

Sex Assessment Using Clavicle Measurements in Egyptian Population.

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ABSTRACT

Background: In many studies various skeletal remains have been used for identification but different accuracy of sex determination has been reported with clavicle. For determining the sex of adult human clavicles in Egyptian population. **Methods:** Length and mid-clavicular circumference were measured and weight was taken of 105 clavicles (50 males and 55 females). The data was subjected to statistical analysis. **Results:** By taking only length of the clavicle into consideration, sex could be determined correctly in 62.4% right male, 54.3% left male, 25.6% right female and 42.1% left female. Similarly from mid-clavicular circumference of bone sex could be estimated in 78.7% right male, 67.2% left male, 41.3% right female and 40.6% left female clavicles. On the basis of weight alone sex could be determined in 68.4% right male, 59.8% left male, 63.1% right female and 45.8% left female clavicles. **Conclusion:** The length of the adult left clavicle was more than that of the right side. The mid clavicular circumference was the best measurement for the identification of sex of female clavicles in Egyptian population.

Keywords: Clavicle, Sex Assessment.

INTRODUCTION

The determination of sex using whole Skeleton or boney remnant had been explored by many workers since more than a century and individual bones including clavicle may help at least in part if not whole in this regard (Kamdi et al., 2014). Sometimes only skeletal remains are available for forensic identification (AkhLaghi et al., 2012). The sex determination of the individual is a primary criterion of identification but this is a very difficult problem and become more challenging when only single bone like the clavicle is available (Math et al., 2014). Determination of sex is an important essential step towards establishing identity of an unknown human from skeletal remains. In many studies various skeletal remains have been used for identification but different accuracy of sex determination has been reported with clavicle (Patil, 2005, Frutos, 2005, Shobha et al., 2014). The female clavicle is shorter, Thinner, less curved and smoother and its acromial end is carried lower than the sternal end in comparison with male. In males the acromial end is on a level with or slightly higher than the sternal end when the arm is pendant. Mid shaft circumference of clavicle is the most reliable indicator of sex, a combination of this measurement with weight and

length yields better results (Stranding Susan, 2008). Terry (1932) and Singh et al. (1972) observed the difference in different parameters of clavicle between white and Negros. They gave us the concept of demarking point (3σ) which was found extremely useful and provided almost 100% specificity in sex determination. Clavicle is among long bones and it is relatively resistant against environmental corruption and degradation. However, differentiation of sex determination using this bone has been reported in literature and on the other hand, an anthropometric dimensions of different bones are unique in each race and geographical region (Introna et al., 1998). Therefore, this study was carried out to assess the accuracy of the length of clavicle, mid shaft circumference and weight of clavicle for determination of sex in Egyptian population.

MATERIALS AND METHODS

This study was conducted on 105 clavicles of which 48 were of right side and 57 of left side. The bones were collected from the anatomy and Forensic medicine departments, Faculty of Medicine Zagazig University. The length of clavicle is the distance between the sternal end and scapular articular end which is measured by using digital caliper (Vernier calliper) and recorded in MM [Figure 1]. The mid shaft circumference of clavicle is midway between the articular ends and was measured with help of measuring wire or metal tape and recorded in (MM) [Figure 2]. The weight of clavicle was recorded with

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the help of a single pan electric balance in grams. All readings were taken 3 times by the same person to prevent inter observer error. Clavicles with pathological changes or unfused were excluded. The data was collected, analyzed and subjected to statistical analysis using statistical packages for social sciences (SPSS) to analyse the relation between these measurements and the sex of persons. The means and standard deviations for each measurement and compare the mean differences between the sexes.

Statistical analysis

Significance of difference between mean length, midshift circumference, and weight of right and left clavicles was tested by student's t-test. P-value of less than 0.05 was considered as significant. Demarking points (D.P) (Jit and Singh, 1966) were worked out from the calculated ranges (Mean \pm 3SD) and percentages of clavicles identified beyond D.P were noted.

