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Original article

Morphometric study of fully ossified head and neck diameter of the human left femur

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Abstract:

The femur is the weight bearing typical long bone of lower limb which extends from the pelvis to the knee. The anatomical knowledge of different dimensions of femur specially head and neck of the femur is very essential in anthropological and medico-legal practice for sex determination and as well as to radiologists, rheumatologists and orthopedic surgeons for diagnosis and planning of treatment. This is an observational descriptive type of study carried out in the Department of Anatomy, Sir Salimullah Medical College (SSMC), Dhaka from July 2011 to June 2012. The present study was performed on one hundred and ninety-nine (n=199; male-89 & female-110) left sided fully ossified human femur bones collected from the Department of Anatomy and the medical students of 1st & 2nd year MBBS source Sir Salimullah Medical College (SSMC), Dhaka and Dhaka National Medical College (DNMC), Dhaka. Morphometric study was carried out on all samples by direct physical methods. There was statistically significant difference found in the diameter of the head and neck of the femur bones between male and female bones. The present study attempted to provide a morphometric base line data of adult human left sided femur and also to see the sexual variations.

Keywords: Human femur, Head and neck diameter, Sexual variations.

Introduction:

The femur is the longest and strongest bone of the human body. Morphologically it is a typical long bone. The upper part of the femur forms the hip joint with the pelvis and the lower part of the femur forms the knee joint with the tibia[8]. It forms the skeleton of the thigh, bears body weight in erect posture, supports movement of legs, provides attachment to muscles, form blood cells and acts as store house for calcium and phosphate[1]. Identification of skeletal remains is one of the most difficult skills in forensic medicine. Sex determination is also important in identification. When the skeleton exists completely, sex can be determined with 100% accuracy[3]. As the femur is composed of hard tissue, they are the best preserved part of skeleton after death and in many times they are the only available parts for forensic examination[4]. In clinical practice dislocation of the hip joint and fracture neck femur is very common. The knowledge about different diameter of the head and neck of the femur is essential in orthopedic surgery in prosthesis and nail application and for radiological practice in identifying pathology of bone and also for determining age. The femoral normative values are also essential to plastic and reconstructive surgeons in their reconstruction and medical rehabilitation. Morphometric data of femur might help a doctor or nutritionist for calculating body energy need of a normal individual or to identify malnourished cases. So this type of study has a vital role in anatomy, forensic science, radiology, orthopedic surgery, plastic surgery, reconstructive surgery, medical rehabilitation, sports science and nutrition science.

Materials:

This is an observational descriptive type of study which was performed on one hundred and ninety-nine (n=199; male-89 & female-110) left sided fully ossified human femur bones collected from the Department of Anatomy and the medical students of 1st & 2nd year MBBS source Sir Salimullah Medical College (SSMC), Dhaka and Dhaka National Medical College (DNMC), Dhaka. This study was carried out in the

Department of Anatomy, Sir Salimullah Medical College (SSMC), Dhaka from July 2011 to June 2012.

Basis of consideration of selection of study samples:

The ossification of femur is completed by the age of twenty five (25) years (Mahadevan et al.,2008. pp. 1360). So femur achieves its adult form and fixed measurements after this age. On the other hand at the International Congress of Prehistoric Anthropology and Archeology, Geneva a resolution was taken that for bilateral paired structures measurements of left side are recommended (MacCurdy 1912. p. 621). According to the reported observation of Dogra and Singh, in 1971 (Chhabra et el, 2010. p. 216), left lower limb is functionally dominant in majority of human beings. On this basis left sided adult femur were considered as sample.

Variables to be studied:

- Vertical diameter of head of the femur (VDH)
- Transverse diameter of head of the femur (TDH)
- Vertical diameter of neck of the femur (VDN)
- Transverse diameter of neck of the femur (TDN)

All the measurements were recorded in metric unit – centimeters **(cm).**

Methods:

Morphometric study was carried out on all samples by direct physical methods.

Procedure for measurement of vertical diameter of head of the femur

(Fig 1): (Martin and Saller, 2002, p.32)

The fixed jaw of the digital slide caliper was placed on the superior surface and the sliding jaw was placed on the inferior surface of the head of the femur and three readings were taken between different points. The maximum reading was recorded as vertical diameter of head of the femur.

Procedure for measurement of transverse diameter of head of the femur

(Fig 2): (Martin and Saller, 2002, p.32)

The fixed jaw of the digital slide caliper was placed on the posterior surface and the sliding jaw was placed on the anterior surface of the head of the femur and three readings were taken between different points. The maximum antero-posterior reading was recorded as head transverse diameter.

Procedure for measurement of vertical diameter of neck of the femur

(Fig 3):(Martin and Saller, 2002, p.320)

The fixed jaw of the digital slide caliper was placed on the superior surface and the sliding jaw was placed on the inferior surface of the neck of the femur and several readings were taken between different points. The minimum reading was recorded as vertical diameter of neck of the femur

Procedure for measurement of transverse diameter of neck of the femur (Fig 4):(Martin and Saller 2001)

The fixed jaw of the digital slide caliper was placed on the anterior surface and the sliding jaw was placed on the posterior surface of the neck of the femur and three readings were taken between different points. The minimum antero-posterior reading was recorded as transverse diameter of neck of the femur.

