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ORIGINAL ARTICLE

Different dimensions of knee joint and their gender variations among adult Bangladeshi population

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Abstract

Background: *Human knee shows significant variation in different radiographic dimensions. Different knee joint dimensions can be studied by visual observation, anthropometric measures and radiographic measures. Among these methods, radiographic measurements were regarded as most important for assessing skeletal alignment of knee joint in a static weight bearing position.*

Objective: *The present study was aimed for finding out the differences in dimensions of knee joint between adult Bangladeshi male and female.*

Methods: *A cross-sectional analytical type of study was carried out in the Department of Anatomy, Dhaka Medical College, Dhaka from July, 2018 to June, 2019. The study population was adult Bangladeshi male and female attending the Radiology and Imaging department of Dhaka Medical College and Hospital (DMCH) for the X-ray advised by their physicians. Digital radiographs of antero-posterior and lateral view of knee joint were taken.*

Results: *The study was performed on 80 Bangladeshi population where 40 was male and 40 was female. In male, the mean interepicondylar distance (IED) was 71.87±3.73 mm, intermetaphyseal diameter (IMD) was 69.32±3.61 mm, femoral width (FW) was 66.72±3.61 mm and tibial width (TW) was 69.11±2.66 mm. In female, the mean interepicondylar distance (IED) was 63.48 ±3.67 mm, intermetaphyseal diameter (IMD) was 61.80 ±4.49 mm, femoral width (FW) was 59.21 ±3.86 mm and tibial width (TW) was 61.85 ±3.89 mm. The mean (±SD) of all distances were found to be more in male than in female.*

Conclusion: *In the present study, interepicondylar distance (P<0.01), intermetaphyseal distance(P<0.01), femoral width (P<0.01) and tibial width (P<0.01) were significantly higher in male than in female.*

Key words: *Dimensions of knee joint. Gender variation*

Introduction

The knee is a weight-bearing synovial joint comprising of two condylar joints and a saddle joint.[1] Condylar joints are formed between femoral and corresponding tibial condyles. The tibio-femoral articulations are separated by articular cartilages and menisci with little contributions from cruciate ligaments.[2,3] Normal knee joints are analyzed to determine a quantitative relationship between the joint line of knee and the bony landmarks.4 Wide variability is found in the absolute distance from each landmark to the joint line of knee, including significant differences between sexes.[5]

The bony landmarks are identified on a digital radiograph of knee joint in both antero- posterior and lateral view.[6] Anatomical landmarks of knee joint are adductor tubercle. tibial tuberosity, medial epicondyle, lateral epicondyle, medial flare, lateral flare, intercondylar eminence and proximal tibiofibular joint.[7] Joint line of knee is defined as the tangent that passes through the most distal points of the medial and lateral femoral condyles.8 In the technical goals of a total knee arthroplasty (TKA), res toration of the joint line of the knee is important. Failure to restore the joint line of the knee to anatomical position can lead to mid-flexion instability, a reduction in range of motion, impingement of the patellar tendon against the tibial

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tray and gap imbalance.[9,10]

The values of different radiographic dimensions of knee of adult Bangladeshi population may be helpful to the anatomists for a normative reference. For the radiologists, the normative values may be helpful in their diagnosis. For proper designing of a prosthetic knee by the ergonomist and for surgical reconstruction by the orthopedic surgeons, knee radiographic data is essential.[11,12] The aim of the study was to construct a radiographic standard data on different dimensions of knee joint and to find out the differences in dimensions of knee joint between adult Bangladeshi male and female.

Materials and Methods

This was a cross-sectional analytical type of study. The study was performed on 80 Bangladeshi population of 24-49 years of age who were attending the Radiology and Imaging department of Dhaka Medical College and Hospital (DMCH) for the X-ray advised by their physicians. Among them 40 was male and 40 was female. The subjects were requested to give permission for another exposure of radiation for anterior posterior and lateral view radiographs of knee joint. Informed written consent was taken from each subject. Permission was also taken from the Head of the Department of Radiology and Imaging of DMCH.

