Original Article

Indian Journal of Anatomy
Volume 6 Number 4, October - December 2017
DOI: http://dx.doi.org/10.21088/ija.2320.0022.6417.2

A Study on Dimensions of Condyles and Intercondylar Region of Femur in Wayanad Population

Sushanth N.K.[1], Lakshmikantha B.M.[2], Javeed Hussain Sharieff[3]

Abstract

Context: The knee joint is a complex synovial joint. It is subjected to considerable loads in locomotion and hence the joint is highly unstable and prone for injuries and degeneration particularly during ageing. This may require knee replacement and internal fixation. The various dimensions and area of knee components are very essential during placement of prosthesis. Hence, the study on dimensions of condyles and intercondylar region of Femur is taken up to provide useful information. *Aims*: To measure various dimensions of condyles and intercondylar region of femur in Wayanad population. *Settings and Design*: Sixty seven (38-left and 29-right) adult fully ossified femur were collected from the department and were properly labeled. Vernier caliper, thread, paper to record observations were kept ready. *Methods and Materials*: Various dimensions of the Lower end of Femur were measured using Vernier caliper. *Statistical Analysis Used*: Mean, SD was calculated from data using the SPSS software version 16. *Results*: Results obtained for right and left femur were as follows. Left: Mean ±SD of Intercondylar depth-2.94±0.42cm; Area of medial condyle-15.021±2.354cm^2; Area of lateral condyle-14.880±2.29cm^2 and Intercondylar area-3.853±0.954 cm^2. Right: Mean±SD of Intercondylar depth-2.83± 0.31cm; area of medial condyle 14.359±2.4cm^2; area of lateral condyle 15.026±2.549cm^2 and Intercondylar area 4.193±1.011 cm^2. *Conclusion*: This study gives various dimensions of condyles and intercondylar regions of Femur which will of great significance to anatomists, anthropologists and orthopedicians in cases of surgical procedures for implantation of prosthesis in knee joint.

Keywords: Condyle; Femur; Intercondylar Region; Prosthesis.

Introduction

The knee is probably the most stressed joint in the human body. It is a complex joint which is subjected to considerable loads during locomotion. Hence the joint is highly unstable and prone for injuries and degeneration as age advances. In essence the knee is perceived as just a joint that bends and straightens lower leg on the thigh, but the complexity of movement also involves a gliding and a rotation of the femur on the tibia. Hence the knee is vulnerable to twisting injuries such as when skiing or playing football, leading to cruciate ligament damage and also damages to the menisci. Therefore knee replacement and internal fixation becomes necessary. A knee-joint prosthesis comprises a femoral condyle component and a tibial condyle component secured, respectively, to the femoral and tibial condyles by a cement in resected areas of the bones [1]. To manufacture a knee prosthesis the measurements of the condyles (quantitative anatomy) and intercondylar areas of femur and tibia are important for the design of total joint replacement and internal fixation. In the present study the dimensions of the lower end of the femur were measured. Since morphometry of tibial condyles are also equally important as femoral condyles, it has been studied by the same authors in a different study. The dimensions both condyles of right and left femurs were measured and correlated.

Author's Affiliation: [1]Assistant Professor [2]Associate Professor [3]Professor, Department of Anatomy, DM-WIMS, Naseera Nagar, Meppadi. P.O, Wayanad (Dt), Meppadi, Kerala 673577, India.

Corresponding Author: Lakshmikantha B.M., Associate Professor of Anatomy, DM-WIMS, Naseera Nagar, Meppadi. P.O, Wayanad (Dt), Meppadi, Kerala 673577, India.
E-mail: drchandan24@gmail.com

Received | 30.08.2017, **Accepted** | 14.09.2017

Materials and Methods

Sixty seven adult fully ossified femurs irrespective of age and gender were selected from the Department of Anatomy, DM-WIMS, Wayanad as samples for the present study. First, the femora were segregated into Right and Left and then they were numbered separately. Out of these 38 were left sided and 29 were right sided. Measurements were taken twice for each entity using vernier calipers.

Fig. 1: Showing photograph of the femur bones used for the study

The parameters measured were,

- Anteroposterior measurements of right medial condyles
- Anteroposterior measurements left medial condyles
- Anteroposterior measurements right lateral condyles
- Anteroposterior measurements left lateral condyles
- Transverse measurements of right medial condyles
- Transverse measurements of left medial condyles
- Transverse measurements of right lateral condyles
- Transverse measurements of left lateral condyles
- Anteroposterior measurements of right intercondylar fossa
- Anteroposterior measurements of left intercondylar fossa
- Transverse measurements of right intercondylar fossae
- Transverse measurements of left intercondylar fossae

All the measurements were taken by a single author in order to minimize human error. The data were recorded on a white sheet paper and later entered into the data entry sheet in computer. Statistical analysis of this data was done using SPSS software version 16 in Windows 8.

