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Morphometry of Femoral Neck in Adult Bangladeshi Population

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Abstract

Context: *Morphometry of femoral neck is important to anatomists, radiologists, orthopaedic surgeons, prosthetists and forensic experts. The study was aimed to provide a standard data of different morphometric parameters of the femoral neck in adult Bangladeshi population and to determine the differences in these parameters between male and female.*

Materials and methods: *The study was conducted in the Department of Anatomy, Sir Salimullah Medical College, Dhaka from July 2020 to June 2021 on the anteroposterior radiographs of pelvis of 70 adult Bangladeshi population age ranging from 25-45 years. Femoral neck width, femoral neck length and femoral neck- shaft angle were measured unilaterally on the radiographs with MB ruler software. Comparison on the parameters between adult Bangladeshi male and female was done by unpaired student's 't' test.*

Results: *Mean femoral neck width of male and female were 34.46 ± 2.79 mm and 29.59 ± 3.05 mm respectively, mean femoral neck length were 53.86 ± 0.97 mm and 49.03 ± 4.33 mm respectively and mean femoral neck- shaft angle were 132.11° ± 4.04° and 131.16° ± 3.69° respectively.*

Conclusion: *In the present study mean femoral neck width and femoral neck length were significantly higher in male than female.*

Key words*: morphometry, femoral neck.*

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Introduction

Neck of the femur undergoes structural and functional specification for maintaining erect posture in human.[1] It acts as a lever for the muscles crossing the hip joint. The long axis of the femoral neck makes an angle with the long axis of the femoral shaft called neck- shaft angle which is an important stability factor of the hip joint. The neck-shaft angle facilitates freedom of movement of hip joint by displacing the femoral shaft laterally from the pelvis. The neck-shaft angle is nearly 150° at birth and steadily decreases to 115° - 140° in adult age.[2]

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'Morphometry' comes from the Greek word 'morphe' that means 'shape or form' and 'metria' means measurement. Morphometry is a branch of anthropometry that deals with the study of the size, shape of the components of biological forms and their variations in populations.[3]

Morphometry of femoral neck is important to anatomists, radiologists, clinicians, orthopaedic surgeons and forensic experts. Fractures of the femoral neck is very common. Various implants and fixators are used by the orthopaedic surgeons during management of the patients of fracture of femoral neck.[4] Inappropriate and oversized implants and prostheses cause anterior thigh pain, improper load distribution, stress fracture, and ultimately implant failure.[5] To avoid these postoperative complications, it is important to select appropriate size implants and prostheses. Morphometry of femoral neck will assist the prosthetists in designing population specific orthopaedic implants and prostheses. The differences in the neck-shaft angle between male and female will help the forensic experts in determination of sex.[6]

Morphometry of femoral neck was studied by many authors in different countries by using different materials such as dry bones,[4,7] plain radiographs[8] and computed tomography scans.[9] Previous studies showed that morphometry of femoral neck varies among population due to age, sex, race, social custom and level of daily activity. So far it is known a few work has been done on the morphometry of femoral neck in Bangladesh; therefore, this study was aimed to provide a standard data of different morphometric parameters of the femoral neck in adult Bangladeshi population.

Materials and methods

This was a cross sectional analytical type of study carried out in the Department of Anatomy, Sir Salimullah Medical College, Dhaka from July 2020 to June 2021. The study population was adult Bangladeshi population age ranging from 25-45 years who were advised by their physicians to take plain digital radiograph of pelvis. Convenient sampling technique was adopted.

Informed consent was obtained from every study subject with explanation of the purpose and nature of the study. The radiographs of pelvis in which the hip joints were reported as normal were collected.The sample was collected by convenient sampling method.

After proper magnification and resolution, femoral neck width, femoral neck length and neck- shaft angle were measured unilaterally on the left side on the radiographs with MB ruler software. Comparison on different parameters of the femoral neck between adult Bangladeshi male and female was done by unpaired student's 't'- test.

Operational definition

Femoral head center: A circle was drawn over the femoral head. Then center of the circle was identified and marked as femoral head center.

Femoral neck axis: The most constricted part of the femoral neck was determined by observation. A transverse line was drawn connecting the upper and lower edge of the most constricted part of the femoral neck, midpoints of this line was identified and then joined with the femoral head center to draw femoral neck axis.

Femoral shaft axis: Two transverse diameters of femoral shaft were measured: (i) at the level of most distal point of lesser trochanter and (ii) 5cm distal to the 1st diameter. The midpoints of these two diameters were identified, marked and then joined to get the femoral shaft axis.

Procedure of measuring different morphometric parameters of femoral neck:

Femoral neck width (FNW) (Figure1):

The minimum diameter of femoral neck at the narrowest part of neck is the femoral neck width.[10] To measure femoral neck width of the left hip joint on the plain digital radiograph of pelvis AP view, the most constricted part of the femoral neck was determined by observation. Three transverse lines were drawn connecting the upper and lower edge of the constricted part of the femoral neck and measured by MB ruler software and the minimum value was recorded on the data sheet.