Inclusion Criteria: subjects were selected purposively who were Bangladeshi by nationality. Their age were confirmed by her/his national identity card. Subjects were not suffering from any congenital lower limb deformities, abnormal gait, trauma or surgery of knee joint, clinical or radiographic evidence of inflammatory/ degenerative arthritis and any active or chronic joint disease. The ossification of all bones of lower limb completes by the age of twenty to twenty-four years. So fully ossified foot achieves its adult form and fixed measurements after this age.

An International Agreement for the unification of anthropometric measures on the living was adopted in the Fourteenth International Congress of Prehistoric Anthropology and Archeology held in Geneva, September 9-14, 1912. According to this agreement for paired measurements, it is recommended to operate on the left side. Measures were taken to minimize the radiation hazards of the subjects: A good quality radiograph was taken at the first attempt to reduce the number of repeated exposures. Collimated primary X-ray beam was used to reduce scattered radiation. Gonadal shields and protective eye wear were used for protection of testes and eye.

This protocol was first presented and approved by the Research Review Committee (RRC) of Dhaka Medical College. A written clearance from the Ethical Review Committee (ERC) of Dhaka Medical College, Dhaka was taken.

Data were collected on soft copy of X-ray film by MB ruler by quantitative method. All the data obtained were recorded using an Excel spread sheet (Microsoft Office 2010; Microsoft, Redmond, WA). All statistical analyses were performed by using the statistical software SPSS software package (IBM SPSS Statistics Base, version 22), keeping the objective of the study in view. Statistical test such as Unpaired Student's 't' test was performed.

Then the calculation of mean and standard deviation (SD) with minimum and maximum values were done for each variable in both groups. Statistical significance was accepted at P-value equal to or less than 0.05 ($p<0.05$).

Medial epicondyle: it is the medial most prominent point in the lower end of femur below the bulging curve from which medial collateral ligament originated (Figure-1).

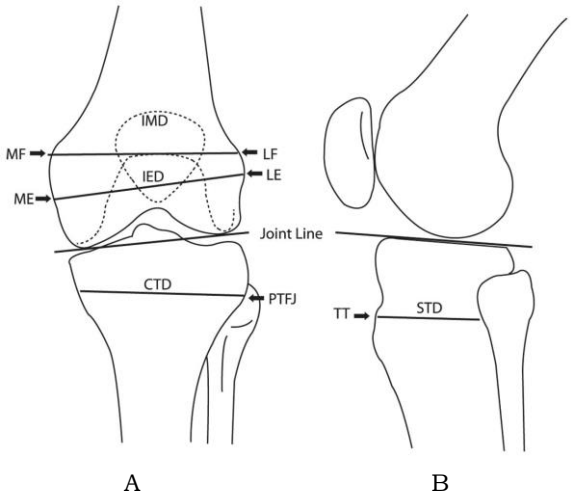

Figure 1: Coronal (A) and sagittal (B) diagrams of anatomical landmarks. Arrows: LE: lateral epicondyle; MF: medial flare, LF: lateral flare ME: medial epicondyle; PTFJ: proximal tibio-fibular joint; TT: tibial tubercle. Red line: CTD: coronal tibial diameter; IED: interepicondylar diameter; IMD: intermetaphyseal diameter; STD: sagittal tibial diameter. The blue line represents the joint line of the knee in the coronal and sagittal planes.

Lateral epicondyle: it is the lateral most prominent point in the lower end of femur above the margin of popliteal groove from which the lateral collateral ligament originated. Medial flare: it is the medial most prominent point in the lower end of medial epicondyle of femur. Lateral flare: it is the lateral most prominent point in the lower end of lateral epicondyle of femur. Joint line of knee: the line passes through the most distal point of the medial and lateral femoral condyles in the coronal plane or the line passes through the most distal point of the femur perpendicular to the anatomical axis of the tibial shaft in the sagittal plane. Joint line in coronal plane: in case of radiological measurement of knee joint (anterior- posterior view) joint line in coronal plane is defined as the tangent that connects two most distal point of femoral condyles. Joint line in sagittal plane: in case of radiological measurement of knee joint (lateral view) joint line in sagittal plane is defined as the line passes through the most distal point of the femur perpendicular to the anatomical axis of the tibial shaft.

