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ORIGINAL ARTICLE

Reconstructions of Length of Radius From its Fragments- A Pilot Study in Eastern Indian Population

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Abstract:

In a demographically diverse, vast and densely populated country like India, the establishment of identity of a deceased assumes great medico-legal importance. It also poses a true challenge to the forensic scientist working in an environment where decomposition and taphonomic process are rapid. Structurally bones resist common degradation and putrefactive changes and remain longer as material for evidential value. Human skeletal remains are found under suspicious circumstances and doctors examining them need to give an opinion in the court of law. Forensic experts are often consulted regarding identification of skeletal remains. One of the important data for identification is the stature. The estimation of skeletal samples, for age, sex and stature are vital when found from sites in mixed lot. For this purpose, a technique will be highly appreciated for reconstruction of total length of long bones from their fragments. This current pilot investigation was designed to estimate the total length of radius using its fragmentary bone length in a population specific study thus in turn to employ them in stature formulae for population specific cases to estimate the final stature of the individual. After getting institutional ethical committee clearance, the study over 57 radii revealed linear equation where total length of radius was used as dependent variable and the different fragmentary length being the independent variables.

Keywords: Reconstruction; Radius fragments; Total radius length; Anthropometry.

Introduction:

In a country like India where population is demographically diverse, vast and dense, the fixation of identity of a dead body bears great medico-legal importance. It is also very challenging to the forensic experts to work in an environment where decomposition and taphonomic process are very fast. Structurally bones are resistant to degradation and putrefactive changes and act as a material for evidential value for long time. Human skeletal remains, found under suspicious circumstances are sent to forensic experts for examination in order to get an opinion in the Court of law.

Among four pillars of identification, stature is considered as one of the pillars. The estimated age, sex and stature of skeletal samples, plays a pivotal role when found from sites in mixed lot. For this purpose, a technique will be highly appreciated for reconstruction of total length of long bones from their fragments.

This pilot investigation was designed to estimate the total length of radius using its fragmentary bone length in a population specific study thus in turn to employ them in stature formulae for population specific cases to estimate the final stature of the individual.

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Dismembered human body parts throws greater challenge to the forensic experts. Various forensic experts, anthropologists have tried different methods in order to reconstruct the length of a long bone from its fragmentary remains. Various studies have established their methods with different degrees of precision. All such calculations pivot on the fact that the fragmentary parts show evidences of consistent ratios relative to the total length of long bones and it is the most vital part of identification of individuals from their skeletal remains. Among all the mathematical methods which have been used since dates, Regression formulae based on long bone measurements found to be more appropriate and trustworthy method which yields consistent and accurate results.

In Indian subcontinent, unidentified and unclaimed dead bodies are often mutilated by wild and stray animals. Loss of structural integrity of skeletal remains due to gnawing make identification difficult. Fragmented bones with destroyed ends are often brought for forensic works. In both anthropological and forensic practice, fragmented long bones are often presented as the only available resource to establish individuality. When the entire long bone is unavailable, one should apply the desired method to the available bony fragments to reconstruct its total length.

Reconstruction of total length of long bones from their fragments have been done widely earlier on different populations. Many attempts have been made by research scholars from different parts of the world to establish authentic population related models for practical use in forensic anthropology. Studies from India are also highly significant in number and relevance.

In 2010, in a scientific study Mukhopadhyay et al. presented a useful insight on the stature estimation from maximum femoral

length and the epicondylar breadth. The study was conducted among the Indian Bengali male's population. Software (SPSS statistical software for windows 10) revealed the regression equation as y=7.02 + 4.83x, where the dependent variable (x) is the epicondylar breadth (cm) and the independent variable (y) is the maximum femoral length (feet). 95% confidence interval with a p-value of less than 0.001 was obtained with Pearson's coefficient of 0.85, a standard error of 1.68 and R squared value of 0.722.[1]

In the domain of stature estimation of total length of radius from its fragments, author Huddar M had put significant effort through his work. He divided the radius into 7 segments (a-b,b-c,c-d,d-e,e-f,f-g,g-h) based on morphological characteristics from top of head to tip of styloid process.[2]

Significant effort had also been put on the value of radius bone in prediction of sex and height in the Iranian population by Mitra Akhlaghi, et al. The study was conducted on 106 (61 male, 57 female) cadavers of Iranian population. The total length of the cadaver was measured. Along with it, the maximum length of radius and ulna were measured. Statistical analysis was done using SPSS software version. P value of <0.05 was considered significant. The age groups were divided into 4 categories:

I = <20 years old; II= 20-39 years old; III= 40-64 years old; IV= 65 and> 65 years old. The mean age of individual was 39.19 yrs.

