(e) ISSN Online: 2321-9599

(p) ISSN Print: 2348-6805

ORIGINAL ARTICLE

GENDER IDENTIFICATION USING DISCRIMINANT FUNCTION ANALYSIS OF STUDY POPULATION

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ABSTRACT:

Background: Discriminant function analysis is the most popular statistical model in sex determination. This method is now becoming the choice for analysis the gender. Femor is important bone used for gender determination. The present study was conducted to determine the gender of individual using femoral head in study population. **Materials & Methods:** This study was conducted in the department of forensic medicine in year 2014. It consisted of 80 cadaveric femur of both sides (males- 45, females 35). The vernier caliper with 0.01 millimeter of resolution was used for the study. Vertical diameter of femoral head and transverse diameter of head of femur was measured using vernier caliper. For measuring vertical diameter of femoral head, the distance between the most superior and most inferior point on the femoral head that is right angles to the long axis of the neck of femur was considered. The transverse diameter of head of femur was measured at right angles to the vertical diameter of femoral head. It is a horizontal distance between most anterior point to the most posterior point on the head of femur. **Results:** Mean of vertical diameter of head of femur was 45.10 and standard deviation (S.D) was 3.62. The mean of transverse diameter of head of femur was 44.86 and standard deviation (S.D) was 3.24. Mean of vertical diameter of femur head of males was 45.12 and in females was 41.63. Transverse diameter in males was 46.22 and in females was 41.24. The difference was significant ($P < 0.05$). Classical functional coefficient of vertical diameter in males was 5.84 and in females as 5.21. Hence following discriminant function equation was obtained. For Males, Score=X_1 X 5.84 – 132.26, for Females: Score=X_1 X 5.21 –128.34 where, X1 =Vertical diameter of Head of Femur. Vertical diameter of head of femur correctly sexed 85.22% of the males and 84.45% of the females with overall classification rate of 85 %. Classical functional coefficient of transverse diameter in males was 6.25 and in females as 5.62. Hence following discriminant function equation was obtained. For Males, Score=X_1 X 6.25 – 134.12. For Females: Score=X_1 X 5.62 –118.16 where, X1 = Tranverse diameter of Head of Femur. Transverse diameter of head of femur correctly sexed 90.28% of the males and 78.44% of the females with overall classification rate of 87.9% but on cross validation it is reduced to 82.6%. **Conclusion:** Femoral head may be useful in determination of gender of an individual. However, large studies are required to substantiate the data obtained in this study.

Key words: Femur, Discriminant function analysis, gender

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This article may be cited as: Singh A. Gender identification using discriminant function analysis of study population. J Adv Med Dent Scie Res 2017;5(2):16-18.

Access this article online	
Quick Response Code	Website: www.jamdsr.com
	DOI: 10.21276/jamdsr.2017.5.2.5

INTRODUCTION

Bones are useful in identification of gender of an individual. A thorough knowledge of bone enables the forensic anthropologist to acquire information on subtle variations in the human skeleton that useful in establishing individual identity. [1]

Forensic medicine is now considered for trauma analysis, facial reconstruction, photographic superimposition, determination of time interval since death, and crime-scene recovery. After adolescence, when the secondary sex characters have made their appearance it is possible to recognize the sex of a skeleton and on the experience of the observer. Pelvis, the skull and the joint ends of some of the long bones play important role in determination of gender of an individual.[2]

Discriminant function analysis is the most popular statistical model in sex determination. This method is now becoming the choice for analysis the gender. It is more reliable methods than other methods. The sexual dimorphism of long bones is generally reflected by larger size and bigger muscular development of the males. Hence their study may be used in knowing the gender of person.[3]

Forensic identification often involves fragmentary remains. Fragmented, scattered, incomplete or burned remains limit the success obtained in sex determination. The sex can be successfully determined from fragmentary remains if appropriate bones are selected. The bones that are chosen for sex determination should be resistant to damage and sexually dimorphic.[4]

Femur is the long bone that is widely used for sex determination. It has benefit that it has specific parameters that helps in determination of males and females.[5]

The present study was conducted to determine the gender of individual using femoral head in study population.

MATERIALS & METHODS

This study was conducted in the department of forensic medicine in year 2014. It consisted of 80 cadaveric femur of both sides (males- 45, females 35). The vernier caliper with 0.01 milimeter of resolution was used for the study. Vertical diameter of femoral head and transverse diameter of head of femur was measured using vernier caliper. For measuring vertical diameter of femoral head, the distance between the most superior and most inferior point on the femoral head that is right angles to the long axis of the neck of femur was considered. The transverse diameter of head of femur was measured at right angles to the vertical diameter of femoral head. It is a horizontal distance between most anterior point to the most posterior point on the head of femur. Results thus obtained were subjected to statistical analysis. P value less than 0.05 was considered significant.

RESULTS

Table I shows that mean of vertical diameter of head of femur was 45.10 and standard deviation (S.D) was 3.62. The mean of transverse diameter of head of femur was 44.86 and standard deviation (S.D) was 3.24. Graph I shows that mean of vertical diameter of femur head of males was 45.12 and in females was 41.63. Transverse diameter in males was 46.22 and in females was 41.24. The difference was significant ($P < 0.05$).