RESULTS

A statistical analysis of three parameters of the clavicles were undertaken. Range, mean and standard deviations of length, mid clavicular circumference and weight of adult male and female clavicles were calculated and are given tables 1,2,3 . The difference between the means of each of these measurements in the two sexes was found to be highly significant ($P < 0.001$)

As regarding the length of clavicle [Table 1]:

- 1- Right clavicle: The length of male clavicles varies from 125-167mm with a mean of 143.9 \pm 10.1 mm whereas that of female ranges from 119.5-149mm with mean of 126.5 \pm 7.5 mm. The mean length of female right clavicle in this series is 87.9% of the mean length of right male clavicle. No female right clavicle in this series has been found to have length more than 149mm. Similarly, the smallest male right clavicle in this series is 125mm. The demarking point (+ 3SD of Jit and Singh , 1966) was 149mm for the male clavicles and 113.6 mm for the female clavicles. The percentage of male clavicle beyond the demarking point was 25.1% and of female clavicles it was 2.62%.
- 2- Left Clavicle: The length of male left clavicle varies from 132.5-168 mm with a mean of 144.5 \pm 10.5mm. The length of female clavicle ranges from 115-149mm with a mean of 128.1 \pm 8.3mm. The mean length of female clavicle is 88.7% of the mean length of the male clavicle. No female left clavicle in this series has been found to have length more than 149mm. Similarly, the smallest male left clavicle in this series is 132.5mm. The demarking point (+3SD of Jit and singh, 1966) was 153mm for the male clavicles and 113mm for the female clavicles. The percentage of male clavicle beyond the demarking point was 15.1% and of female clavicles it was 7.88%.

Mid clavicular circumference [Table 2]

Right clavicle: The mid circumference of male right clavicles varies from 32-48mm with a mean of 32.2 \pm 3.1mm. The mid circumference of female right clavicle ranges from 26-37 mm with a mean of 31.9 \pm 2.6mm. The mean circumference of the female clavicle is 83.5% of the mean circumference of the male clavicle. The female mid circumference in this series was no more than 37mm, whereas, the smallest male circumference was 32 mm. The demarking point (+3SD of Jit and Singh,1966) was 39.7 mm for the male clavicles and 28.9 mm for the female clavicles, of the male clavicles 45.52% were beyond the demarking point whereas , in case of female clavicles 13.6% were beyond the demarking point.

Left clavicle: The mid clavicular circumference of the male left clavicles varies from 32-51 mm with a mean of 38.1 \pm 3.5mm. The mid clavicular circumference of the female left clavicles ranges from 22.5-37mm with a mean of 32.3 \pm 3.1mm. The female mid clavicular circumference in this series was no more than 37mm whereas the smallest male mid circumference was 32mm. The demarking point(+3SD of Jit and singh,1966) was 41.6mm for the male clavicles and 27.6mm for the female clavicles .Of the male clavicles 33.91% were beyond demarking point whereas, in case of female clavicles only 6.71% were beyond demarking point.

Table 1: Statistical analysis of the length of clavicles (in mm) No. of clavicles examined. Males = 50 Females = 55.

Details of measurements	Right		Left	
	Male	Female	Male	Female
Mean	143.9	126.5	144.5	128.1
Standard deviation	\pm 10.1	\pm 7.5	\pm 10.5	\pm 8.3
Range	125-167	119.5-149	132.5-168	115-149
Mean \pm SD (Range)	113.6-174.2	104-149	113-176	103.2-153
Demarking point	>149	<113.6	>153	<113
Percentage of clavicles beyond demarking point	25.1	2.62	15.1	7.88
t-test	10.08		8.92	
P-value	<0.001		<0.001	

Table 2: Statistical analysis of mid-clavicular circumference (in mm) No. of clavicles examined. Males = 50 Females = 55.

