International Journal of Research in Medical Sciences
Khaleel N et al. Int J Res Med Sci. 2014 Feb;2(1):104-107
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: 10.5455/2320-6012.ijrms20140221

Research Article

Osteometric study of human femur

Khaleel N.[1]*, Hussain Saheb Shaik[2]

[1]Department of Anatomy & Cell Biology, College of Medicine, Al-Imam Muhammad Ibn Saud Islamic University, Riyadh, Saudi Arabia
[2]Department of Anatomy, JJMMC, Davangere, Karnataka, India

Received: 25 September 2013
Accepted: 16 October 2013

***Correspondence:**
Dr. Khaleel N.,
E-mail: nagarchikhaleel@gmail.com

ABSTRACT

Skeleton is playing important role in various like Medicine, Forensic sciences, Anthropology etc. Estimation of sex, age, race, stature by skeleton and the presence of disease is discovered by Krogman and Iscan (1986). Sex is determined after death by skeletal remains of that individual by some forensic anthropologists with the help of pelvis, skull and long bones. The study was undertaken in 50 femurs for measuring epicondylar breadth, Neck shaft angle, transverse and vertical diameter of head. The results were the average meanepicondylar breadth was 75.6 ± 6.06mm, mean right epicondylar breadth was 73.96 ± 4.99mm and left it was 76.35 ± 7.0mm. The average mean neck shaft angle was 125.3 ± 6.50mm, mean right neck shaft angle was 124.44 ± 5.7mm and left it was 126.3 ± 7.33mm. The average mean transverse diameter of head was 37.86 ± 3.06mm, mean right transverse diameter of head was 37.74 ± 3.05mm and left it was 38.00 ± 3.13mm. The average mean vertical diameter of head was 42.24 ± 3.53mm, mean right vertical diameter of head was 41.63 ± 3.09mm and left it was 42.96 ± 3.92mm, Neck shaft angle ranges from a minimum of 106° to maximum 135° with a mean value of 125.3°. The knowledge of osteometric values is helpful to anthropological and forensic practice.

Keywords: Human femur, Transverse diameter of head of femur, Vertical diameter

INTRODUCTION

The femur is longest and strongest in the body with thickened shaft because of its strong nature it is able to preserving archeological deposits. The shaft of the femur is fairly bowed and with a forward convexity on its upper end a rounded head projects medially on a short neck and articulates with the acetabulum of the hip bone, the lower end shows a wide expansion with double condyle which articulates with the upper end of tibia. Femora length is associated with weight and muscular forces. On standing femora are oblique, shaft converge downwards and medially. Femoral obliquity approximates the feet, bringing them under the line of the body weight in standing or walking, it gives forward movement by increasing speed and smoothness. The femoral obliquity is greater in women due to greater pelvic breadth and shorter femora. Femora are able to provide information for the purpose of stature estimation sex determination and identification of regional and racial estimation. There is consensus as to the femur's anatomical peculiarities, age, gender and locomotion physiology.[1] Determination of an individual's sex from the available skeleton is of great importance in forensic medicine. In medico legal cases, determination of stature, sex and age from skeletal remains of deceased person is often referred to the anatomist and other professionals in the field of anthropology.[2-4]

Proximal femur consists of head, neck, greater and lesser trochanters. The rounded ball like head faces medially to articulate with acetabulum. The head of femur is covered by cartilage except in a depression, the fovea on its medial side. The fovea serves for attachment of ligament of head of femur. The neck is smaller about 5cm long; it connects