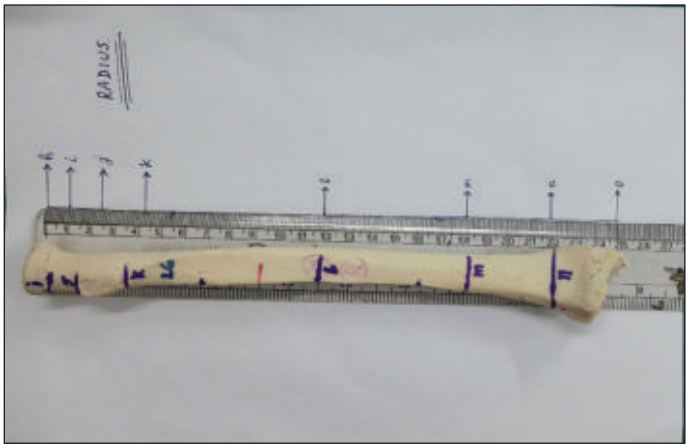

Figure 1

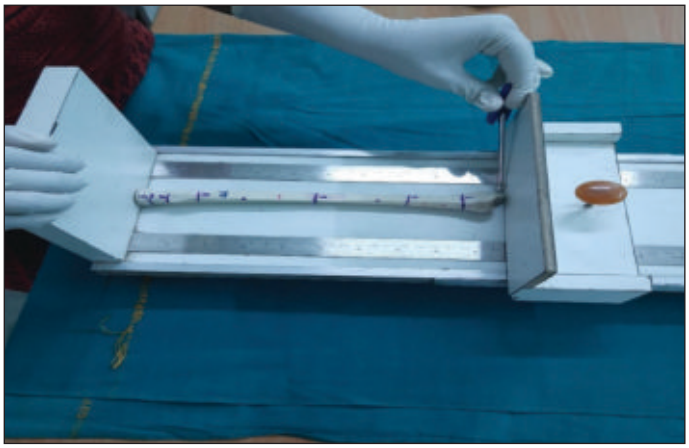

Figure 2

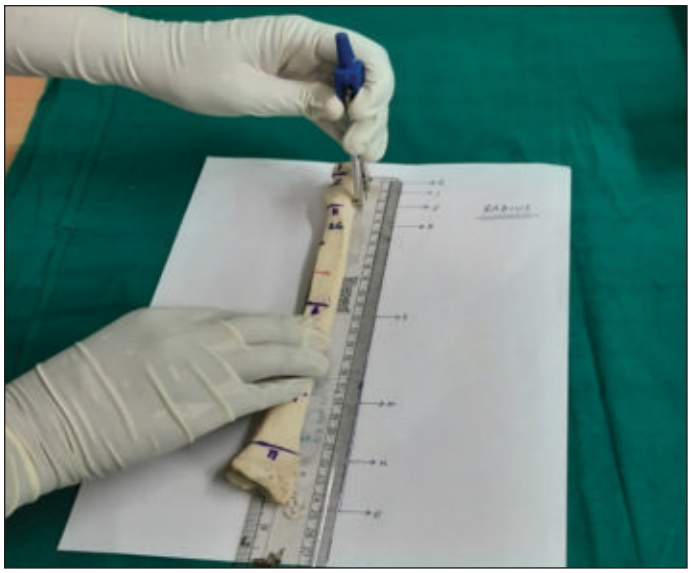

Figure 3

age (female=41.27; male=37.66). According to the regression test, there was a statistically significant (p=0.00) relation between the height of persons and the length of radius bone. The following equation was obtained to estimate the height on the basis of length of radius bone: Height (cm) = 74:79 + [3:91x the length of radius (cm)]. With the help of the above equation the stature and sex can be determined.[3]