The mean of the anteroposterior and transverse measurements of the medial and lateral condyles and the intercondylar region of both right and left was calculated in Excel sheet. The standard deviations of the means of all these parameters were calculated using SPSS version 16. After obtaining the results, bar diagram was plotted for better interpretation of the results.

Fig. 2: Showing taking the anteroposterior measurements of the condyle using vernier caliper.

Fig. 3: Showing taking the transverse measurement of the intercondylar region of the femur using vernier caliper

Results

In the present study results obtained for right and left femur are shown in Table 1 and 2.

Table 1: Showing Standard deviation and mean of right and left medial and lateral condyles and intercondylar region of femur

Particulars	Right	Left
Medial Condyle	14.359± 2.4cm²	15.021± 2.354cm²
Lateral Condyle	15.026± 2.549cm²	14.880 ± 2.29cm²
Intercondylar fossa	4.193±1.011 cm²	3.853 ± 0.954 cm²
Intercondylar Depth	2.83± 0.31cm	2.94±0.42cm

Table 2: The mean of anteroposterior and Transverse measurements of Right and Left medial and lateral femoral condyles

Measurements	Right-MC	Left -MC	Right-LC	Left-LC
Anteroposterior	5.52 cm	5.63 cm	5.54 cm	5.53 cm
Transverse	2.58 cm	2.65 cm	2.7 cm	2.67 cm

Abbreviations: MC- Medial condyle, LC- Lateral condyle, CM- Centimeter

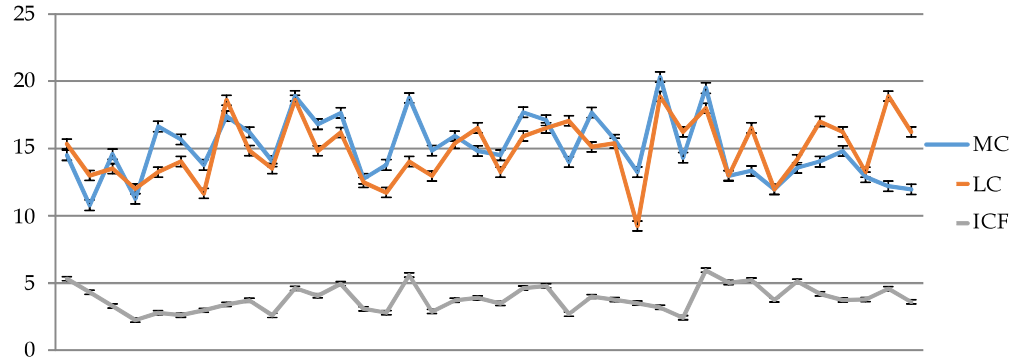

Fig. 4: Areas of Medial and Lateral condyles & Intercondylar fossa of Left Femur (mm²)
Abbreviations:
MC- Medial condyle
LC- Lateral condyle
ICF- Intercondylar fossa

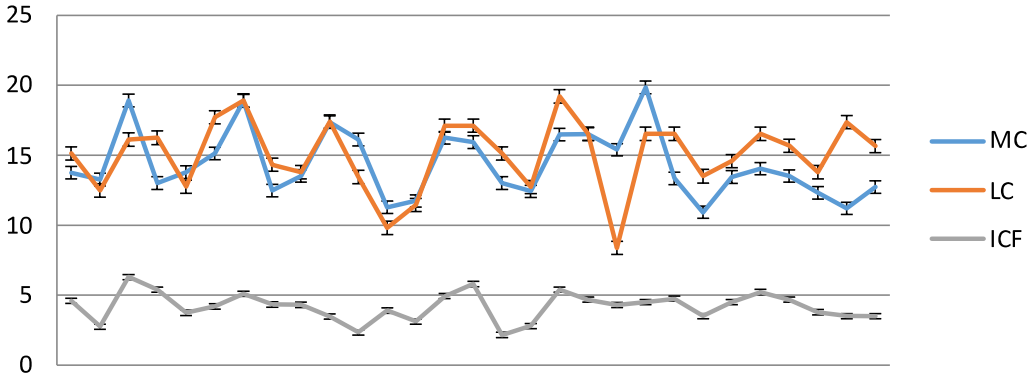

Fig. 5: Areas of Medial and Lateral condyles & Intercondylar fossa of Right Femur (mm²)
Abbreviations:
MC- Medial condyle
LC- Lateral condyle
ICF- Intercondylar fossa