the head to the shaft at an angle of about 120°. This facilitates the movement of hip joint and enables the lower limb to swing of the pelvis. The neck is laterally rotated with respect to shaft about 10° - 15°. It differs in different races. The neck is much smaller through its middle than the head but flares out somewhat both where it joins the head and where it joins the body, because of size and position it is liable to fracture. At the junction of neck with shaft, a rough Intertrochanteric line is present and posteriorly at this junction rounded Intertrochanteric crest is present. The greater trochanter projects above the junction of the neck and the body, posteriorly on its medial side, between it and the neck is trochanteric fossa. The lesser trochanter is located posteromedially at the junction of neck and body and is smaller than the greater trochanter. Both trochanters serve for attachment of muscles. When the trochanteric line is well developed it can be followed below the lesser trochanter where it spirals onto the back of the femur. On the posterior surface of femur at about the same level as the lesser trochanter there is rough area laterally, the gluteal tuberosity sometimes it is termed as the 3rd trochanter. The body of the femur below the trochanter is approximately cylindrical until expands at the lower end to form the condyles. Its important marking is the linea aspera, the rough, rather broad line along the posterior aspect. The medial lip of linea aspera being above in continuity with pectineal line. The lateral beings above the gluteal tuberosity. On the lower end of femur these two lips diverge and leave between them a broad, smooth popliteal surface. The femur end in rounded condyles that projects only a little in front of ked body of femur but very well marked behind. Their articular surfaces blend together anteriorly to form the patellar articular surface but condyles are separated posteriorly by a deep intercondylar fossae. This is separated from popliteal surface by the intercondylar line. On the sides of the condyles are roughened areas, the medial and lateral epicondyles. The larger medial epicondyle is surrounded by a projection the adductor tubercle. Certain features of femoral condyles are particularly important in analysing movements at the knee but these are best considered during the discussion of these movements. The femur gives attachment to many muscles of lower limb. The femur is ossified from one primary center for the shaft, three secondary centers for upper end, one each foe head, greater trochanter and lesser trochanter and one secondary center for lower end. Strecker et al. stated that mean values of lengths of right and left femora were found to be similar, althrough the left femora was generally showed larger values than the right they were not significantly greater.[5] Parsons F G proposed that there was no significant bilateral difference found in bones, he reported that males has bigger neck shaft angles than females through his study in English populations the results are males 126° and females 125.5°.[6] Pons stated that the head diameter and width of lower end discriminated sex better than any other part of bone.[7] Lonfgren stated that neck shaft angle is bigger in male than in females by his study in Finns and explained that males 125° and females 125.1°.[8] Walensky stated that anterior femoral curvature increases as the age progress upto young adult age. There is no significant difference between males and females in expressions of anterior femoral curvature.[9] Graham et al. stated midshaft circumference show 85% accuracy for determination of sex and mid shaft circumference more in males than females.[10] Steel insisted on measuring the diameter of femur head taking long axis of neck determined by eye judgment.[11] Van Gerven studied in Amerindians and stated that males 129.63° and females 131.61° of neck shaft angle and females has more angle than males.[12] Kate observed the platymeric Index which is highest in Asiatic group platymeric index is more in females than males.[13] Francein females the femoral head has to adopt to changes brought about in the hip joint due to reproductive function of pelvis suggested males use muscle more heavily than females.[14]

William et al. stated that axial skeleton weight of male is relatively and absolutely heavier than the female.[2] According to Alan M W Proter discriminative analysis confirmed that male femur usually larger than the female femur.[15] In the study of Yasar Iscan M distal epicondylar breadth, maximum length and anterioposterio diameter of midshaft gives 92.3% classification accuracy, distal epicondylar breadth alone proved 94.9% of accuracy.[16] Ruma Purkait stated that there is enormous sexual difference in male and females head of femur.[17] According to study of Issac B et al. (1997) the neck- shaft angle ranges from 12° - 136° with of 126.7°, and stated that any estimated defective angle can be help for forensic identification of an individual with pathological changes leading to an abnormal gait.[18]

According to Asala S A and Santigo Safontthe mean head diameter of male femur was significantly greater than the mean head diameter of female femur and male individuals of population had greater mechanical stress than females.[19] Taner Zuylan stated that the neck angle of femora od Rt dide is 127.6° ± 3.3 and Lt side is 128.7° ± 4.7 and he stated that determination of sex of an individual from a single femur was a more difficult task.[20] Ruma Purkait (2004) proposed that the maximum head diameter alone could correctly assign sex to 92.5 of males and 95.5% females.[16]

METHODS

The material used for the study contained 5° human femora of unknown sex obtained from different SV medical college, Tirupathi, Andhra Pradesh. The instruments used are metal sliding caliper and osteometric board. The maximum length of femur and anterioposterior diameter of upper, middle and lower shaft of femur were measured.