In another study on South West Nigerian population by Ibeabuchi Nwachukwu Mike, et al., regression equation to estimate the total length of radius from its morphometry was obtained.[4]

Author Phalguni srimani, et al. gave emphasis on the usefulness of the biccipital groove of humerus in the morphometric analysis. The paper highlighted its clinical implications through its study in West Bengal population. The study was conducted on 107 dried cadaveric humeri (59 of right side and 48 of left) of unknown age and sex, collected from different Medical colleges of West Bengal. The total length, antero-posterior and transverse width of humeri at the surgical neck along with length, width, depth, medial wall and opening angles of biccipital groove were measured, with the help of ruler and vernier callipers. The length of BG was determined as the maximum distance between the most proximal and distal point of the groove. Width was calculated as the maximum distance between medial and lateral lips of the groove. Similarly depth was estimated as the distance between the greater/lesser tuberosity to the floor of the groove. The medial wall angle and the opening angle were computed as image analysis technique. All the parameters were measured by two observers separately and average values were taken. Data thus obtained were tabulated as Mean ± SD and statistically analyzed using SPSS software, version 16. The total length of the right humerus was found to be 303.71 ± 21.25 mm, the antero-posterior width of the right humerus was found to be 22.39 ± 1.35 mm and the right humerus transverse width was found to be 24.89 ± 2.00 mm. Similarly for the left humerus, the total length was found to be 294.69 ± 24.39 mm, the antero-posterior width was found to be 21.60 ± 1.38 mm and the transverse width was found

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to be 24.01 ± 1.62 mm. The measurements of the length of the biccipital groove for the right humerus was found to be 71.59 ± 3.78mm and that for the left side was found to be 70.78 ± 5.04 mm which results in a mean length of 23.84% of total length of the humeri. The corresponding measurements of the width of the Biccipital Groove for the right and left humerus was found to be 71.59 ± 3.78 mm and 70.78 ± 5.04 mm respectively which results in a mean length of 33.22% of transverse width of the humeri. Finally the measurements of the depths of the biccipital groove was found as 4.63 ± 0.38 mm for the right humerus and 4.45 ± 0.30 mm for the left humerus which was found to be 20.65% of antero-posterior width of humeri. The average medial wall and opening angles of BG were found to be 50.22 + 5.350 and 81.41 + 10.900 on the right side. On the left side the corresponding measurements were found to be 53.83 +6.800 and 79.31 + 11.320 mm. Besides the non-existence of the supratubercular ridge of in some specimens, significant statistical differences were found in length, width, depth and medial walls angles of BG between right and left sides ($p<0.005$).[5]

Reviewing the literature, similar study on morphometric estimation on the humerus fragments on Turkish population was performed by S. Deniz Akman, et al. 120 adult humerus bones (64 right, 56 left) were collected from Cukurova University. The bone was divided into 6 segments. Statistical analysis was done using SPSS software version 9. The distances in maximum humeral length, H1, H2, H3, H4 and H5 segments were found to be 307.1 ± 20.8 mm, 6.5 ± 1.6 mm, 41.0 ± 5.1 mm, 24.2 ± 2, mm, 20.0 ± 2.2 mm and 23.9 ± 2.6 mm, (on the right side) and 304.8 ± 18.9 mm, 6.6 ± 1.3 mm, 40.9 ±3.9 mm, 40.6 ± 3.3 mm, 19.7 ± 2.5 mm and 39.7 ± 3.4 mm (on the left side), respectively. No significant difference was found in the morphometric measurements between left and right side specimens. The results thus obtained in this study on Turkish population were similar to that of 6 population of other countries.[6]

In similar type of study conducted by Kundu SD et al. showed, conducting over 79 numbers of humerus, the regression formula for Total length of humerus = 0.95+2.46ab+1.00bc+1.11de +0.62cd +1.02ef-0.68fg.[7]

R Squared value = 0.95

With the following landmarks

1) a = Most proximal point on the head. 2) b = Most distal point on the circumference on head. 3) c = Convergence of two areas of muscle attachments, just below the major tubercle. 4) d = lower end of deltoid tuberosity. 5) e = Upper margin of olecranon fossa 6) f = Lower margin of olecranon fossa. 7) g = Most distal part of trochlea.