Table II shows Classical functional coefficient of vertical diameter in males as 5.84 and in females as 5.21. Hence following discriminant function equation was obtained. For Males, Score=X_1 X 5.84 – 132.26, for Females: Score=X_1 X 5.21 –128.34 where, X1 =Vertical diameter of Head of Femur. Vertical diameter of head of femur correctly sexed 85.22% of the males and 84.45% of the females with overall classification rate of 85 % (Table III). Table IV shows Classical functional coefficient of transverse diameter in males as 6.25 and in females as 5.62. Hence following discriminant function equation was obtained. For Males, Score=X_1 X 6.25 – 134.12. For Females: Score=X_1 X 5.62 –118.16 where, X1 = Tranverse diameter of Head of Femur.

Table V shows that Transverse diameter of head of femur correctly sexed 90.28% of the males and 78.44% of the females with overall classification rate of 87.9% but on cross validation it is reduced to 82.6%.

Table I Showing Mean, Standard Deviation, Minimum and Maximum of Different Parameters

Parameters (mm)	Mean	S.D	Min	Max
Vertical diameter of femur head	45.10	3.62	36.44	52.19
Transverse diameter of femur head	44.86	3.24	37.13	53.86

Graph I Mean and Standard Deviation of Different parameters in males and females

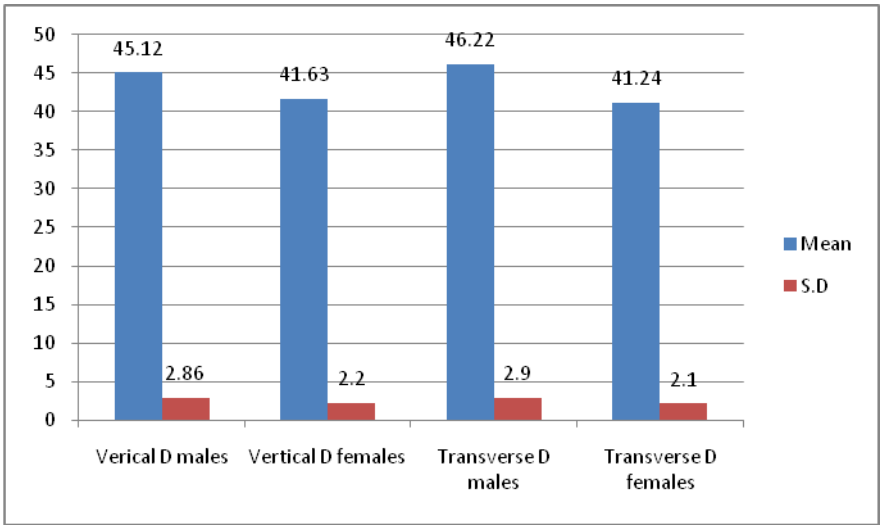

Table II Classical functional coefficient

	Male	Female
Vertical diameter of head	5.84	5.21
Constant	-132.26	-128.34

Table III Predicted group membership

	Sex	Predicted group membership		Total
Count		**Male**	**Female**	
	Male	40	5	45
	Female	5	30	35
%	**Male**	85.22	15.55	100
	Female	14.78	84.45	100

Table IV Classical functional coefficient

	Male	Female
Transverse diameter of head	6.25	5.62
Constant	-134.12	-118.16

Table V Predicted group membership

	Sex	Predicted group membership		Total
Count		**Male**	**Female**	
	Male	39	6	45
	Female	6	29	35
%	**Male**	90.28	21.56	100
	Female	9.72	78.44	100

DISCUSSION

Age, sex and racial affinity are the three most crucial determinations that must be taken care of when dealing with skeletal remains. It would be nearly impossible to identify an individual without this information. Sex is usually one of the easiest determinations made from skeletal material and one of the most reliable if the essential parts of the skeleton are present and in good condition.[6] The present study was conducted to determine the gender of individual using femoral head in study population. In present study, vertical diameter of head of femur and transverse diameter of head of femur were taken into consideration. In our study we found that mean of vertical diameter of head of femur was 45.10 and standard deviation (S.D) was 3.62. The mean of transverse diameter of head of femur was 44.86 and standard deviation (S.D) was 3.24. The mean of vertical diameter of femur head of males was 45.12 and in females was 41.63. Transverse diameter in males was 46.22 and in females was 41.24. Similar study was done by Kerley ER et al.[7]

We found that Vertical diameter of head of femur correctly sexed 85.22% of the males and 84.45% of the females with overall classification rate of 85 %. This is in accordance to Burris BG et al.[8] In present study, we found that transverse diameter of head of femur correctly sexed 90.28% of the males and 78.44% of the females with overall classification rate of 87.9% but on cross validation it is reduced to 82.6%. Similar results were seen in study of Hsaio et al.[9]

A study conducted by Gargi Soni[10] found sexual dimorphism of 78% in males and 82% in females.

CONCLUSION

Femoral head may be useful in determination of gender of an individual. However, large studies are required to substantiate the data obtained in this study.

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Source of support: Nil **Conflict of interest:** None declared