Original Article

Study on combined cortical thickness, total diameter of clavicle and cortical index of adult human clavicle in north Indians

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ABSTRACT

Introduction: *Clavicle has a complex bone structure, is variable in shape and exhibits dramatic variations both in curvatures and cross sectional geometry. Clavicle has been globally studied for purpose of generating a suitable, correct and economical treatment of clavicular fractures.*

Objective: *The present study was done to determine the total diameter of bone, combined cortical thickness and cortical index i.e (proportion cortical thickness to total diameter) of adult clavicles.*

Material method*: 200 pairs (200 males and 200 females) of adult clavicles of known sex obtained from bony collections and cadaveric dissections were cut parasagittally and measurements were taken at midclavicle level. The clavicular parameters (cortical index, total diameter of clavicle and combined cortical thickness) measured for known sex were compared. The data obtained was analyzed statistically.*

Results: *The values obtained for all parameters were found to be higher in case of males as compared to females. When parameters as measured for the right and left sides were compared for same sex there was not much difference. Values for right and left sides were very much close to each other.*

Conclusion: *The present study establishes the morphometeric criterion for cortical index, total diameter of clavicle and combined cortical thickness in north Indians and compared the observations with therefore other populations and races giving a special emphasis on the influence of sex factor on these parameters.*

Introduction

The field of forensic anthropology involves the building of an antemortem profile of an individual from skeletal remains. This includes sex and race, determination of age and stature estimation. [1] Osteometery, a vital component of anthropometry includes measurements on skeletal material. Through this technique, a forensic scientist can study variation in bony skeleton of different population of the world. The technique has been successfully used in estimation of age, sex traces in forensic and legal sciences. [2] Anthropometery is being used more often in sexing the skeletal remains. Sex is considered as one of the easiest determinations from the skeletal material and one of the most reliable, if essential parts of the skeleton are available in good condition. The clavicle or collar bone is highly variable and exhibits dramatic variation in shape and geometry. [3] The variation should be taken into account while performing clinical procedures like intramedullary fixation and plate fixation of fractures. The clavicle displays definite gender and side specific anatomical features and has a complex anatomy with an S shape curvature and cephalad- to – caudal bow. [4] The introduction of precise measurement methods not only provides simplicity and accessory but also is an attempt where science replaces art. [5] Clavicle has been described as useful for meteric determination of sex of human remains. Whenever it is possible to predict sex, identification is simplified because one person of one sex needs to be considered. The present study endeavored to give a special emphasis on the influence of sex factor on the cortical index, total diameter of bone and combined cortical thickness, so as establish the dimorphic criterion and its significance both in males and females.

Material and methods

The present study was done on 200 pairs (100 male and 100 female total 400) of adult clavicles (age 18 to 70 yrs) of known sex obtained from bony collection and routine dissection in department of Anatomy, Govt. Medical College, Amritsar. Before performing the study due permission was taken from ethical committee at Govt. medical college, Amritsar. Clavicles with any kind of deformity were excluded from the study. Clavicles obtained by dissection were removed along with sternum together. After Dissection bones were separated, macerated, cleaned and dried and divided in to four groups (RM-Right male, RF-Right female, LM-Left male, LF-Left female). Vernier calliper (with least count 0.02mm) was used for measuring the different parameters on clavicles. For calculating cortical index, total diameter of bone and combined cortical thickness clavicles were cut parasagittally (at right angle of axis of bone) at midclavicular point with a saw. (Fig.1) Cut section of clavicle showing the difference of cortical and spongy part of clavicle. (Fig.2) The total diameter of bone at midclavicular point (Fig.3), anterior and posterior thickness of cortical bone was measured with the help of vernier calipers anteriorly (Fig.4) and posteriorly (Fig.5) respectively. These measured parameters were used for calculating cortical index as follows:

$$\text{Cortical index} = \frac{\text{Combined cortical thickness}}{\text{Total diameter of bone}} \times 100$$

Combined cortical thickness calculated as:
Anterior cortical thickness (Fig.4) + Posterior cortical thickness (Fig.5)

Total diameter of clavicle: Total diameter of clavicle taken at midclavicular point of clavicle with the help of vernier calipers. (Fig.3) Measured values of clavicular parameters by above mention methods were statistically analyzed by applying Paired and Unpaired t-test for calculating p value and t values. Mean±SD for male and female of right and left side were calculated by apply direct statistical formulas.

Fig. 1 Parasagittal cutting of clavicle

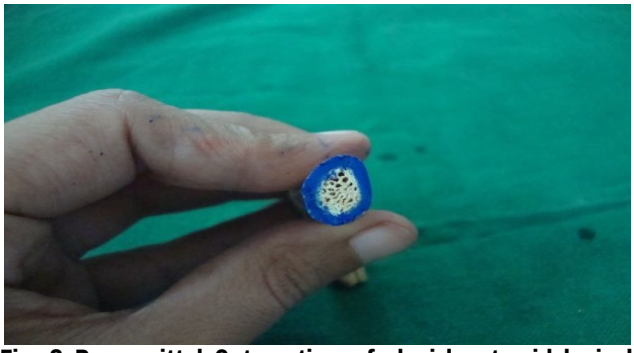

Fig. 2 Parasagittal Cut section of clavicle at midclavicular point. Blue: Cortical area Porus: spongy part

Fig. 3 Diameter at midclavicular point before cutting

Fig. 4 Anterior cortical thickness measurement with Vernier Calliper

Fig. 5 Posterior cortical thickness measurement with Vernier Caliper

The clavicular parameters (cortical index, total diameter of clavicle and combined cortical thickness) measured for adult clavicles of known sex were compared and statistically analyzed for side specificity and sexual dimorphism. The values were found to be higher in case of males as compared to females. When the parameters as measured for the right and left sides were compared in same sex they were found to be statistically insignificant (p>0.05). However, when parameters as measured for males and females were compared, they were found to be statistically highly significant (p<0.01).