Materials and Methods:

After getting the clearance from the institutional ethical committee, examination and measurements of all the fully ossified, dried and processed radius bones (57 in number from the departmental archive of Forensic Medicine, Burdwan medical college, Burdwan for the teaching program of undergraduate and postgraduate students (museum specimens) were done after excluding apparently unossified, diseased and injured bones, to conduct a descriptive cross-sectional study. Using anthropometric set consisting of osteometric board, electronic digital calliper, measuring tape, flexible tape, dusting brush, pencil, OHP marker, standard prepared master charts for data recording. All the 57 radius were arbitrarily divided into different fragments by taking important anatomical landmarks on the bones, on the basis of their morphological characters. Measurements were taken using anthropometric set consisting mainly of osteometric board and electronic digital calipers. The author along with other three observers took four readings, and the mean value of these readings was recorded to minimize the inter-observer bias. Record was taken in centimeter (cm) and the measurement was up to one decimal place (nearest millimeter).

Table 1. Descriptive statistics of radius, showing its total length and fragmentary lengths of its seven segments.

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Total length	57	19.30	30.10	23.3456	1.95056
h to i	57	.60	1.30	.9281	.18201
i to j	57	.70	2.20	1.1789	.31608
j to k	57	1.40	2.80	2.0877	.31057
k to l	57	5.70	9.70	7.3719	.67076
l to m	57	4.20	7.20	5.4772	.74211
m to n	57	2.00	4.40	3.0509	.55874
n to o	57	1.00	3.60	2.3088	.54847
Valid N (listwise)	57				

Table 2. The correlations of the total length and fragmentary segments of the radius with its proximal four segments (i.e. H to i, i to j, j to k and k to l).

Correlations						
		Total Length	h to i	I to j	j to k	k to l
Pearson Correlation	Total Length	1.000	.685	.657	.738	.582
	h to i	.685	1.000	.582	.442	.289
	I to j	.657	.582	1.000	.672	.286
	j to k	.738	.442	.672	1.000	.203
	k to l	.582	.289	.286	.203	1.000
	l to m	.728	.598	.534	.505	.164
	m to n	.435	.137	.112	.204	.358
	n to o	.578	.348	.096	.432	.355
Sig. (1-tailed)	Total Length	.	.000	.000	.000	.000
	h to i	.000	.	.000	.000	.015
	I to j	.000	.000	.	.000	.015
	j to k	.000	.000	.000	.	.065
	k to l	.000	.015	.015	.065	.
	l to m	.000	.000	.000	.000	.111
	m to n	.000	.155	.203	.064	.003
	n to o	.000	.004	.239	.000	.003
N	Total Length	57	57	57	57	57
	h to i	57	57	57	57	57
	I to j	57	57	57	57	57
	j to k	57	57	57	57	57
	k to l	57	57	57	57	57
	l to m	57	57	57	57	57
	m to n	57	57	57	57	57
	n to o	57	57	57	57	57

Table 3. The correlations of the total length and fragmentary segments of the radius with its distal three segments (i.e. l to m, m to n and n to o).

Correlations				
		l to m	m to n	n to o
Pearson Correlation	Total Length	.728	.435	.578
	h to i	.598	.137	.348
	I to j	.534	.112	.096
	j to k	.505	.204	.432
	k to l	.164	.358	.355
	l to m	1.000	.120	.394
	m to n	.120	1.000	.092
	n to o	.394	.092	1.000
Sig. (1-tailed)	Total Length	.000	.000	.000
	h to i	.000	.155	.004
	I to j	.000	.203	.239
	j to k	.000	.064	.000
	k to l	.111	.003	.003
	l to m	.	.187	.001
	m to n	.187	.	.249
	n to o	.001	.249	.
N	Total Length	57	57	57
	h to i	57	57	57
	I to j	57	57	57
	j to k	57	57	57
	k to l	57	57	57
	l to m	57	57	57
	m to n	57	57	57
	n to o	57	57	57

A. Dependent variable: Total Length.

Table 4. Model summary depicting the r-squared values and standard error of estimate of the different radial fragmentsa.

