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Original Research Paper

Anatomy

GENDER DETERMINATION USING PER-CUTANEOUS ULNAR LENGTH IN GWALIOR REGION

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ABSTRACT Gender determination either in living or in dead is the first step in identifying and individualizing an unknown person in forensic medicine. But when dismembered human body parts or bone from any mass disaster like earthquake, plane crash or in some cases of homicide etc. are the materials to work with, it is of a greater challenge for the forensic experts and in such cases the identity of an individual can be identified from measuring the bone length. The present study made an attempt to determine the gender from Per-Cutaneous Ulnar Length (PCUL) measurements for people of Gwalior region. A random sample of 210 male and 210 female students of G.R. Medical College, Gwalior between the age group of 18-21 years was chosen. PCUL of right and left side were measured with the help of spreading caliper. The Mean of PCUL for male was significantly ($p<0.0001$) greater than female which was found to be 27.09±1.293cm (Mean±SD) and 24.87±1.236cm respectively which indicates a significant gender difference between male and female PCUL. This study is recommended in anthropological and medico-legal cases for gender determination amongst the ethnic group under study when the only body part available is a mutilated forearm of a deceased.

KEYWORDS : Percutaneous Ulnar Length, Forensic Anthropology, Gender determination, Ulna.

INTRODUCTION

Identification of an individual can be made by identifying certain physical characteristics about the individual like the name as well as age and sex of the individual. Gender determination either in living or in dead is the first step in identifying and individualizing an unknown person in forensic medicine. But when dismembered human body parts or bone from any mass disaster like bomb blast, earthquake, aeroplane crash or in certain cases of homicide etc. are the materials to work with, it is of an even greater challenge for the forensic experts and in such cases the identity of an individual can be identified from measuring the bone length. Bone of an individual is influenced by numerous anthropometric characteristics as age, gender, stature, race, geographical climate, nutrition and genetic factors.[1-2] Hence, the correlation factors of one region will not hold good for the other, as this necessitates the researches to be done on regional basis.[2-3] Forensic anthropologists while dealing with skeletal remains have very little choice due to non-availability of complete skeleton from a scene of crime in most of the cases.[4] Most methods employ the basic process of comparison and forensic investigator must work with a checklist of the available bones and their accessible measurements, which could then be used altogether to optimize the determination of identity from such existing data.[5]

Many researchers studied the sexual dimorphism of adult skeletons or body parts with bony dimensions like using the dimensions of the long bones, hands, feet etc. [6-7] Some used advanced technique for measuring bony dimensions like CT images for pelvis[8], skull[9-11] etc. but it is not handy and require a lots of stuff before forming a result though the results were more accurate than manual measurements. A morphometric method relies on measurements and statistical techniques. However, many indices depend on direct distances between two bony landmarks.[12-13]

As the degree of sexual dimorphism, and the age at which it occurs in males and females, varies between different populations, sex estimation standards are necessary to be population specific.[14] Standards used to analyze morphometric data are most precise when applied to the population from which they were derived.[15] The ulna has easily identifiable surface landmarks making the measurement possible. Hence, the present study made an attempt to estimate the gender from Per-Cutaneous Ulnar Length (PCUL) which would be helpful to forensic and anthropometric investigations in identifying the remains of unknown dead bodies in Gwalior region.

MATERIAL AND METHODS

It is a cross sectional study. A random sample of 420 students were taken, 210 Male and 210 female, in the age group between 18-21 years from Gajra Raja Medical College, Gwalior (Madhya Pradesh). The Age, Gender, PCUL of right and left side in centimeters were noted. Subjects who had history of major trauma or old fractures, any significant disease, bony deformity, metabolic or developmental disorders, achondroplasia or any other congenital or hereditary bony disease which could have affected the general or bony growth were excluded from the study.

Methodology: The Ulnar length (PCUL) was measured with the help of spreading caliper from tip of olecranon process to tip of styloid process with elbow flexed and palm spread over opposite shoulder. The measurements were taken three times by the same observer and with the same instrument, to avoid any technical and/or inter-observer error and to maintain reproducibility and their mean value was taken. Measurements of length of right and left ulna were taken separately for calculation (Figure 1)[16].

The data was computed, tabulated and statistically analyzed using Graph Pad Prism and Microsoft Excel Windows 2007 softwares. The data obtained were compared with the other similar studies.

Figure 1: Method of measurement of Per-Cutaneous Length of Ulna by Spreading Caliper

RESULTS

The present study reveals that there was no statistically significant difference ($p>0.05$) occurs between the right and left PCUL length in male as well as in female as per Table 1 and Graph 1, thus showing bilateral symmetry in the length of Ulna in both gender. We have also found that the mean right and left PCUL of male is more as comparison to female. The mean Right PCUL for Male was 27.13±0.094 (Mean±SE) and for Female 24.94±0.085. Mean Left PCUL for Male was 27.05±0.088 and for Female 24.79±0.088.