Fig.-1: *Plain digital radiograph of pelvis AP view showing measurement of femoral neck width*

Femoral neck length (FNL) (Figure 2)

It is the distance from the femoral head centre to the femoral shaft axis that is measured along the femoral neck axis.[11] To measure femoral neck length of the left hip joint on the plain digital radiograph of pelvis AP view, femoral neck axis and femoral shaft axis were drawn and then their intersecting point was marked. The distance between the femoral head

centre and the intersecting point was measured by MB ruler software and recorded on the data sheet.

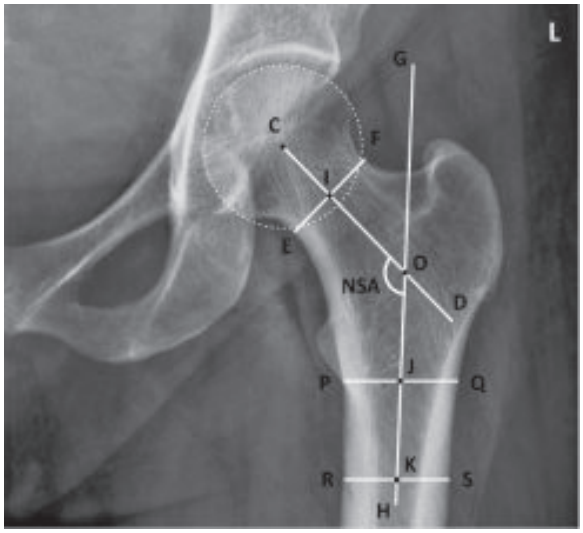

Fig.-2: *Plain digital radiograph of pelvis AP view showing measurement of femoral neck length (CO) and neck- shaft angle ("COH); C- femoral head center, CD- femoral neck axis, PQ- diameter of femoral shaft at the level of lower point of the lesser trochanter, RS- diameter of femoral shaft at 5cm distal to PQ, J- midpoint of PQ, K- midpoint of RS, GH- femoral Shaft axis, O-intersection of CD & GH*

Neck-shaft angle (NSA) (Figure 2)

It is the angle between femoral neck axis and femoral shaft axis.[12] To measure neck-shaft angle of the left hip joint on the plain digital radiograph of pelvis AP view, femoral neck axis and femoral shaft axis were drawn and their intersecting point was marked. The angle between the two axes was measured by MB ruler software and recorded on data sheet.

Ethical clearance

The study was approved by the Ethical Committee of Sir Salimullah Medical College, Dhaka .

Results

Femoral neck length (FNL)

The mean femoral neck length (FNL) was significantly (p=0.000) higher in male compared to female (Table I).

Femoral neck width (FNW)

The mean femoral neck width (FNW) was significantly higher in male compared to female (p=0.000) (Table I).

Neck-shaft angle (NSA)

No significant difference (p=0.308) was found in mean neck-shaft angle (NSA) between male and female (Figure 3).

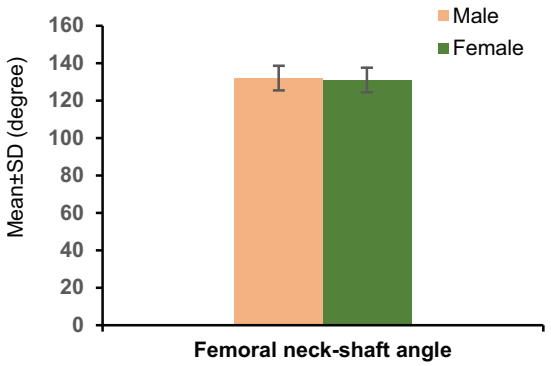

Fig.-3: *Bar diagram showing femoral neck-shaft angle (°) in male and female (N= 70)*

Table I

Femoral neck width and femoral neck length in male and female

Variables	Male (n=35) Mean ± SD (Range)	Female (n=35) Mean ± SD (Range)	P value
Femoral neck width(mm)	34.46 ± 2.79 (29.96- 40.60)	29.59 ± 3.05 (23.44- 39.13)	0.000**
Femoral neck length(mm)	53.86 ± 0.97 (42.30- 65.11)	49.03 ± 4.33 (40.34- 59.14)	0.000**

Comparison between sexes was done by unpaired Student's t- test
N= Total sample size, n= Sample size in each group
**= Significant at P < 0.01 (2 tailed)

Discussion

In the present study, mean femoral neck width was significantly higher (P<0.01) in male than female. Similar finding was also found in population of South India[13,14,15], Southern Assam[16], Eastern India[17], Malaysia[10] and European Caucasian, American Caucasian, African American and Chinese population.[18]

In the present study, mean femoral neck length was significantly higher (P<0.01) in male than female. Study finding of present study correlated with the findings of the population of South India[14], Malaysia[10], European Caucasian, American Caucasian, African American and Chinese population.[18]

In the present study, no significant difference (P>0.05) was observed in mean neck-shaft angle between male and female. Similar finding was observed in population of Mysore, South India[13] Maharashtra, India[19] Eastern India[15] and Malaysia.[10]

However statistically significant gender difference of mean neck-shaft angle was found in South Indian[15], Malaysian[10], European Caucasian, American Caucasian, African American, Chinese[18] and Turky population.[20]

Conclusion

This study might have established a standard data on the morphometry of the femoral neck on the adult Bangladeshi population.The study revealed that statistically significant difference was found in femoral neck width and femoral neck length of adult Bangladeshi population though the difference was not significant regarding the neck-shaft angle.

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