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A Metric Method for Gender Determination Among Adult Patient in University of Benin Teaching Hospital using Femoral Head

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ABSTRACT

The femur is one of the chosen bones for sex determination although the skull and the round heads of the ball joint also provide reliable means for determination of sex. The femur is the longest and heaviest bone in the body. It transmits body weight from the hipbone to the tibia when a person is standing. The femur consists of a shaft (body) and two ends, superior or proximal and inferior or distal. The superior (proximal) end of the femur consists of a head, neck, and two trochanters (greater and lesser). This work was carried out with the use of X-ray films of adult pelvis (230 males and 200 females) collected from university of Benin teaching Hospital, Nigeria. The Objectives is to establish differences between (genders) among patient in university of Benin teaching Hospital. That is, by measurement of the transverse and vertical diameter of the head of femur.

Some numbers of X-ray films of femurs of adult individuals were collected. Their ages ranged between 18 and 90 years and their gender taken note of. The vertical and transverse diameter of the head of the femur was measured using a sliding Caliper. The demarking point and the identification point identifies the sex of a higher percentage of a male femur while the mean diameter of the head of the male femur was significantly greater than that of the female ($P<0.001$). The results clearly show the importance of femur in determination of sex. Both identification and demarking points for males were greater than those of females. It therefore follows that when femurs with intact heads are provided; sex can be assigned to them.

Key words: Gender determination, Femur, Nigeria.

INTRODUCTION

The femora head diameter differ among individuals, therefore the need for gender determination using the femoral diameter cannot be left out among other standardized method used. Human differ in size from each other between races, hence, their morphological proportions would affect metric assessment of sex. Femur is considered as one of the ways of sex determinations from the skeletal material and one of the most reliable if essential parts of the skeleton are available in good condition[1]. The role of the skeleton in estimating attributes such as age, sex, race, stature and the presence of disease is discussed by Iscan *et al.*[2]. They stated that the record of organic evolution is largely written by the hard part of the body recognizable even after many years of death.

Asala[3] carried out a research on sex determination from the head of the femur of South African Whites and Black, where he states that the current practice whereby criminals dismember the remains of their victims in an attempt to make their identification difficult requires that simple methods of sex determination from fragmented skeletal remains are available to forensic anthropologists and skeletal biologist. He said the head of the femur is an example of such fragments; he derived the identification and demarking points from the diameters of the head of the femur and used to determine the sex of individuals.

Albanese *et al*,[4] did a research in Canada on a metric method for sex determination using the proximal femur and fragmentary hipbone. With regards to its study, the pubic bone is considered

one of the best sources of information for determining sex using skeletal remains, but can be easily damaged postmortem. This problem has led to the development of nonpelvic methods for cases when the pubic bone is too damaged for analysis.

Anatomical society of India carried out a research on anatomical parameters of north Indian hip joints – Cadaveric study. Dimensions of acetabulum and femoral head were obtained with venier scale. It was observed that these dimensions were greater in males when compared to that of females but the difference was statistically insignificant. On the left side the parameters measured were greater than those of the right in both the sexes but of no statistical significance. Acetabular diameter was greater than the diameter of femoral head in both the genders.[5]

Asala *et al.,*[6] did a research on the comparative study of femoral head diameters and sex differentiation in Nigerians using the vertical and transverse diameters of 504 paired human of the head of the femurs (257 males and 247 females) from Maiduguri in the northeastern arid zone of Nigeria were measured. Identification points and demarking points were determined. The mean diameter of the head of the male femur was significantly greater than that of the female ($p<0.001$).

Alunni *et al.,*[7] sex determination from the distal part of the femur in a French contemporary population. The mean value of the male bicondylar breadth was found to be greater than that of females (84.3 mm versus 74.8 mm), confirming the sexual dimorphism of this parameter. Furthermore, the results showed a 95.4% accuracy rate for sexing individuals. The aim of this study is to help in determining the gender of an adult individual in university of Benin teaching hospital, by measuring the vertical and transverse diameter of the head of the femur, putting into consideration of sex, age, racial differences or related changes.

MATERIAL AND METHODS

A total of 620 x-ray films of known identity of adult pelvis of age 18-70 years were collected from the University of Benin Teaching Hospital, Ugbowo, Edo State, Nigeria. The films selected fulfilled the criteria i.e. Show the pelvis and hip joints and free from dislocation and fraction. Out of the 620 x-ray films only 437 meet with the aforementioned criteria, 230 pair pelvis (460) is of male while 200 pair pelvis (400) is of female.