Model Summary[g]									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				Sig. F Change
					R Square Change	F Change	df1	df2	
1	.738[a]	.544	.536	1.32840	.544	65.740	1	55	.000
2	.860[b]	.739	.730	1.01413	.195	40.369	1	54	.000
3	.940[c]	.884	.877	.68297	.145	66.063	1	53	.000
4	.953[d]	.908	.901	.61414	.024	13.547	1	52	.001
5	.964[e]	.929	.923	.54279	.022	15.568	1	51	.000
6	.969[f]	.938	.931	.51224	.009	7.264	1	50	.010

The maximum length of the radius was the distance measured from the most proximal point on the head to the tip of the styloid process, using an osteometric board. The tip of the styloid process was placed against the vertical end-board while applying the movable upright to the radial head. The different fragments were measured using the digital calliper

The measurements obtained were initially inserted in the excel sheets and were later analysed using SPSS Statistical software for windows version 10.0. Metric data was reported as Mean, Standard deviation, Median and 95% confidence interval. P value of <0.05 was taken as significant Pearson's correlation to examine the association between the total lengths of radius bones and their fragmentary lengths.

After finding a positive correlation between length of radius bones and their respective fragments, Regression equation was obtained for the radius with the fragmentary lengths as the independent variable and the maximum length as the dependent variable, using the total sample (N= 57 Radius bone).

Table 5. Analysis of variance (anova) to compare the means of the radial segments.

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	116.006	1	116.006	65.740	.000b
	Residual	97.055	55	1.765		
	Total	213.061	56			
2	Regression	157.524	2	78.762	76.582	.000c
	Residual	55.537	54	1.028		
	Total	213.061	56			
3	Regression	188.339	3	62.780	134.590	.000d
	Residual	24.722	53	.466		
	Total	213.061	56			
4	Regression	193.449	4	48.362	128.226	.000e
	Residual	19.613	52	.377		
	Total	213.061	56			
5	Regression	198.036	5	39.607	134.434	.000f
	Residual	15.026	51	.295		
	Total	213.061	56			
6	Regression	199.942	6	33.324	126.999	.000g
	Residual	13.120	50	.262		
	Total	213.061	56			

Table 6. Standardised coefficients of the individual radial segments to the constant.

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	13.670	1.206		11.334	.000
	j to k	4.634	.572	.738	8.108	.000
2	(Constant)	5.207	1.619		3.215	.002
	j to k	4.059	.446	.646	9.108	.000
	k to l	1.311	.206	.451	6.354	.000
3	(Constant)	2.303	1.148		2.007	.050
	j to k	2.695	.344	.429	7.838	.000
	k to l	1.229	.139	.422	8.818	.000
	l to m	1.161	.143	.442	8.128	.000
4	(Constant)	2.000	1.035		1.932	.059
	j to k	2.548	.312	.406	8.173	.000
	k to l	1.068	.133	.367	8.045	.000
	l to m	1.163	.128	.442	9.055	.000
	m to n	.585	.159	.168	3.681	.001
5	(Constant)	2.561	.926		2.766	.008
	j to k	2.353	.280	.375	8.403	.000
	k to l	.966	.120	.332	8.039	.000
	l to m	.917	.130	.349	7.075	.000
	m to n	.599	.141	.172	4.261	.000
	h to i	2.055	.521	.192	3.946	.000
6	(Constant)	2.992	.888		3.368	.001
	j to k	2.156	.274	.343	7.863	.000
	k to l	.870	.119	.299	7.325	.000
	l to m	.858	.124	.326	6.910	.000
	m to n	.637	.133	.183	4.778	.000
	h to i	2.009	.492	.187	4.085	.000
	n to o	.403	.150	.113	2.695	.010

The radius bone was divided into 07 (seven) segments where measurements were taken from the pre-determined anatomical points which are as follows—

1. h= Most proximal portion of the radial Head.

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Table 7. The coefficients of the different radial segments, showing their individual correlation and the tolerance values.