Discussion

An important factor required to achieve long-term success in total knee arthroplasty surgeries is

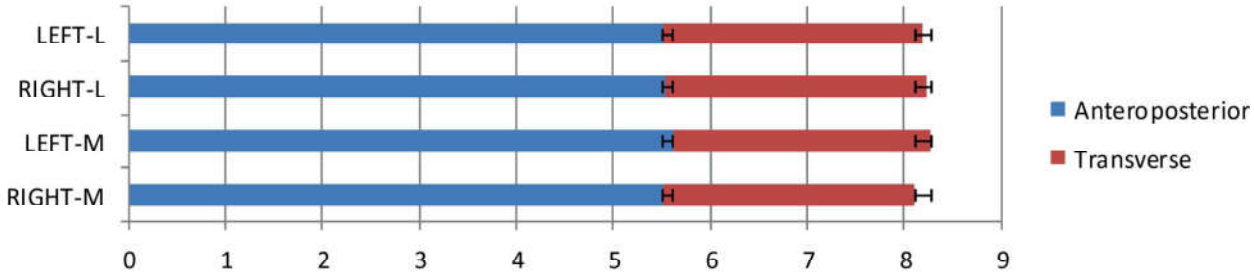

Fig. 5: Plot of Mean of Anteroposterior and Transverse Measurements of Medial and Lateral Condyles of Right and Left Femur (cm)
Abbreviations:
M- Medial
L- Lateral

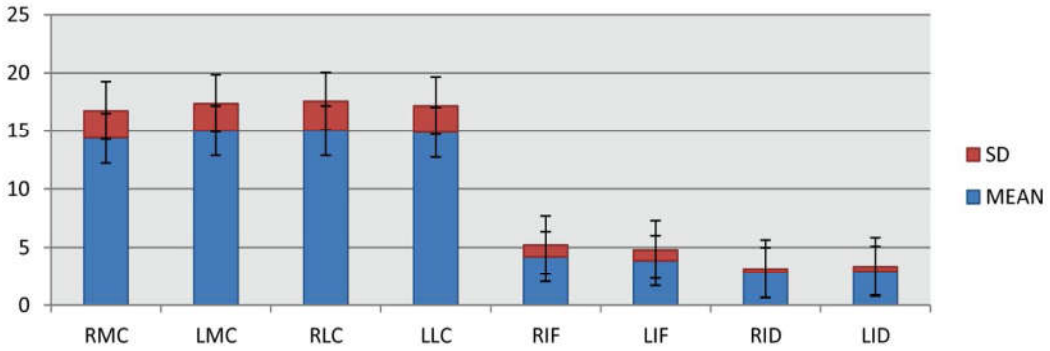

Fig. 6: Plot of standard deviation and mean of right and left medial and lateral condyles, intercondylar fossae and intercondylar depths of femur
Abbreviations:
RMC- Right Medial Condyle, LMC- Left Medial Condyle, RLC- Right Lateral Condyle, LLC- Left Lateral Condyle RIF- Right Intercondylar Fossa, LIF- Left Intercondylar Fossa, RID- Right Intercondylar Depth, LID- Left Intercondylar Depth, SD- Standard Deviation

the use of geometrically matched prosthesis, which simulates the natural conditions of knee joints [2]. Many researchers are working on generating anthropometric data for designing knee prosthesis [3-9]. Bicondylar width was measured by many researchers as sole or a part of some other study of lower femoral anatomy.

A study by Kirby Hitt et al (2003) measured medio-lateral and antero-posterior dimensions of the lower end of the femur and tibia (also bicondyar) and obtained an aspect ratio in order to correlate to the sizing of present knee arthroplasty systems. This study concluded that it is important to manufacture patient specific prosthesis for more successful and satisfactory postoperative experience in a patient, especially women, in whom knee joint prosthesis implantation, was the only option [6].

Another study conducted on Korean population by Dai- Soon Kwak et al (2010) also measured medio-lateral and antero-posterior diameters of the lower end of the femur along with length, height and width of the anterior, posterior and inferior sections of the resected distal femurs using three dimensional computer tomographic measurements in 200 knees. The authors got a slightly different aspect ratio from studies conducted by other authors on other group of people [7].