Vertical diameter of head

It measures the straight distance between the highest and deepest points of the head, for this sliding caliper is used.

Epicondylar breadth

It measures the distance between the most projected points on the epicondyles, for this Osteometric board is used.

Neck shaft angle

It is angle made by axis of shaft with the axis of the upper anterior column. Axis of column is determined by means of a thread which divides the anterior surface of the column in two equal halves. Axis of the shaft is determined by a thread which extends in the mid sagittal plane over the anterior surface of the bone from the upper end of the oblique line of the condyles. In case of strongly developed torsion, it may be difficult to fix a thread on the entire surface, so take only the axis of the upper shaft into consideration for such cases; the materials used are thread and mud clay.

Transverse diameter of head

It measures the straight distance between the most laterally projected points on the equatorial plane taken at right angle to the vertical diameter, sliding calliper is used for this measurement.

RESULTS

The study was undertaken in 50 human femurs for measuring epicondylar breadth, Neck shaft angle, transverse and vertical diameter of head. The results were the average mean epicondylar breadth was 75.06 ± 6.6mm, mean right epicondylar breadth was 73.96 ± 4.99mm and left it was 76.35 ± 7mm. The average mean neck shaft angle was 125.3 ± 6.5mm, mean right neck shaft angle was 124.44 ± 5.7mm and left it was 126.3 ± 7.33mm. The average mean transverse diameter of head was 37.86 ± 3.06mm, mean right transverse diameter of head was 37.74 ± 3.05mm and left it was 38 ± 3.13mm. The average mean vertical diameter of head was 42.24 ± 3.53mm, mean right vertical diameter of head was 41.63 ± 3.09mm and left it was 42.96 ± 3.92mm, Neck shaft angle ranges from a minimum of 106° to maximum 135° with a mean value of 125.3°

DISCUSSION

Vertical diameter of head of femur ranges from a minimum 34mm to maximum 51mm with a mean value of 42.24mm. When compared to the range of known sex, 23 out of 50 identified as belonging to male and 27 to female. Vertical diameter of head of femur has been reported earlier. This is in correlation with the present observation and this parameter is giving higher percentage of accuracy in sexing the femur. Pearson[21] also studied and presented data on what was termed the mathematic sexing of femur and suggested vertical diameter of head as one of sex category for the femur. The mean diameter of male femur was significantly greater than the female femur.[19] In study of Rumapurkait[17] found that maximum head diameter alone could correctly assign sex to 92.5% of males and 95.5% females, in the same study they also found that head vertical diameter of right femur was significantly greater than left. Pons[7] stated that the head diameter discriminated the sex better than any other part of bone.

In our study we found out that epicondylar breath varies from a minimum of 58mm to maximum of 92mm with a mean value of 75.06mm and this parameter is highly variable in sexing of femur, according to Tracho et al.[22] this sex difference can be result of genetic factors, environmental factors affecting growth and development. In study of Parson[6] bicondylar with was <72mm in female and >78mm in male. In present study Neck- shaft angle ranges from minimum of 1°6° to maximum of 135° with a mean value of 125.3°. Neck-shaft angle earlier reported by Henry Hollinshead[23] as an average 126° and TanerZuylan[20] has given report as an average 125° and shame author stated that the results of neck shaft angle of left femur were generally shown to have greater value, but they were not significantly greater than the corresponding dimensions of right femur. Issac B et al.[18] stated that any estimated defective angle can be help for forensic identification of an individual with pathological changes leading to abnormal gait. In our present study the Transverse diameter of head of femur varies from a minimum 28mm to maximum 44mm with a mean value of 37.86mm, when compared to range of known sex 22 femora out of 50 identified as belonging to male and 28 to female, this parameter is giving higher percentage of accuracy for sexing the femur and there are no much significant differences between Rt and Lt femora in the present study. Taner Zuylan[20] reported that there is no significant difference between right and left femora. According to Ruma Purkait[17] there is enormous sexual difference in male and female head of femur, the results are of great applied and practical value in referred specimen in medico legal field. The present study reveals that femora of unknown gender can be sexed to extent of 75-80% by three parameters namely, vertical diameter of head, Neck-shaft angle and Transverse diameter if head.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

