

Sex Determination From Femur : Standardisation of Measurement Using Fovea as Landmark

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ABSTRACT There is enormous sexual difference in male and female head of femur, which is not a sphere but not even a uniform spheroid. The theme and stress during this work was to identify the anatomical landmarks, followed by anthropometry. This resulted in more uniform readings taking away the eye judgement and observer's error. The reported standardised techniques of measurements - of curvatures in horizontal and vertical axis gave the results which are statistically highly significant. The results are of great applied and practical values in referred specimen in the medicolegal field.

INTRODUCTION

Out of the many studies devised by the author to determine sex from the femur, the reported is one of them (Purkait, 1989). The head of the femur has been chosen for the study, because, when we consider its most important strategic position in the hip joint, the congruity of articular surface is bound to reflect the stress and strain, which will form the best possible physical character to take advantage in recording the resulting sexual differences. The study is a slight deviation from the routine physical measurements of various bones and arriving at the conclusion there upon, without relationship to any of the anatomical landmarks. The small pit on the head of the femur situated in the postero-inferior quadrant in the human has never been considered worthy of its existence anthropologically or medico-legally. Anatomically, this pit giving attachment to the ligamentum teres also does not find any functional reference but upto the age of 8 years (William and Warwick, 1980; Breathnach, 1958).

The pelvis of the female is anatomically

modified with growth to perform the additional reproductive function thereby differentiating it with male. It also must be stressed that axial skeleton weight of a male is more than that of a female (William and Warwick, 1980). Keeping these facts in view we concentrated our thoughts with the intention to discover the sexual differentiation.

MATERIAL

The material used in this study consisted of 280 adult femora (200 males and 80) from the collection at Medicolegal Institute, Bhopal, where references are made on known and unknown bony skeleton discovered in crime cases.

All the bones were devoid of fat, without the soft tissues and cartilage and were in a dry condition. All pathological and abnormal bones were not considered in the study.

There was no significant statistical bilateral difference found in the bones. This view is supported by many scientists (Gerven, 1972; Ingalls, 1924; Parson, 1913-1914 and Pearson and Bell, 1917-1919). As such they have been considered as one in the study.

METHOD

Before we discuss the method, there are certain points which has to be considered in this study.

Eye Judgement : Various authros (Graham and Yarbrough, 1968; Ingalls, 1924; Krogman and Iscan, 1986; Martin and Saller, 1957; Pearson and Bell 1917-1919; and Steel, 1972) have recommended that certain

drawn to represent the axis on the bones by eye judgement. We have not agreed to this point for the simple logical conclusion that such judgement will always have contributory individual observer's error (Purkait, 1995). When we consider this in connection with angles sustained by any of these two, so called lines on a bone there could be enormous resultant error. As such we have defined and standardised landmarks for such lines. This will not only facilitate making standards but the data so obtained would be better comparable for times to come.

In this study the femur was placed with both the condyles touching the flat surface and the fovea facing the observer. The junction of the vertical diameter of fovea taken in the coronal plane and the horizontal diameter taken at right angles to vertical diameter was considered as the centre 'O'.

A plumb line was drawn from 'O' parallel to the line MN, 'M' being the centre of antero-posterior diameter at the distal end of upper one-fourth of the maximum femur length and 'N' was the centre of antero-posterior diameter at the distal end of upper three-fourth of the maximum femur length (Fig. 1). The antero-posterior diameter of the shaft is measured between the anterior and posterior surfaces of the femur with the help of dial caliper.

This plumb line drawn from the centre of fovea marked as 'O', was extended superiorly and inferiorly along the articular surface of head as AB. Another curved line XY at right angles to the curve line AB was drawn through the centre of fovea along the surface of the head of femur. The extreme limit of AB and XY were the ends of the articular surface (Fig. 1). Then A, B, X and Y were the acquired anthropological landmarks.