A morphometric study was performed by Sujay Mistri et al (2014) on Eastern Indian Population which considered bicondylar width of lower end of the femur in addition to other parameters such as width of the shaft, in contrast to the present study in which individual width and other measurements were taken. The authors were of the opinion that, the data obtained as a result of the study would greatly help the biomedical engineers who are involved in designing and manufacturing the knee joint prosthesis for Indian recipients [9].

All these studies and similar other studies necessitate manufacturing of a patient specific knee joint prosthesis, which would be possible only by studying a specific group of people residing in a particular region in whom the prosthesis is intended to be implanted. These variations in the

measurements of the dimensions of the lower end of femur in different regions of the world may be attributed to due to race and ethnicity.

Present study is different from those already done in the fact that here we measured the dimensions of individual condyles which may help to generate much more accurate prosthesis. In this study we noticed that the difference of mean areas between the medial and lateral condyles of left femora were 0.14±0.06 cm^2 and medial and lateral condyles of right femora were 0.67±0.14cm^2 respectively. Also difference of mean areas between right and left medial condyles were 0.662±0.05cm^2 & right and left lateral condyles were 0.146±0.259cm^2.

Conclusion

One of the factors which make human beings unique from his so called close ancestors, the primates is the bipedal mode of locomotion, which also enables upright posture. An important requirement for this is a healthy, fully functional knee joint. However with age, humans tend to lose the healthiness of the knee joint due to various known and unknown factors. For such patients, the total or partial knee replacement surgeries are done in order to regain most of the lost functions of the knee. The recent advances in knee replacement by prosthesis implantation has been the choice of treatment modality for many years now. Since its inception there has been tremendous research going on in this field for a simple reason that in various permanent knee diseases, replacement arthroplasty of knee is becoming fast popular mode of treatment. The knee prosthesis requires the measurements of the engaging parts of the condyles of femur and tibia which this study has attempted to provide the various dimensions of individual condyles and intercondylar fossae of femur. This information will be of much use to anatomists, forensic anthropologists and orthopedicians in cases of surgical procedures on knee joint. The present study may prove to be highly informative to the biomedical engineers engaged in prosthesis designing for recipients form Wayanad population.

Key message

The study was conducted in Wayanad population of South India. Purpose of this study was to give appropriate dimension of lower end of Femur which is useful for manufacturing correct size knee joint prosthesis for particular population with precision. The results were obtained by measuring the dimensions of lower end of the femur to calculate the area of the articulating surfaces and thereby arriving at a conclusion.

Conflict of Interest: NA

References

1. Peter S. Walker, Cheng FB, Ji XF, Lai Y, Feng JC, Zheng WX, Sun YF, Fu YW, Li YQ. Three dimensional morphometry of the knee to design the total knee arthroplasty for Chinese population. Knee. 2009;16(5):341-347.
2. Crockarell JR Jr, Hicks JM, Schroeder RJ, Guyton JL, Harkess JW, Lavelle DG. Total knee arthroplasty with asymmetric femoral condyles and tibial tray. Journal of Arthroplasty. 2010;25(1):108-113.
3. Mensch JS, Amstutz HC. Knee morphology as a guide to knee replacement. Clin Orthop Relat Res. 1975;(112):231-241.
4. Chin KR, Dalury DF, Zurakowski D, Scott RD. Intraoperative measurements of male and female distal femurs during primary total knee arthroplasty. J Knee Surg. 2002;15:213–217.
5. Fisher DA, Dierckman B, Watts M. Looks good but feels bad: factors that contribute to poor results after total knee arthroplasty. J Arthrop. 2007;22(6 Suppl 2):39–42.
6. Hitt K, Shurman JR, Greene K, McCarthy J, Moskal J, Hoeman T, Mont MA. Anthropometric measurements of the human knee: correlation to the sizing of current knee arthroplasty systems. J Bone Joint Surg Am. 2003;85:115–122.
7. Kwak DS, Han S, Han CW, Han SH. Resected femoral anthropometry for design of the femoral component of the total knee prosthesis in a Korean population. Anat Cell Biol. 2010;43(3):252-259.
8. Cheng FB, Ji XF, Zheng WX, Lai Y, Cheng KL, Feng JC, Li YQ. Use of anthropometric data from the medial tibial and femoral condyles to design unicondylar knee prostheses in the Chinese population. Knee Surg Sports Traumatol Arthrosc. 2010;18(3): 352-358.
9. Sujay Mistri, Sudeshna Majumdar, Sarmistha Biswas. Morphometric study of some lower femoral anatomy in Eastern Indian population. Indian Journal of Basic and Applied Medical Research. 2014;3(4):182-190.