Interepicondylar distance (IED): the distance between the medial epicondyle (ME) and the lateral epicondyle (LE) in coronal plane. It is also known as the surgical trans-epicondylar axis (Figure 2).

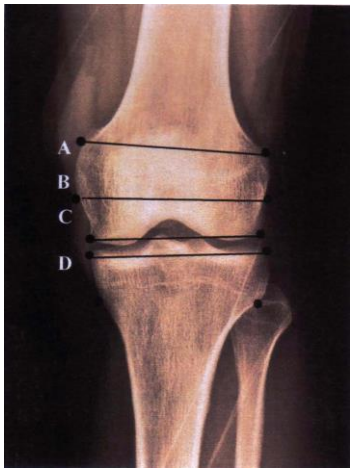

Figure 2: Digital radiograph of the left knee joint anterior- posterior view showing the A-intermetaphyseal distance (IMD), B-interepicondylar distance (IED), C-femoral width (FW), D-tibial width (TW)

Intermetaphyseal distance (IMD): the distance between the medial flare (MF) and the lateral flare (LF) in the coronal plane.

Tibial width (TW): the maximum distance from the lateral side of the lateral condyle to the medial side of the medial condyle of tibia.

Femoral width (FW): the distance between the most prominent point of the medial and the lateral condyle of femur.

All data were checked and edited after collection. Later the data were put into computer and were analyzed with the help of SPSS version 19.0 for windows. Statistical analyses were done by ANOVA test.

Results

All the study subjects were divided into two groups according to sex. After collection of data, the findings of this study were analyzed by SPSS (Statistical Package for Social Sciences) version 19.0.

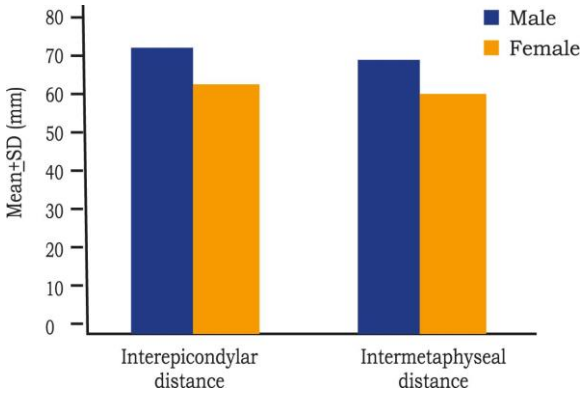

Figure 3: Bar diagram showing interepicondylar disance (mm) and intermetaphyseal distance/ diameter (mm) in male and female.

In male, interepicondylar distance (IED) ranged from 64.24 mm to 79.63 mm and the mean length was 71.87±3.73 mm (Figure-3). In female, interepicondylar distance (IED) ranged from 55.04 mm to 68.83 mm and the mean length was 63.48 ±3.67 mm. The mean (±SD) of interepicondylar distance was found to be more in male than in female. Highly significant difference of interepicondylar distance was observed when compared between male and female ($p<0.01$).

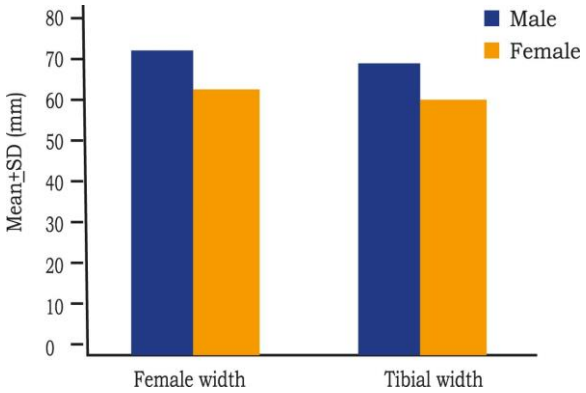

Figure 4: Bar diagram showing femoral width (mm) in male and female.