Fig. 1 Measurement of vertical diameter of head of the left femur. VDH- vertical diameter of head

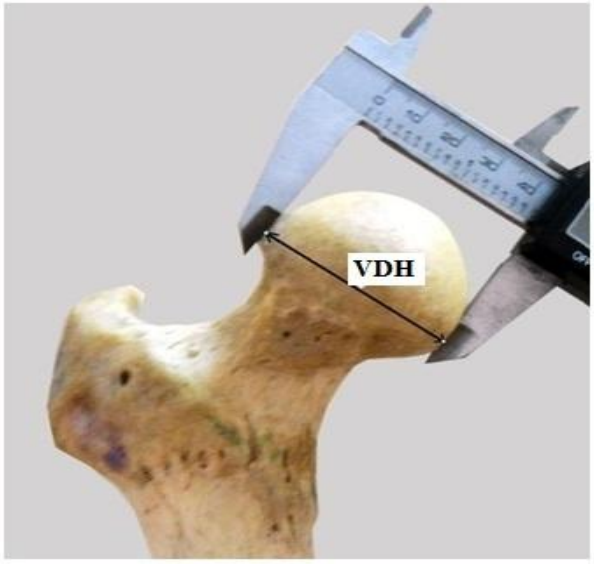


Fig. 2 Measurement of transverse diameter of head of the left femur. TDH- transverseertical diameter of head

Fig. 3 Measurement of vertical diameter of neck of the left femur.

VDH- vertical diameter of neck

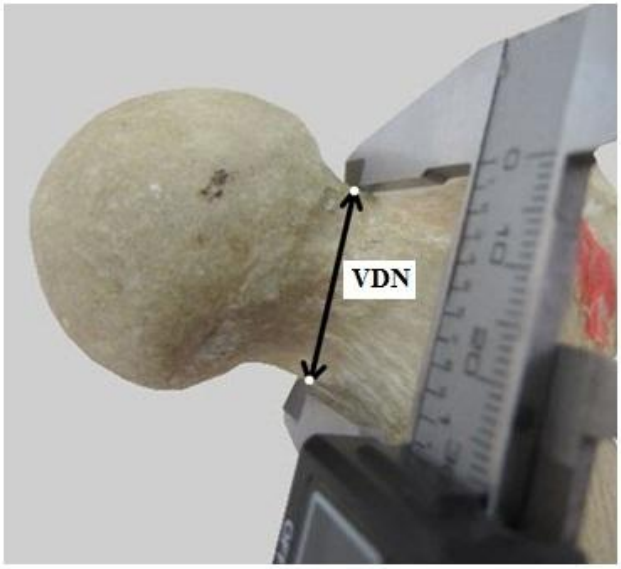
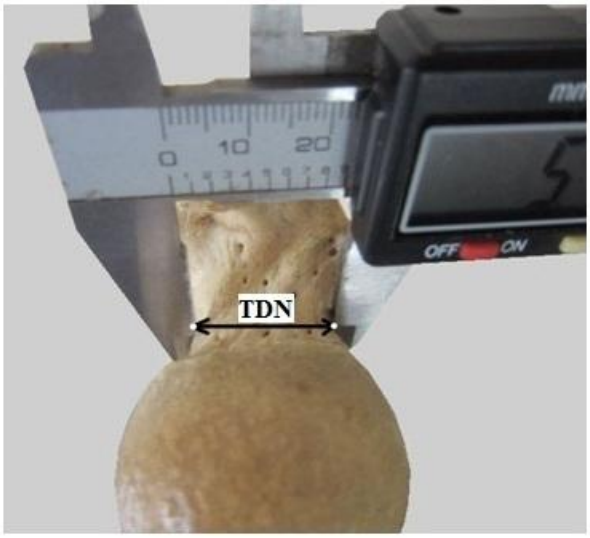


Fig. 4 Measurement of transverse diameter of neck of the left femur.

TDH- transverseertical diameter of neck



Results:

In the present study, the mean (±SD) value of vertical diameter of head of the femur bones of left side were 5.84 (± 0.42) cm in male and 4.06 (± 0.18) cm in female as shown in Table 1. There was significant difference (p=0.000) between male and female bones in vertical diameter of head as shown in Table 1 and Fig 5. The mean (±SD) value of transverse diameter of head of the femur bones of left side were 5.82 (± 0.19) cm in male and 4.21 (± 0.20) cm in female as shown in table 2. There was significant difference (p=0.000) between male and female bones in head transverse diameter as shown in Table 1 and Fig 5. The mean (±SD) value of vertical diameter of neck of the femur bones of left side were 4.69 (± 0.19) cm in male and 2.83 (± 0.21) cm in female as shown in Table 2. There was significant difference (p=0.000) between male and female bones in vertical diameter of neck as shown in Table 2 and Fig 6. The mean (±SD) value of transverse diameter of neck of the femur bones of left side were 4.67 (± 0.17) cm in male and 2.55 (± 0.11) cm in female as shown in Table 2. There was significant difference (p=0.000) between male and female bones in neck transverse diameter as shown in Table 2 and Fig 6.