Coefficients[a]							
Model		95.0% Confidence Interval for B		Correlations			Collinearity Statistics
		Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance
1	(Constant)	11.253	16.088				
	j to k	3.489	5.780	.738	.738	.738	1.000
2	(Constant)	1.960	8.453				
	j to k	3.166	4.952	.738	.778	.633	.959
	k to l	.897	1.725	.582	.654	.441	.959
3	(Constant)	.001	4.605				
	j to k	2.005	3.385	.738	.733	.367	.730
	k to l	.949	1.508	.582	.771	.413	.954
	l to m	.874	1.447	.728	.745	.380	.741
4	(Constant)	-.077	4.078				
	j to k	1.923	3.174	.738	.750	.344	.718
	k to l	.801	1.334	.582	.745	.338	.850
	l to m	.905	1.421	.728	.782	.381	.741
	m to n	.266	.904	.435	.455	.155	.854
5	(Constant)	.702	4.420				
	j to k	1.790	2.915	.738	.762	.312	.696
	k to l	.724	1.207	.582	.748	.299	.811
	l to m	.657	1.177	.728	.704	.263	.569
	m to n	.317	.881	.435	.512	.158	.853
	h to i	1.009	3.100	.685	.484	.147	.586
6	(Constant)	1.208	4.776				
	j to k	1.605	2.706	.738	.744	.276	.646
	k to l	.631	1.109	.582	.719	.257	.738
	l to m	.609	1.108	.728	.699	.243	.552
	m to n	.369	.905	.435	.560	.168	.844
	h to i	1.021	2.997	.685	.500	.143	.585
	n to o	.103	.704	.578	.356	.095	.696

2. i= Distal margin of radial head.
3. j=Upper end of radial tuberosity.
4. k = lower end of radial tuberosity.
5. l = Midpoint of insertion of pronator teres muscle.
6. m =Bifurcation of interosseous border.
7. n = Upper end of ulnar notch of radius.
8. o = Tip of styloid process.

Results:

Above table indicating that the variability of group means is large relative to the within group variability. F value = variance of the group means (mean square between) /mean of the within group variances (mean squared error). Larger F-values indicate good significance. However since the study population is small (n=57), F-values are somewhat lower; but still the values are quite significant and did not occur only by chance).

The above table showed the standardized regression coefficient of the segment (j to k) i.e. the segment between the upper and lower ends of the radial tuberosity, measured the greatest (7.863) at a significance level (1-tailed) of greater than 95%. This proves that this segment bears the best correlation with the total radial length compared to the other fragments).

Discussion:

57 dried and ossified radius bones were taken from the Departmental Archive and these were arbitrarily divided into 08 segments based on anatomical and morphological landmarks from the most proximal point on the head to the distal tip of the styloid process. The measurements obtained were analysed by SPSS statistical software for windows version 10.0. P value of less than 0.05 was considered significant, and 95% confidence intervals was employed in this study. Pearson's correlation was used to study the degree of association between the total radial length and the individual fragmentary lengths. The predicted cum observed lengths were calculated and they almost tallied and thus the results proved accurate and consistent.

The measurements of both sides (left and right) were grouped and noted separately but the results were pooled to obtain the regression equation. This was done because no significant difference in measurement between the left and right side in the sample of 57 radii.

The present investigation was a preliminary work and can be considered as a pilot study for estimating the regression equation to estimate the total length of radius from its fragmentary lengths. In a population specific sample. Being population specific, it can be applied in case studies pertaining to identification of human remains of that geographic domain when grossly mutilated bodies or bony fragments are sent for forensic autopsy.

Our study revealed the Regression equation of Radius as follows:

Total length of radius = 2.92+ 2.15 JK + .87KH + .85LM + .63 MN +2.00 HI+ 0.42NO

R Squared Value = 0.938

In his scientific study Mukhopadhyay et al. took 65 adult male human femur bones (23 were of the right side and 42 were of the left side) which were dried and ossified. Osteometric board and callipers were used as anthropometric tools to take the measurements of the specimens. In this work, the maximum length had been defined as the distance between the highest point on the head of the femur to the lowest point on the distal condyles. The epicondylar breadth has been defined as the distance between the two most laterally projecting points on the epicondyles. Software (SPSS statistical software for windows 10) revealed the regression equation as y=7.02 + 4.83x, where the dependent variable (x) is the epicondylar breadth (cm) and the independent variable (y) is the maximum femoral length (feet). 95% confidence interval with a p-value of less than 0.001 was obtained with Pearson's coefficient of 0.85, a standard error of 1.68 and R squared value of 0.722.[1]

