Sex Determination from Clavicle Bone for Punjab Zone

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Abstract

Determination of sex from the skeleton is possible only when all the bones were available. The clavicle has been described as a useful bone for the metric determination of sex in Punjab zone. In the present study 100 clavicles (78males and 22 females) were taken from Department of Anatomy, Sri Guru Ram Das Institute of Medical Sciences and Research, Amritsar. The parameters like Maximum length, Weight and circumference at midshaft circumference of the clavicle were taken and demarking points were evolved for identification of sex for the various measurements of the clavicles of the Punjab zone.

Key words: Clavicle, Circumference, Midshaft, Demarking points.

Introduction

The clavicle or collar bone extends almost horizontally with a double curve across the root of the neck laterally towards the points of the shoulder.1 The human clavicle is described as a long bone.2 Unlike most other long bones it does not possess a medullary cavity.3 The right sided long bones of the limbs were usually longer than those of the left side. Sex determination from the skeletal remains is difficult and attempt has been made from a number of bones.4,5,6,7,8,9 Genetic, nutritive and environmental factors may influence the form of the bones which is responsible for the various racial differences10.

Material and Method

The material for this study was taken from the Department of Anatomy, Sri Guru Ram Das Institute of Medical Sciences and Research, Amritsar. It consists of 100 clavicles, 78 from males and 22 from the females. The bones showing any pathology were not included in the study. The

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length of the bone which was the straight maximum distance between the two ends was measured with the help of a Vernier caliper. Table 1 shows the details 100 clavicles used in this study.

Bones were boiled, cleaned and dried before measuring them. The following three measurements were taken:

1. Maximum length of the clavicle in mm.
2. Weight of the bone in grams
3. The circumference of the clavicle in mm.

Table 1: Numerical analysis of clavicles used in the present study

Clavicle	Male	Female	Total
Right Side	39	11	50
Left Side	39	11	50
Total	78	22	100

Observations

Length of clavicle

It was seen from the table 2 and 3 that the left clavicle was longer than the right clavicle as mentioned by Olivier11 also observed by Jit and Singh.9 In paired male clavicles, left clavicle was longer than the right 71.8%, right was longer in 18% of cases and in 10.2 % both were equal. In the female paired clavicles the left clavicle was longer in 63.6% cases, right was longer in 27.3% of cases and in 9.1% both were equal.

Sex Differences

Right clavicle

Length of the male right clavicle varied from 122.00 mm to 155.00mm with a mean of 138.87±8.41 mm whereas in females it ranged from 108.00 to133.00 mm with a mean of 123.18mm±7.82 mm. The mean length of the right female clavicle was 88.7 % of that of the right male clavicle. No female right clavicle was found to be longer than the 133.00 mm. While in 76.92% of male right clavicle the length was longer than 133.00 mm. Similarly the smallest right male clavicle in this series was 122.00mm and 54.54% of female right clavicle in this series was smaller than this. So taking these points the76.92% of male and 54.54% of female clavicles can be identified. However the right clavicles in the range of 122.00-133.00 mm can not be assigned any sex. These upper and lower limits of the right clavicle may not identify sex in similar percentage of cases when some other data was tested. Hence these limiting pointed has to be overcome which should be applicable to any data of this zone. For this reason larger was the sample greater will be the accuracy. In the normal distribution, the maximum and the minimum limits can be safely calculated by the formula Mean±3 Standard Deviation whereas the Mean+3SD gives the maximum value and Mean-3SD gives the minimum value. Such a range includes 99.80

% of the samples varieties. In this way we can statistically fix a measurement above which no female right clavicle can be found and similarly another measurement below which no male clavicle can be seen in a particular zone. These limiting measurements were known as the Demarking points (Table 2,3 and 4)

Table 2: Statistical measurements of length of clavicles

Detail of measurement	RIGHT		LEFT	
	Male (n=39)	Female (n=11)	Male (n=39)	Female (n=11)
Mean	138.87 mm	123.18 mm	141.95 mm	123.95 mm
Standard Deviation	8.41	7.82	8.42	8.72
Min-Maximum Value	122-155	108-133	124-160	106-135
Indentified point	>133.00 mm	<122.00 mm	>135.00 mcm	<124.00 mm
Percentage above Indentified point	76.92	27.27	79.48	36.36
Range Mean±3 SD	113.61-164.10	100.35-147.27	116.69-167.21	97.79-150.11
Demarking Point	>147.27 mm	<113.61 mm	>150.11 mm	<116.69 mm
Percentage beyond demarking point	17.94	18.18	12.82	18.18

