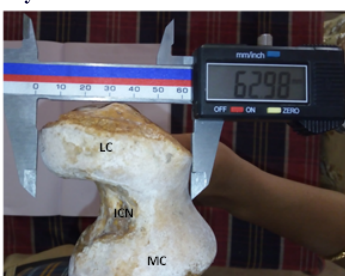


Fig 3: Showing The Measurement Of Ap (antero Posterior) Diameter Of Lateral Condyle Of Femur



FIG 4: Showing Measurement Of Transverse Diameter Of Medial Condyle Of Femur



Fig 5: Showing Measurement Of Transverse Diameter Of Lateral Condyle Of Femur



Fig 6: Showing Measurement Of Width Of Intercondylar Notch

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