Section: Anatomy

Original Research Article

MORPHOMETRIC ANALYSIS OF HUMAN FEMORA IN SOUTH INDIAN POPULATION

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ABSTRACT

Background: The sex and age determination are crucial elements in anthropology and forensic medicine. To determine the age and sex of a person; many statistical methods were developed by using various bone fragments. The femur is the longest bone and it is believed that age variations in this bone with a method can be used in both living and deceased. **Aim:** to study the morphometric analysis of human femora.

Materials and Methods: 50 dry human femora of unknown sex were collected from Department of Anatomy, Kurnool Medical College, Kurnool and different Medical Institutions. The morphometric parameters like maximum length of femur, epicondylar breadth and antero-posterior diameter of midshaft of femora was measured.

Results: The maximum length of the femur varies from a minimum of 375 mm to maximum of 475 mm with a mean value of 419.42 mm. The epicondylar breadth of femur varies from a minimum of 66mm to maximum of 91 mm with a mean value of 75.98mm. Middle antero-posterior diameter of femur varies from minimum of 23mm to maximum of 38mm with a mean value of 30.66mm noted in the present study.

Conclusion: Individual parameter contributes certain percentage of certainty to decide the sex of unknown femur. Morphometric parameters of the present study to be considered together for the purpose of sex determination of femur to acknowledge its importance.

Keywords: Epicondylar, midshaft, maximum length.

INTRODUCTION

The femur is the strongest and longest bone of lower extremity of the human body. The femur bone long shaft, proximal end and distal end. The femur transmits the body weight and helps in stability, due to widely expanded lower end of the femur, providing weight bearing surface over the upper surface of the shin bone.[1] The femur would be the better choice for reconstruction of the length of femur from fragments of the bone is an essential step in the estimation of stature in forensic investigations.[2,3] The morphometry of the bone varies among different races, and populations. The Age, sex and race are also factors that contribute to the length of bones.[4] The sex can be estimated using femoral dimorphism. The age is determined using metric measurements between distinct points on the femur.[5,6,7] The present study aimed to analyse the morphometric parameters of human femora in south Indian population and its clinical significance.

MATERIALS AND METHODS

50 dry human femora of unknown sex were collected from the Department of Anatomy, Kurnool Medical College, Kurnool and different Medical Institutions around Kurnool region. The morphometric parameters like Maximum length of femur, Epicondylar breadth, Antero-posterior diameter of the middle shaft of femur were measured.

1. MAXIMUM LENGTH OF FEMUR

It was measured as the straight distance between the highest point of the head and the deepest point on

the medial condyle by using Osteometric board (Figure 1).

2. EPICONDYLAR BREADTH OF FEMUR

It was measured as the distance between the most projected points on the epicondyles by using Sliding calipers. [Figure 2]

3. ANTEROPOSTERIOR DIAMETER OF THE MIDDLE SHAFT OF FEMUR

It was measured as the distance between the anterior and posterior surfaces of the bone approximately at the middle of the shaft ie. The highest elevation of lineaaspera by using sliding calipers. [Figure 3]

All the measurements were statistically analyzed and tabulated.

RESULTS

The maximum length of the femur varies from a minimum of 375 mm to maximum of 475 mm with a mean value of 419.42 mm, the epicondylar breadth of femur varies from a minimum of 66mm to maximum of 91 mm with a mean value of 75.98mm, and the middle antero-posterior diameter of femur varies from minimum of 23mm to maximum of 38mm with a mean value of 30.66mm in our study [Table 1]. The range of the known sex in reference to maximum length, 25 femora out of 50 could be identified as belonging to male and 25 to female and based on the epicondylar breadth, 27 femora out of could be identified as belonging to male and 23 to female and the range of known sex in reference to middle antero-posterior diameter of femur, 25 out of 50 femora could be identified as belonging to male and 25 to female by using middle antero-posterior diameter of femur in the present study [Table 2].

Figure 1: Measuring maximum length of femur by using Osteometric board

Figure 2: Measuring epicondyalr breadth of femur by using sliding calipers

Figure 3: Measuring antero posterior diameter of midshaft of femur by using sliding calipers

Table 1: Descriptive Statistics

Name of the variable	Number of femora	Minimum	Maximum	Mean	Standard deviation	Variance
Maximum Length	50	375.00	475.00	419.42	24.74	12.06
Epicondylar Breadth	50	66.00	91.00	75.98	6.241	38.95
Antero-posterior diameter of Middle Shaft	50	23.00	38.00	30.66	3.402	11.57

Table 2: Sexing of femur by individual parameters

S. No	Parameters	Male	Female	Number of Femora
1	Maximum Length	25	25	50
2	Epicondylar Breadth	27	23	50
3	Antero-posterior diameter of Middle Shaft	25	25	50

DISCUSSION

The Maximum length of femur was the best parameter for sexing the unknown femora. The comparisons were drawn separately for male left and right femora as well as for female left and right femora, because individuals tend to favor one limb over other.[8]