1. Mayhew PM, Thomas CD, Clement JG, Loveridge N, Beck TJ, Bonfield W, Burgoyne CJ, Reeve J. Relation between age, femoral neck cortical stability, and hip fracture risk. Lancet. 2005;366(9480):129-35.
2. William P.L., Warwick R., Dyson M. Appl Neurophysiol. In: Bannister L. H., eds. Gray's Anatomy. 37th ed. Edinburgh: Churchill Livingstone; 1989: 1598.

3. Stewart T. D. "Identification by the Skeletal Structures," In: Camps FE, eds. Gradwhol's Legal Medicine. 3rd ed. Chicago: Year Book Medical Publishers; 1976: 109-135.
4. Strecker W, Keppler P, Gebhard F, Kinzl L. Length and torsion of the lower limb. J Bone Joint Surg Br. 1997;79(6):1019-23.
5. Parsons, F.G. The character of the English thigh bone. Journal of Anatomy and physiology 1914;48:238-67.
6. Pons J. Sexual diagnosis of isolated bones of the skeleton. Human Biology. 1955;27:12-21.
7. Lofgren, L. Some anthropometric anatomical measurements of the femur of Finns from the view point of surgery, Acta Chir Scandinavia. 1956;110:477-84.
8. Walensky N A, Michael P O Brien. Anatomical factors relative to racial selectivity of femoral neck fracture. American Journal of Physical Anthropology. 1968;28:1:93-6.
9. Graham J H, Freeman D C, Emlen J M. Antisymmetry, directional asymmetry and dynamic morphogenesis. Genetica. 1993;89:121-37.
10. Steel, F. L. D. The sexing of the long bones with reference to the St. Bride's series of identified skeletons, Journal of the Royal Anthropological Institute of Great Britain and Ireland. 1972;92:212-22.
11. Van Gerven, D. P. The contribution of size and shape variation to patterns of sexual dimorphism of human femur, American Journal of Physical Anthropology. 1972;37:49-60.
12. Kate B R, Robert S L. The angle of femoral torsion. J. Anat. Soc. India. 1963;12:8.
13. France D L. Osteometry at muscle origin and insertion in sex determination, American Journal of Physical Anthropology. 1988;76:515-26.
14. Alan M W Porter. Analyses of measurements taken from adult femurs of a British population. International Journal of Osteoarchaeology. 1995;5(4):305-23.
15. Yasar Iscan M, Ding Shihai. Sexual dimorphism in the chinese femur. Forensic science international. 1995;74;79-87.
16. Ruma Purkait, Chandra H. Sexual Dimorphism in Femora: An Indian Study. Forensic Science Communications. 2002;4(3):1-6.
17. Isaac B, Vettivel S, Prasad P, Jeyaseelan L, Chandi G. Prediction of the femoral neck shaft angle from the length of the femoral neck. Clin Anat. 1997;10:318-23.
18. Asala S. A. Sex determination from the head of the femur of South African whites and blacks, Forensic Science International. 2001;117:15-22.
19. Taner Zuylan, Khalil Awadh Murshid. An analysis of anatolian human femur Anthropometry turk j med sci. 2002;32:231-5.
20. Parsons F G. The character of the English thigh bone. Journal of anatomy. 1914;48:238-67.
21. Trancho G. J., Robledo B., Lopez-Bueis I., Sanchez A. Sexual determination of femur using discriminant function analysis of a Spanish population of known sex and age, Journal of Forensic Sciences. 1997;42:181-5.

DOI: 10.5455/2320-6012.ijrms20140221
Cite this article as: Khaleel N, Shaik HS. Osteometric study of human femur. Int J Res Med Sci 2014;2:104-7.