The films were taken at a routine object film distance of 5cm and focal – film distance of 92cm in the anterioposterior view and with the two big toes touching on their medial aspects. A magnification correlation factor of 2.86% was applied to the measurements. [8]

The following methods adopted from Singh and Singh [9] were used for the measurements of the vertical and transverse diameters of the head of the femur.

The vertical diameter of the head of the femur was measured using a sliding caliper. The limbs of the sliding caliper were held in the obliquely horizontal plane and placed parallel to the long axis of the neck of the femur. So the head of the femur was situated between the limbs of the caliper and the maximum vertical was recorded.

Transverse (Mediolateral) Diameter

The transverse diameter of the head of the femur was measured with the help of the sliding venier caliper. The limbs of the caliper were held in the vertical plane and the transverse diameter was taken from the region of the fovea centralize up to the junction of the neck with the head of the femur.

The method of Singh and Singh [8] was applied in taking the measurement of the femoral head diameter vertically and transversely using the x-ray fluoresce box. The data collected was statistically analyzed using descriptive statistics and unpaired T – test, with the aid of Microsoft Excel 2007 and the T –tests was employed in finding the differences of both sexes and the values of the right and left femoral head diameters.

Identification points (IP) are levels of femoral head diameters whose values are those of male bones and below which are female bones. The male identification point is therefore the maximum value of the range of diameters of the

head of the female femur, while the identification point for the female is the minimum value of the range of values for male.

Demarking points (DP) are defined by the mean of femoral head diameters of the opposite sex plus (male) or minus (female) 3 times its standard deviation. Identification points are not as accurate when data are obtained from different locations within the same geographical areas (3). In medico-legal cases, where 100% accuracy of identification of skeletal remains is required, the use of demarking point is preferable. Identification points, however, identify more bones than demarking points but with less accuracy.

RESULTS

Vertical Diameter

The vertical diameters of the head of the male right and left femur were significantly greater than the corresponding diameters of the head of the female right and left femur (P< 0.001) as depicted in (Table III) below. The mean vertical diameters of the male femur were 52.03mm and 52.09, while that of the female were 46.06mm and 47.79mm.

Transverse Diameter

Table IV shows the result of the measurements of transverse diameter of the femur

Table 1: Measurement of the Vertical Head Diameter in 430 femora (230 males and 200 females)

Parameters	Right		Left	
	Male	Female	Male	Female
No	230	200	230	200
Mean (mm)	52.03	46.06	52.09	47.79
Actual Range (mm)	34.7 – 63.5	32.4-59.3	34.8-64.4	32.4-60.2
I.P. (mm)	59.3	34.7	60.2	34.8
SD (mm)	±3.54	±3.48	±3.57	±2.57
SE (mm)	0.394	0.364	0.321	0.321

I.P. = Identification Point, SD = Standard Deviation, SE=Standard Error

Table 2: Measurement of the transverse head diameter in 430 femora

Parameters	Right		Left	
	Male	Female	Male	Female
No	230	200	230	200
Mean (mm)	54.19	48.23	54.33	48.44
Actual Range (mm)	38.5-64.2	34.6-57.4	36.5-67.4	38.9-58.6
I.P. (mm)	57.4	38.5	58.6	36.5
SD (mm)	±3.51	±3.22	±3.53	±3.20
SE (mm)	0.263	0.287	0.299	0.295

I.P. = Identification Point, SD = Standard Deviation, SE=Standard Error

Table 3: Descriptive Statistics Vertical and Transverse Diameters Right and left combined Males and Females

Parameters	Vertical Diameter		Transverse Diameter	
	Male V.D	Female V.D	Male T.D	Female T.D
No	460	400	460	400
Mean (mm)	52.06	46.93	54.26	48.33
Actual Range (mm)	34.7-63.6	32.4-58.3	40.2-66.5	37.6-59.4
SD (mm)	±3.24	±3.02	±3.36	±3.20
SE (mm)	0.342	0.331	0.381	0.291

SD = Standard Deviation, SE=Standard Error

Table 4: Identification point and demarking points for determining sex from the vertical and transverse diameter of the femur

Parameters	Vertical Diameter				Transverse diameter			
	Right		Left		Right		Left	
	Male	Female	Male	Female	Male	Female	Male	Female
No.	230	200	230	200	230	200	230	200
Mean (mm)	52.03	46.06	52.09	47.79	54.19	48.23	54.33	48.44
I.P (mm)	59.3	34.7	60.2	34.8	57.4	38.5	58.6	36.5
S.D (mm)	±3.54	±3.48	±3.57	±2.57	±3.51	±3.22	±3.53	±3.20
D.P. (mm)	56.5	41.5	55.5	41.38	57.89	43.66	58.04	43.74
S.E. (mm)	0.394	0.364	0.32	0.321	0.263	0.287	0.299	0.295

I.P. = Identification Point, SD = Standard Deviation, D.P = Demarking point and SE=Standard Error.