The female femur is shorter than male and in male the left longer than right and vice versa in female.[9] The male femur usually larger than the female femur and the sex differences in long bones revealed that male bones are longer and more massive than female bones.[10,11] There was wide variation of maximum length of femur noted in our study. There was a difference in the lengths of the right and left side bones but statistically insignificant] All such parameters must be considered and specific formulae computed while estimating the total length of a bone.[4,12,13] The female epicondylar breadth of femur was shorter than male femur. The epicondylar breadth of femur was the best parameter for sexing the unknown femora. The male femur epicondylar breadth usually larger than the female femur.[14] The width of lower end as sex category was stated that more than 72mm noted in male and less than 71mm noted in female, between 71- 72mm may be male or female.[15,16] The technique used to measure the maximum antero-posterior diameter of shaft was according to previous literature. Sex determination with maximum antero-posterior diameter of shaft was discussed.[17] All dimensions of femur were larger in males than females, but determination of sex of an individual from a single femur was a more difficult task.[18,19] The shaft of femur was shaped that it varies at midlevel and at subtrochanteric level. Hence several transverse and sagittal diameters are useful in sex determination of femora.[11] The importance of the morphometric analysis of femoral segments is acknowledged in forensic, anatomic and archaeological cases to identify unknown bodies and stature.[20,21] The parameters measured and their morphometric analysis in the study were in mere agreement with previous literature and to determine the sex of femora some more parameters need to be measured and considered together for better understanding the sex determination of femora and its importance.[11,18,20,21]

CONCLUSION

Individual parameter contributes certain percentage of certainty to decide the sex of unknown femur. Morphometric parameters of the present study to be considered all together for the purpose of sex determination of femur to acknowledge its importance.

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REFERENCES

1. Susan Standring, Gray 's Anatomy, The Anatomical basis of clinical practice, 40 edition, Elsevier Churchill Livingstone, London. 2008; 1360-13.
2. Trotter M, Gleser GC. A re-evaluation of estimation of stature based on measurements of stature taken during life and of long bones after death Am J Phys Anthropol. 1958; 16:79–123.
3. Abledu JK, Offei EB, Osabutey CK. Reconstruction of femoral length from fragmentary femora Anat Cell Biol. 2016;49:206–9.
4. Hauser R, Smoliński J, Gos T. The estimation of stature on the basis of measurements of the femur Forensic Sci Int. 2005; 147:185–90.
5. Ozer I, Katayama K (2008) Sex determination using the femur in an ancient Japanese population. Coll Antropol 32(1):67–72
6. Barrier P, Dedouit F, Braga J, Joffre F, Rouge D, Rousseau H, Telmon N (2009) Age at death estimation using multislice computed tomography reconstructions of the posterior pelvis. J Forensic Sci 54(4):773–778.
7. Han H, Oh S, Chang CB, Kang SB (2015) Anthropometric difference of the knee on MRI according to gender and age groups. Surg Radiol Anat. doi:10.1007/s00276-015-1536-2
8. Leelavathy N, Rajangam S, Janakiram S, Thomas JM. Sexing of the femora. Indian journal of anatomical. Society of india.2000; 49(1):17-20.
9. Alan M. W. Porter. Analyses of measurements taken from adult femurs of a British population. International Journal of Osteoarchaeology. 1995; 5(4):305-323.
10. Singh S. P., Singh S. (1975) Collo-diaphyseal angle of femur in North India. Indian Med. Gaz. 15, 11–14.
11. Krogman W. M., Iscan M. Y. (1986) The Human Skeleton in Forensic Medicine, 2nd edn. Illinois, USA, Charles C. Thomas, pp. 200 and 259.
12. Khanal L, Shah S, Koirala S. Estimation of total length of femur from its proximal and distal segmental measurements of disarticulated femur bones of Nepalese population using regression equation method J Clin Diagnostic Res. 2017;11: HC01–C5.
13. Lee JH, Kim YS, Jeong YG, Lee NS, Han SY, Tubbs RS, et al Sex determination from partial segments and maximum femur lengths in Koreans using computed tomography Folia Morphol (Warsz). 2014; 73:353–8.
14. Purkait, R. Determination of sex from human long bones of Madhya Pradesh, India. Diss. PhD Thesis, Delhi University, India, 1989.
15. Pearson K., Bell J. (1917/1919) A study of the long bones of the English skeleton. 1: The femur. In: Draper's Co. Research Memorandum. University of London. Chap. 1–4. Biom. Series, X.
16. Parsons F. G. (1913/1914) The character of English thigh bone: I. J. Anat. Physiol. 48, 238–67.
17. Mac Laughlin SM, Bruce MF. A simple univariate for determining sex from fragmentary femora: its application to a Scottish short cist population. Am J Phys Anthropology 1985; 67:413–7.
18. Steyn M, İşcan MY. Sexual dimorphism in the crania and mandibles of South African whites. Forensic Sci Int. 1998; 98:9–16.
19. Taner ziylan. An analysis of Anatolian human femur anthropometry, turkey journal of medical sciences. 2002; 32:231-235.
20. Hussian SS, Mavishetter GF, Thomas ST, Prasanna LC, Muralidhar P. Occipitalization of Atlas: A case report. J Biomed Sci and Res 2010; 2:73-5.
21. Hussain Saheb S, Mavishettar GF, Thomas ST, Prasanna LC. Incidence of metopic suture in adult south Indian skulls. J Biomed Sci Res 2010; 2:223-6.