In male, intermetaphyseal diameter (IMD) ranged from 62.10 mm to 75.96 mm and the mean length was 69.32±3.61 mm. In female, intermetaphyseal diameter (IMD) ranged from 53.13 mm to 69.36 mm and the mean length was 61.80 ±4.49 mm. The mean (±SD) of intermetaphyseal distance was found to be more in male than in female. Highly significant difference of intermetaphyseal distance (IMD) was observed when compared between male and female ($p<0.01$).

In male, femoral width (FW) ranged from 60.58 mm to 76.21 mm and the mean length was 66.72±3.61 mm. In female, femoral width (FW) ranged from 52.56 mm to 66.93 mm and the mean length was 59.21 ±3.86 mm (Figure-4).

The mean (±SD) of femoral width (FW) was found to be more in male than in female. Highly significant difference of femoral width (FW) was observed when compared between male and female ($p<0.01$).

In male, tibial width (TW) ranged from 63.44 mm to 75.40 mm and the mean length was 69.11±2.66 mm. In female, tibial width (TW) ranged from 51.12 mm to 68.37 mm and the mean length was 61.85 ±3.89 mm.

The mean (±SD) of tibial width (TW) was found to be more in male than in female. Highly significant difference of tibial width (TW) was observed when compared between male and female ($p<0.01$).

Discussion

This study was carried out to get different radiographic knee dimensions of adult Bangladeshi male and female. The morphometry of knee joint is influenced by gender, age, geographical, socio- economic, food habits, ethnicity and racial factors. So, each population has specific baseline knee radiographic data to optimize the accuracy of identification.

In the present study, the mean value of interepicondylar distance, intermetaphyseal diameter, femoral width and tibial width was significantly higher in male than female and when compared statistically significant ($p=0.0000$) difference was observed.

According to PEREIRA, et al. investigated on American population reported that mean interepicondylar distance was significantly ($p<0.005$) higher in male than in female. The values of interepicondylar distance were also higher than the present study. The dissimilarity reported might be due to variation in race, cultural and socioeconomic condition.

Amarnath, et al. (2017, pp. 1118-23) who worked on Indian population reported that mean intermetaphyseal distance was significantly ($p<0.0160$) higher in male than in female. But the values of intermetaphyseal distance were also higher than the present study. India and Bangladesh are both dominated by Australoid race however the dissimilarities were found.

Fan, et al. (2018, pp.4-10) from China and Li. Pingyue, et al. (2016, pp.260-68) from America who investigated upon Chinese population reported that mean femoral width was significantly ($p<0.001$) higher in male than female. But the mean values of femoral width were also higher than the present study. Chinese people are Mongoloid in origin. The dissimilarity in findings might be due to race, ethnicity, socioeconomic condition and food habits.

Suryanarayan, et al. (2014, pp.1-12) who studied on Indian population reported that mean tibial width was significantly ($p<0.05$) higher in male than in female. The values of tibial width were similar to the present study.

Results of different radiographic variables of this study were compared with the radiographic variables of other studies from different countries. But so far it is known, there is no published data on radiographic knee dimensions in our country. So the present study could not be compared with any previous similar study on Bangladeshi adult population.

Limitations: the present study was conducted only in a single institute, at the Radiology Department of Dhaka Medical College Hospital. So, the results may not fully represent the whole community of Bangladesh. During selection of study subjects the assessment of the exclusion criteria was based totally on the information gathered through verbal enquiry and on visual impression. The study was based on measurement of different variables on soft copy of X-ray film by MB ruler which might have produced minor errors.

Conclusion

In this study, interepicondylar distance, intermetaphyseal distance, femoral width and tibial width were significantly higher in male than female. The findings also suggest that morphological measurements of the left knee joint dimensions significantly varies among adult Bangladeshi male and female people.

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