Table 1 Vertical and transverse diameter of head of the left femur in male and female

Sex	Vertical diameter of head (cm) Mean±SD	Transverse diameter of head (cm) Mean±SD
Male (n=89)	5.84 ± 0.42	5.82±0.19
	(3.10-6.20)	(5.30-6.30)
Female (n=110)	4.06±0.18	4.21±0.20
	(3.70-4.80)	(3.80-4.70)
P-value	0.000**	0.000**

Figures in parentheses indicate range. Comparison between sex was done by unpaired Student's 't' test.

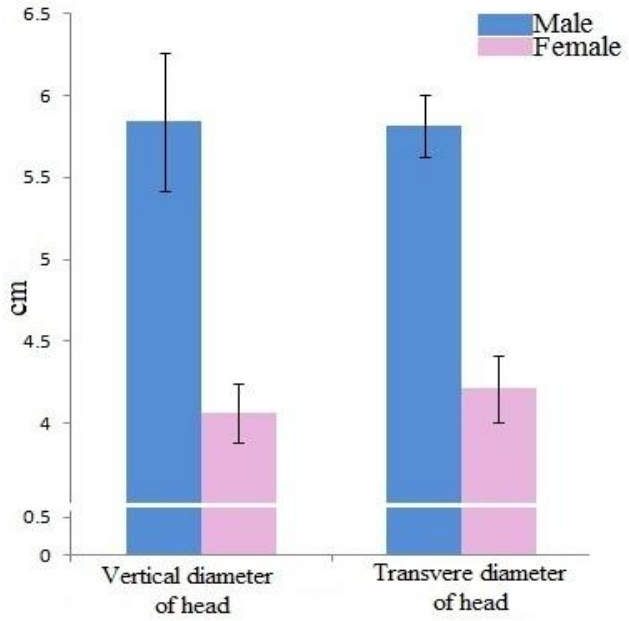
** = Correlation is significant at the 0.01 level (2-tailed).

Table 2 Vertical and transverse diameter of neck of the left femur in male and female

Sex	Vertical diameter of neck (cm) Mean±SD	Transverse diameter of neck (cm) Mean±SD
Male (n=89)	4.69 ± 0.19	4.67 ± 0.17
	(4.30-5.70)	(4.1-4.9)
Female (n=110)	2.83±0.21	2.55 ± 0.11
	(2.40-3.20)	(2.2-2.8)
P-value	0.000**	0.000**

Figures in parentheses indicate range.

Comparison between sex was done by unpaired Student's 't' test.



** = Correlation is significant at the 0.01 level (2-tailed).

Fig 5 Bar diagram showing vertical and transverse diameter of head of the left femur in Male (n=89) and female (n=110).

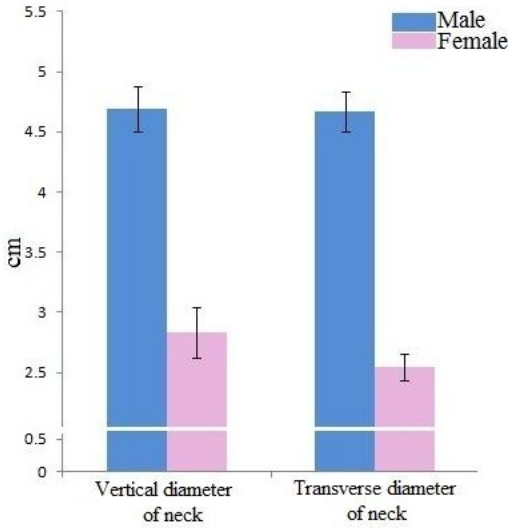


Fig 6 Bar diagram showing vertical and transverse diameter of neck of the left femur in Male (n=89) and female (n=110).

Discussion:

The mean vertical and transverse diameter of head & neck of the femur in adult male and female femur of North Indian[13], Central India[11], Gujarat[10], Thailand [6] and China [5] were similar to that of the present study. The mean vertical and transverse diameter of head & neck of the femur in adult male and female femur of South African[5] and American[5] were higher than that of this present study population. The mean vertical and transverse diameter of head & neck of the femur in adult male and female femur of South Indian[12] and Brazilian[14] were lower than that of the present study. The food habit (plenty of carbohydrate and less protein) of North, Central and Gujarat Indian, Thai and Chinese people and that of people of Bangladesh are similar. This similarity of food habit may predispose to the same growth pattern of the femur of these populations. The south Indian are vegetarians. So they lack the protein in their food habit and this may be the reason for their low dimensions. Significant differences were found between the males and females femoral dimensions. The results were similar to that of Srivastava et al. [13], Soni, Dhall and Chhabra[12] and Purkait[11].

Conclusion:

The present study was an attempt to construct data on different dimensions of adult femur and sexual variations in Bangladeshi people. To establish a standard data similar study with larger sample size and wider age group (including child group), radiographic study and comparative study with other mammals are suggested.

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