Table 3: Statistical measurements of weight of clavicles

Detail of measurement	RIGHT		LEFT	
	Male (n=39)	Female (n=11)	Male (n=39)	Female (n=11)
Mean	15.73 gm	12.65 gm	15.58 gm	12.69 gm
Standard Deviation	1.95	2.18	1.85	2.16
Min-Maximum Value	11.00-19.20	10.20-16.80	12.20-19.00	10.20-16.50
Indentified point	>16.80 gm	<11.00 gm	>16.50 gm	<12.20 gm
Percentage above Indentified point	30.76	27.27	28.20	45.45
Range Mean±3 SD	9.88-21.58	6.11-19.19	10.03-21.13	6.21-19.17
Demarking Point	>19.19	<9.88	>19.17	<10.03
Percentage beyond demarking point	2.56	0	0	0

Table 4: Statistical measurements of the circumference of clavicles

Detail of measurement	RIGHT		LEFT	
	Male (n=39)	Female (n=11)	Male (n=39)	Female (n=11)
Mean	35.86 mm	28.73 mm	35.13mm	28.14 mm
Standard Deviation	3.90	4.14	3.63	4.07
Min-Maximum Value	28-43	22-36	31-43	21-34
Indentified point	>36.00 mm	<28.00 mm	>34.00 mm	<31.00 mm
Percentage above Indentified point	38.46	45.45	61.53	63.63
Range Mean±3 SD	24.61-47.56	16.31-41.15	24.24-46.02	15.93-40.35
Demarking Point	>41.15	<24.61	>40.35	<24.24
Percentage beyond demarking point	7.69	9.09	12.82	9.09

Left Clavicle

The length of the male left clavicle varies from 124.00-160.00 mm with the average of 141.95 mm ± 8.42 mm. The length of the female left clavicle ranges from 106.00 mm to 135.00 mm with the average of 123.95mm ± 8.72. The mean length of the left female clavicle was 87.3 % of the mean length of the male left clavicle. Of the male left clavicles, 79.48 % were longer than the longest female left clavicle i.e. 135.00 mm. Similarly 36.36 % of the female left clavicles were shorter than the shortest male left clavicle. The longest female clavicle and the shortest male clavicle were thus the limiting points for assigning sex on criterion of length. However the demarcating points were different but they were safe and can be applied to practically the population of this zone.

The demarking point for the right male clavicle was 147.27 mm. No female right clavicle can be longer than this and hence it was perfectly safe to call any right clavicle longer than 147.27 mm as male but smaller than this does not necessarily a female clavicle. Female right clavicle has its own demarking point i.e. 113.61 mm. Any right clavicle which was shorter than 113.61 mm was positively a female though longer than this can also be a female clavicle. Any clavicle between 113.61 mm and 147.27 mm can not be assigned any sex on the basis of length alone. Hence the demarking point of one measurement say length alone does not sort out all the clavicles. The demarking point for the left clavicle was similarly applicable to bones of the left side.

Weight of Clavicles

It was clear from the table-3 that the mean weight of the right clavicle was slightly more than that of the left in males while they were nearly equal in cases of females. This can be due to the less number of the female clavicles. But it was seen that in the paired male clavicles, right was heavier than the left in 51.3 % and left in 43.5 % and equal in weight in 5.2 % of cases. In the female paired clavicles, right clavicle was heavier in 54.54 % of the left, left was heavier in 27.27 % of cases and in 18.19 % cases both were of equal weights.

Right Clavicle

The weight of the right male clavicle varies from11.00 gm to 19.20gm with the average of 15.73 gm $\pm$ 1.95. The weight of the right female clavicle ranges from 10.20 gm to16.80 gm with the average of 12.65 gm $\pm$ 2.18. The weight of the right female clavicle was 84.2 % of right male clavicle. A right clavicle weighing more than 16.80 gm may be called the male and that measuring less than 11.00 gm may be called as female. By these limiting points 30.76 % of male and 27.27 % of female right clavicles can be sorted out. However, the statistical analysis of the data provides different demarking point (Table 3) and the different percentages that can be applied in a wider population of the zone.