Student t-test with t – value for PCUL in male and female was t=18 (Table 2). It shows that the PCUL of male was significantly (p<0.0001) higher as comparison to female thus, showing the sexual dimorphism in PCUL.

Table 1: Descriptive statistics of Per Cutaneous Ulnar Length of Male and Female

Statistics	Male (n = 210)			Female (n = 210)		
	Rt PCUL	Lt PCUL	Rt+Lt PCUL	Rt PCUL	Lt PCUL	Rt+Lt PCUL
Range (cm)	24.7 - 31	24.7 - 30.5	24.7 - 30.75	22 – 27.6	21.5 – 27.5	21.75-27.3
Mean (cm)	27.13	27.05	27.09	24.94	24.79	24.87
SD	1.4	1.3	1.3	1.2	1.3	1.2
SE	0.094	0.088	0.089	0.085	0.088	0.085
P value	Ns	-	Ns	-		

PCUL= per-cutaneous Ulnar length; Rt= right; Lt= left; SD= Standard Deviation; SE= Standard Error; Ns= not significant (p>0.05).

Graph 1: Showing Mean Per Cutaneous Ulnar length (PCUL) of Male and Female

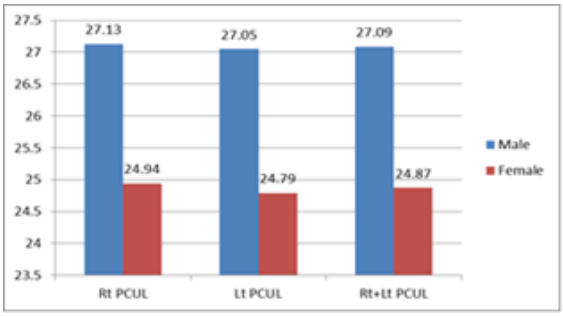

Table 2: Student t- test between Male and Female Ulnar length

t – value	t=18.00
p – value	P<0.0001 (Significant)
Difference between means	2.22 ± 0.12
Are means significantly different? (P < 0.05)	Yes
95% confidence interval	1.98 to 2.45
R squared	0.44

DISCUSSION

Anthropometric characteristics have direct relationship with gender, shape and form of an individual and these factors are intimately linked with each other.[17] There was no significant difference (p>0.05) in the per-cutaneous length of right and left Ulna in both genders, thus showing bilateral symmetry in the length of Ulna in both gender. The mean PCUL was 27.09cm and 24.87cm in male and female respectively which was significantly (p<0.0001) greater for male compared with female.

In a similar study by Ansah et al[18], Male participants had significantly longer right and left ulnae than females (p < 0.05), where mean right ulnar length (RUL) of all participants was 28.54 ± 1.91 cm and the mean left ulnar length (LUL) was 28.51 ± 1.88 cm. The male participants recorded a mean of 29.30 ±1.38 cm and 29.25 ± 1.33 cm for the RUL and LUL respectively. The mean RUL of females was 27.54 ± 2.04 cm and the mean LUL was 27.54 ± 2.03 cm with a range of 23.90 cm - 37.50 cm.

Okai et al[19] concluded that the ulna length is a better predictor of sex than radial length. Overall accuracy of sex determination based on radial or ulna length alone was 75.3% and 82.3% respectively.

In a study to predict sex from ulnar and radial lengths Issa et al[20] concluded radius and ulna bones, can help in sex prediction with high accuracy in unknown cadavers or remains. The accuracy of both radial and ulnar lengths in sex determination was 98%, while it was 97.5%, and 92.3% consecutively, in case of using radial or ulnar lengths alone.

In a study was carried out by Prasad et al[21] in 200 medical students they found that values are higher for male and the difference is statistically significant (p < 0.005). This statistically significant difference is because in females, oestrogen causes early closure of epiphysis with diaphysis. So there occurs early maturity of girls than boys; consequently, the boys have two more years of physical growth.

It is concluded that gender differences in mean per cutaneous ulnar length in males were found more than in females and were highly significant (p <0.05). There were no significant difference in the per-cutaneous length of right and left ulna in both genders, thus showing bilateral symmetry in the length of ulna in both genders. This study is very much useful for forensic expert as well as for the anthropologist in medico legal investigations which made possible to determine the gender of a deceased person whose only body part available is a mutilated forearm, by using the data calculated for people of these region fairly accurately to some extent. However the data derived cannot be generalized to all population groups, hence it is necessary to work on these kind of study region wise and population specific. Thus the data of this study is recommended in anthropological studies and forensic cases for gender estimation amongst the ethnic group under study.

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