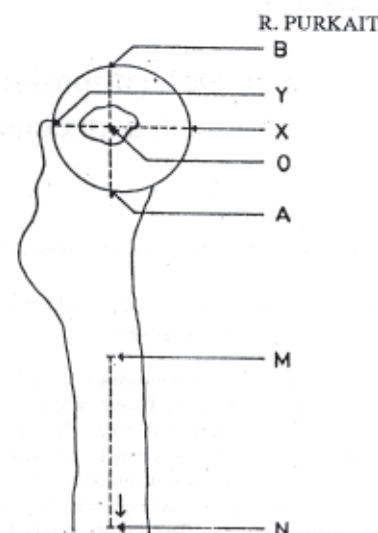


Fig. 1. The vertical 'AB' and the horizontal 'XY' measurements taken on the curved articular surface of the femur head

The vertical curved distance AB and horizontal curved distance XY through centre 'O' were measured and compared in both the sexes. The measurement along the curved surfaces were done by the electro-cardiographic paper strips.

OBSERVATIONS

The table 1 is simple descriptive data for both the measurement of head of the femur. The male femur exhibits higher comparative mean vertical measurement (74.23 mm) and horizontal measurement (86.29 mm) as compared to female (63.5 mm for vertical and 75.45 mm for horizontal measurements). The sex difference as assessed by 't' test is highly significant at 0.1 per cent level, which is suggestive of the fact that both the measurement could help in discriminating the sex. When the standard deviation

Table 1 : Statistical analysis of the measurements

Measurements (in mm)	Sex	N	Mean	S.D.	C.V.	Significance
Vertical	M	200	74.23	4.90	6.60	P < 0.001
	F	80	63.50	4.79	7.54	
Horizontal	M	200	86.29	5.82	6.75	P < 0.001
	F	80	75.45	4.76	6.31	

N = Number of bones; S.D = Standard Deviation; C.V.=Coefficient of Variation

tion is read with the mean measurements, there is no overlapping of the arrived results.

DISCUSSION

The congruity of the acetabular cavity and head of femur, the biggest joint used for locomotion, when studied anatomically and anthropologically, the results become strong indicators in sex determination. Fovea is the place where the ligament of the head of the femur, the ligamentum teres is attached. When the literature was reviewed, we hardly found any attention being paid to the fovea, to be utilised as landmarks in anatomy or anthropology.

The femur head of females has to adopt to the changes brought about in the hip joint due to reproductive function of pelvis. France (1988) suggested that the muscular forces moving across the joint also affects the articular surfaces of the bones. As it is a well established fact that males use muscle more heavily than females, it is expected that the articular surface of the femur will show a distinct sex difference. Apart from these factors the sexual difference in the weight bearing nature of the femur head (Pressure epiphysis) has also to be considered. The weight of the body above pelvis is more in the male than in the female (Williams and Warwick, 1980). The hip joint would react to such a difference and modify itself to produce maximum mechanical efficiency and as such the stress and strain of the hip joint will be reflected on the femur head (Hirsch and Frankel, 1960).

There are various authors who had defined measurements of the head of the femur without referring either to the anatomical position or arriving at the anatomical landmarks (Bass, 1971; Martin and Saller, 1957 and Wilder, 1920). There are some authors who insisted on measuring the diameter of the femur head taking the long axis of the neck determined by eye judgement (Krogman and Iscan, 1986; Steel, 1972) or the base of the head were considered as reference points (Lavelle, 1974).

As mentioned in methods, such long axis drawn by eye judgement are thrown to observer's error and will vary from person to person.

Atleast the marking of the landmark passing through the centre of the fovea 'O' (Fig.1) obtained precisely by the method described, is an original approach. By this method the curved measurements along the head of the femur become the anthropological standards and will be comparable. These now become acquired landmarks A, B, X and Y.

CONCLUSION

The method of adopting anatomical landmarks prescribed in the study on the head of the femur is free from bias, observer's error with reproducible and comparable results.

It is concluded that this study independently could be used for determining the sex of head of femur with high statistically high significant results.

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