Left Clavicle

The left male clavicles weigh from a minimum of 12.20 gm to 19.00 gm with an average of 15.58 gm. The range of weight for left female clavicle was 10.20 gm to16.50 gm with the average of 12.69 gm $\pm$ 2.16. The mean weight of the left clavicle was 81.45 % of the mean weight of the right male clavicles. By crossing the upper limit of the female clavicles, 28.20 % male left clavicles can be identified and similarly 45.45 % female clavicles were found to be lower than the lowest weight of the left male clavicle (12.20 gm). However these percentages were as usual lowered after evaluation by demarking point which were safest and more widely applicable (table-3)

Midclavicular Circumference

Table-4 showed that the right clavicle has a greater girth than the left. In the paired male clavicles the right clavicle was thicker in 35.9%, left was thicker in 20.5% while both have equal measurements in 43.6%. Similarly in the paired female clavicles the right one was thicker in 54.54%, the left in 27.27% and both were equal in girth in 18.19% of cases.

Right Clavicle

The midclavicular circumference of the right male clavicle varies from 28 mm to 43 mm with an average of 35.86 mm $\pm$ 3.90. The midclavicular circumference of the female right clavicle ranges from 22 mm to 36 mm (average 28.73 mm $\pm$ 3.63). The mean circumference of the right female clavicle was 80.12 % of the mean circumference of the right male clavicle. Of the male right clavicles, 38.46 % have this circumference greater than the highest figure for the female right mid clavicular circumference and 45.45 % female clavicles have circumference smaller than the lowest figure of the male right midclavicular circumference.

Left clavicle

The mid clavicular circumference of the left male clavicle varies from 31.00 mm to 43.00 mm (average 35.13 mm $\pm$ 3.63). The mean mid clavicular circumference of the left female clavicle female was 81.2 % of the same measurement of the left male clavicle. In case of female left clavicle it ranges from 21.00 mm to 34.00 mm with the average of 28.14 mm $\pm$ 4.07. Taking the lowest male and the highest female measurements as the limiting ones, 61.53 % left male clavicles can be definitely defined their sex as they were having the greater midclavicular circumference as compared to that of the thickest left female clavicle. Similarly female left clavicles having smaller mid-circumference than the lowest male left mid clavicular circumference can be positively identified as female bones and these amount to 63.63 %. However these percentages were as usual lowered after evaluation by demarking point which were safest and more widely applicable (table-4)

Discussion

Measurements and sexual differences in clavicles of western countries have been studied by Parson12 , Terry13, Olivier 11,14 and Singh 15 McCormick 16. In India, the subject has been studied extensively by Jit and his associates.17,9,18,19 This study of the clavicle has provided the information about the racial and sex differences. Length of the clavicles was not a good indicator for the stature jodgement.17 Olivier11 had studied the various lengths of the clavicles. But the different races may have the similar lengths9.According to the various anthropologists one population of a country was not a homogeneous group but was heterogeneous group. Thus the Indian crania were divided into various groups. 20,21 Jit and Singh 17 recorded the length of the paired clavicles of 80 male and 40 female Punjabi's, and found that left clavicle was longer than the right The demarcating points evolved by Jit and Singh17 for Punjabis were applicable by Singh and Gangrade 22 was also applicable to our study also. Jit and Sahni 19 found the left clavicle to be longer than the right in 60% instances and both clavicles were of equal length in 30 % instances. Further according to them the length of the clavicles of Chandigarh zone was greater as compared to that of Amritsar zone but was smaller than that of American Whites.

It was not essential that that a given clavicle must cross all the demarking points before it can be positively asigned its sex. Any one demarking point can be positively assigned its sex. Any one demarking points can decide the issue e:g If a given clavicle of punjabi zone was longer than 147.27 mm or heavier than 19.19 gm or has midcircumference more than 41.15 mm, it was bound to be a male clavicle and if it was shorter than 113.61 mm or lighter than 9.88 gm, or has a midcircumference less than 24.61mm it was bound to be a female clavicle. However a right clavicle with a length 113.61 mm and 147.27mm or with a weight between 9.88gm and 19.19gm or with a midclavicular circumference between 24.16 mm and 41.15 mm can not be assigned its sex by these demarking points. Similarly, demarking points of the left side will identify the sex from left clavicles.

Conclusions

From the present study, it was conclude that length of the adult left clavicle was more than that of the right side. The midclavicular circumference was the best measurement for the identification of the sex of male clavicles in Amritsar zone. Length of the clavicle was the most important measurement for female sex determination.

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