Details of measurements	Right		Left	
	Male	Female	Male	Female
Mean	38.2	31.9	38.1	32.3
Standard deviation	\pm 3.1	\pm 2.6	\pm 3.5	\pm 3.1
Range	32-48	26-37	32-51	22.5-37
Mean \pm SD (Range)	28.9-47.5	24.1-39.7	27.6-48.6	23-41.6
Demarking point	>39.7	<28.9	>41.6	<27.6
Percentage of clavicles beyond demarking point	45.52	13.6	33.91	6.71
t-test	11.32		9.0	
P-value	<0.001		<0.001	

Weight [Table 3]

Right clavicles: The weight of male clavicles varies from 15-35gm whereas, that of female clavicles ranges from 11-21gm. The mean weight of the male clavicle was 21.5+ 5.1gm and that of female clavicle was 14.3+ 3.1gm. The mean weight of the female clavicles is 66.5% of the right male clavicles. The maximum weight of right female bone was 21gm whereas, the minimum weight of right female bone was 15gm. The demarking point (+ 3SD of Jit and singh, 1966) was 23.6gm for the male clavicles and 6.2 for the female clavicles. Only 29.12% of male clavicles were beyond demarking point whereas, none of the female bones was beyond demarking point.

Left clavicles: The weight of male clavicles varies from 15-33gm whereas that of female clavicles ranges from 9-21gm. The mean weight of the male clavicles was 21.1+ 4.9 gm and that of female clavicles was 13.2+ 3.3gm. The mean weight of the female clavicles is 62.6% of that of the left male clavicles. The maximum weight of the left female bone was 21gm where as the minimum weight of the left male bone was 15gm. The demarking point(+ 3 SD of Jit and Singh,1966) was 23.1gm for the male clavicles and 6.4 for the female clavicles. Only 30.21% of none of the female bones was beyond demarking point whereas, none of the female bones was beyond demarking point.

Table 3: Statistical analysis of the weight of clavicles (in gm) No. of clavicles examined. Males = 50 Females = 55.

Details of measurements	Right		Left	
	Male	Female	Male	Female
Mean	21.5	14.3	21.1	13.2
Standard deviation	±5.1	±3.1	±4.9	±3.3
Range	15-35	11-21	15-33	9-21
Mean±SD (Range)	6.2-36.8	5-23.6	6.4-35.8	3.3-23.1
Demarking point	>23.6	<6.2	>23.1	<6.4
Percentage of clavicles beyond demarking point	29.12	0	30.21	0
t-test	8.83		9.77	
P-value	<0.001		<0.001	



Figure 1: Measurement of length of clavicle by Vernier caliper.



Figure 2: Measurement of mid clavicular diameter by tape

DISCUSSION

Male skeleton is considered to be longer and more robust than the average female, the magnitude differs from population to population. This difference can be attributed to genetic factors, environmental factors affecting growth and development like nutrition, physical activity. Differences in long bones is that typically male bones are longer and more massive than typically female bones (Krogman and Iscan, 1986).

Olivier (1951) found that fresh left clavicle to be longer than right. Similar results were obtained by Jit and Singh (1966), Singh and Gangrodel (1968), Jit and Shani (1983), Kaur et al. (1997), Patel et al. (2014) found also the Indian left clavicle to be longer than right. The present study found that the left clavicle was longer than the right in Egyptian population [Table 1].

Habir Kaur (1989) noted that greater curves in the right bone were responsible for its being shorter than the left, whereas curvilinear length of the right bone was longer than that of the left.

The present work showed that the female clavicle has smaller mid-circumference than that of male. This is agree with study of Terry (1932), he found that mid-circumference of female bones was about 5 mm shorter than male in negros. Olivier (1951) found the difference was to be 6.8 mm in French bones. Jit and Singh (1966) found the difference between 6mm-7mm, also Patel et al. (2014) found the same results, the female clavicular circumference was about 6.6 mm shorter than that of male clavicular circumference. The present study also shows that mid-clavicular circumference is the most useful criterion for sexing clavicle.

It is well known that bones of women are generally lighter than that of men. In the present study, the average weight of the female bone has been found to be about 65% of the male bone due to considerable variation in the range of weight of bones, sex could not be determined in more than 29.12% (right) and 30.21% (left) in male clavicles whereas non of

female bones were beyond the demarking point as shown in [Table 3]. The present study is agree with Jit and Singh (1966) and Patel et al. (2014) that criterion (value) of weight is not helpful at all in determine sex of the female bone.

CONCLUSION

From the present study, it was concluded that length of the adult left clavicle was more than that of the right side. The mid clavicular circumference was the best measurement for the identification of sex of female clavicles in Egyptian population. Length of the clavicle was the most important measurement for female sex determination.

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