In the study conducted by Huddar M, 140 dried, fully ossified radius bones were taken randomly from the anatomical department of medical college of Nagpur and a cross-sectional study was performed. Measurements were done using osteometric scale. The mean length, SD, coefficient of variation and proportions of length of the various segments of the radius were calculated. CI was 95%.In this study, the segment d-e, i.e, the lower end of radial tuberosity to the mid point of insertion of pronator teres showed statistically significant results for

calculating the total length of radius.[2]

In another study comprising of radial length, the age groups were divided into 4 categories:

I = < 20 years old; II= 20-39 years old; III= 40-64 years old; IV= 65 and > 65 years old. The mean age of individual was 39.19 yrs. age (female=41.27; male=37.66). According to the regression test, there was a statistically significant (p=0.00) relation between the height of persons and the length of radius bone. The following equation was obtained to estimate the height on the basis of length of radius bone: Height (cm) = 74:79 + [3:91x the length of radius (cm)]. With the help of the above equation the stature and sex can be determined.[3]

The study over nigerian population included 40 radius bones of unknown sex which were collected from University of Lagos. 9 parameters were taken into consideration. The distal breadth, sagittal diameter at mid-shaft, transverse diameter at mid-shaft (TDM), vertical radial head height (VRHH), maximum head diameter (max. HD), and minimum head diameter (min. HD) were measured using digital vernier caliper while the circumference of the radial head and the circumference at the radial tuberosity were measured using an anthropometric tape. Measurements were taken to the nearest cms. Right and left bones were compared using student's t-test and Pearson's coefficient was used for correlation. SPSS version 17 was used for statistical analysis. The mean length of the right radius was 26.3 ± 1.6 cm while that of left was 25.8 ± 1.9 mm. The mean differences were not statistically significant. The following equations were thus obtained: Right = 20.537 + 2.758 Max. HD; Left = 17.760 + 2.648 Max. HD + 2.922VRHH; Both = 13.637 + 5.148 TDM + 2.288 Max. HD.[4]

In the current study, an attempt has been made to get a regression formula from the different segments of radius with whole length of radius in which age of radius and the height of the human was not considered in contrast to study of Mitra Akhlaghi, et al.[3]

The current study also differs from the study of Mike Ibiabuchi,[4] where the diameters of the radius at different site were independent variables and the current study emphasized on different pre-defined anatomical landmarks over the longitudinal length of radial bones.

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References:

1. Mukhopadhyay PP, Ghosh TK, Dan U, Biswas S. Correlation between Maximum Femoral Length and Epicondylar Breadth and its application in stature estimation: A population specific study in Indian Bengali Males J Indian Acad Forensic Med. 2010;32(3):204-07.
2. Huddar M. Estimation of total length of radius from its fragments Panacea Journal of Medical Science. January – April 2015;5(1); 20-23.
3. Akhlaghi M, Sheikhazadi A, Ebrahimnia A, Hedayati M, Nazparvar B, SaberiAnary SH. The value of radius bone in prediction of sex and height in the Iranian population. Journal of Forensic and Legal Medicine. 2012 May; 19(4): 219–22.
4. Mike I, Okon E, Olawale B, Emmanuel A, Priscilla S, Abolaji R. Regression equations for the estimation of radial length from its morphometry in South-West Nigerian population. Journal of Experimental and Clinical Anatomy. 2015;14(2): 51.
5. Phalguni S, Saha R, Goswami B, Mazumdar S. Morphometric Analysis of Bicipital Groove of Humerus with its Clinical Implications: A Study in West Bengal. International Journal of Anatomy and Research. 2016;4 (4):3009-15. DOI: http://dx.doi.org/10.16965/ijar.2016.394. (reviewed 2018 December 18; cited 2019 Jan 06.
6. Akman SD, Karakaş P, Memduha GB. The Morphometric Measurements of Humerus Segments. Turk J Med Sci.2006; 36(2):81-5.
7. Kundu SD, Mukherjee S, Bhandari R, Das A, Roy K, Biswas S. Reconstructions of Length of Humerus from it's Fragments - A Preliminary Study in Eastern Indian Population. JIAFM.2022;44(4):67-71.