Table 5: Comparison of Identification and demarking points for sex differentiation with other geographical regions

Parameters	Vertical Diameter				Transverse diameter			
	Right		Left		Right		Left	
	Male	Female	Male	Female	Male	Female	Male	Female
Present study I.P (mm)	59.3	54.7	60.2	34.8	57.4	38.5	58.6	36.5
DP,(mm)	56.5	41.5	55.5	41.38	57.89	43.66	58.04	43.74
Malawians IP, (mm)	53.00	37.00	56.00	42.00	57.00	41.00	55.00	44.00
DP (mm)	54.93	37.77	54.76	38.95	57.64	39.40	56.34	41.69
Calabar IP (mm)	52.00	45.70	55.00	45.00	58.00	48.00	49.00	46.00
DP (mm)	55.60	42.21	56.59	41.42	57.67	44.41	58.00	43.57

in males and females right and left transverse diameter. The male is greater than that of the female transverse diameter, with a mean of 54.19mm and 54.33mm, and 48.23mm, 48.44mm respectively.

Identification Points

The male identification points that were derived from the vertical diameters were 59.3mm for the right femur and 60.2mm for the left femur. The corresponding female identification points were 34.7 for the right femur and 34.8mm for the left femur (Table III). The transverse diameter of the head of the femur gave identification points of 57.4mm for the male right, 58.6mm for the male left, 38.5mm for the female right and 36.5mm for the female left femur.

Demarking Points

The values of the demarking points are shown in table V. The demarking points for male sex identification were higher than those of the corresponding identification points, while the demarking points for female identification were lower than those of the corresponding identification points (table V).

Table 6: Comparison of the mean femoral diameters between Malawians and Nigerians

	Mean Diameter (mm)			
	Vertical		Transverse	
	Male	Female	Male	Female
Malawians1999	48.30	44.56	50.51	46.52
Nigerians(Present Study2011)	52.06	46.93	54.26	48.33

DISCUSSION

Racial differences have been shown to exist in the dimensions of the femoral heads from studies carried out by different authors. Felts[10] believed that the gross shape of long bones was caused by intrinsic factors, while the specific details were determined by the bone adaptation to the functional environment. It is therefore likely that heredity is a major factor in the formation of the shape of long bones due to its different functions in different races. The average diameter of the head of the femur is therefore different in different races.

Purkait[11] showed that if the vertical diameter of the head of the femur was greater than 48.00mm, the bone belongs to a male bone and when below 44.00mm, it belongs to a female bone. For the Indian femora, Singh and Singh[9] reported figures of above 45.50mm for a male bone and less than 41.50mm for a female bone.

In this present study the vertical and transverse femoral head diameters for males were significantly greater than the corresponding values for females (P=0.001). This is an indication that femora head diameters could be used for sex differentiation among Nigerians. The mean vertical and transverse diameters for Nigerians male were greater than the corresponding values for males in Malawians (Table V). Similarly, the mean vertical diameter for males and females in the present study were greater than those of Malawians studied (table V). Femoral head diameters may therefore be of value in differentiating regional groups in Africa. Previous studies by Singh and Singh [8] and Asala et al [6]. showed that these diameters could differentiate different groups in a particular country. The values of male right and left transverse and vertical diameters for Nigerians, though greater than those of females, were however, relatively greater than those of Black Malawians (Table I). Those differences could be explained on factors like diet, genetic and climatic conditions

The striking differences that exist between the proportion of male and female bones that are identifiable are due to the fact that the mean

diameter of the female femoral head fell within the range of values that did not permit sex identification. This implies that there are a high proportion of female bones that approximate male bones in their femoral head characteristics, and this makes their identification difficult.

With statistically calculated demarking points, however, fewer bones were identified with greater degree of certainty than those identified by identification points. More females than males were identified by both methods due to the fact that the mean head diameter of male's femurs fell within the range of diameters that did not permit positive identification of sex (Table V).

In medicological cases and particularly in some parts of the world where the more sophisticated and precise methods of sex identification from bone are not available, identification and demarking points may be used. Standard values could be established for specific regions. It should however, be noted that although the identification point may identify the sex of a larger number of bones, it may be reasonable to back it up with the use of the more reliable demarking point.

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