Results

Table 1: Side specific statistical analysis for clavicular parameters

VARIABLES	SEX	RIGHT SIDE Mean±SD	LEFT SIDE Mean±SD	t value	P value
Combined cortical thickness	Male	5.474±0.772	5.475±0.771	0.575	0.566
	Female	3.189±0.756	3.188±0.754	2.283	0.025
Total diameter of clavicle	Male	12.016±1.808	12.016±1.807	0.199	0.843
	Female	10.814±1.293	10.813±1.292	1.421	0.158
Cortical index	Male	46.241±8.601	46.243±8.595	0.369	0.713
	Female	29.523±5.826	29.508±5.812	1.689	0.094

Table 2: Gender specific statistical analysis for clavicular parameters

VARIABLES	SIDE	MALE Mean±SD	FEMALE Mean±SD	't' VALUE	P VALUE
Combined cortical thickness	Right	5.474±0.772	3.189±0.756	21.156	**< 0.001**
	Left	5.475±0.771	3.188±0.754	21.196	**<0.001**
Total diameter of clavicle	Right	12.016±1.808	10.814±1.293	5.406	**<0.001**
	Left	12.016±1.807	10.813±1.292	5.409	**<0.001**
Cortical index	Right	46.241±8.601	29.523±5.826	16.093	**<0.001**
	Left	46.243±8.595	29.508±5.812	16.129	**<0.001**

Table 1 showed side specific statistical analysis for various parameters of clavicle. For combined cortical thickness the values of mean±SD for right and left side male clavicles found to be 5.474 ±0.772 and 5.475±0.771 respectively whereas for right and left sided female clavicle values came out to be 3.186±0.756 and 3.188±0.754. The mean±SD for total diameter of clavicles for right and left

sided male clavicles were 12.016±1.808 and 12.016±1.807 whereas these were 10.814±1.293 and 10.813±1.292 for right and left sided female clavicles. Mean ± SD Values for cortical index for right and left sided male were 46.241±8.601 and 46.243±8.595 respectively but for right and left sided females these were found to be 29.523±5.826 and 29.508±5.812. p value calculated for these parametes were not significant (p>0.01) for side specific statistical analyses. Table 2 show there exists highly significant (p<0.01) gender specific sexual diamorphism for all these clavicular parameters.

Discussion

In present study an effort was made to determine the cortical index, total diameter of clavicle and combined cortical thickness of clavicle for known sex. The parameters measured are expected to be in consonance for closely related populations. The values of mean ± SD in the present study for cortical index and other parameters were in general comparable to values previously observed for north Indians and Chandigarh population. In previous study gender specific significant values were observed in north Indians and Chandigarh for combined cortical thickness. (Table 3) In present study it was noted that mean combined cortical thickness value of in female for right side was 3.189± 0.756 whereas for left side it was 3.188±0.754. Similar values for right side in males were 5.474±0.772 but for left side these were 5.475±0.771. The gender specific statistical analysis for combined cortical thickness of clavicle was found to be highly significant (Table 2), which is in consonance with studies done by previous authors in their studies done on Americans, [6] English [7,8] Western [9] and North Indians [10] populations p <0.05 (Table 3). There is no side specific significant difference found in present study for combined cortical thickness (Table 1).

The mean values for total diameter of clavicle came to be 12.016 ±1.808 in males for right side and 12.016±1.0807 for left side. The mean values in females for right side is 10.814±1.293 and for left side is 10.813±1.292. Highly significant gender specific statistical difference was found in case of total diameter of clavicle (Table 2). There is no side specific significant difference found in present study (Table 1). No work has been done on measurement of total diameter of clavicle, so no data is available for comparison with present study. Thus, the present study provides pioneer baseline data for comparison amongst different populations.

Table 3: Gender specific comparison with previous studies

AUTHORS	COMBINED CORTICAL THICKNESS	TOTAL DIAMETER OF CLAVICLE	CORTICAL INDEX
Sedlin et al (1963)[6]	S	_	_
Anton (1969)[7]	S	_	_
Helala et al (1969)[8]	S	_	_
Walker H & Lovejoy(1985)[9]	S	_	_
Harbir kaur and inderjit (1990)[10]	S	_	S
Present study (2016)	S	_	S

S – Significant

The mean value for cortical index in females for right side came out to be 29.523±5.826 and for left side 29.508±5.812. The mean value for right side in males came out to be 46.241 ± 8.601 and for left

side male it came out to be 46.243± 8.595. Highly significant gender specific statistical difference was found for cortical index of clavicle (table no 2) whereas side specific difference found to be insignificant (table no 1). This is in consonance with the studies done by previous authors in north Indians and Chandigarh population. [10] In their previous studies Mean±SD values for right and left sided male clavicles were 45.4±3.4 and 45.0±4.2 respectively and for females these were 33.6±6.4 and 33.8±5.5 for right and left side. [10]

The present study establishes the morphometeric criterion for cortical index, total diameter of clavicle and combined cortical thickness in North Indians and compared the observations with therefore other populations and races giving a special emphasis on the influence of sex factor on these parameters. A statistically significant sexual diamorphism was found to exist for cortical index, total diameter of clavicle and combined cortical thickness. The simple measurements of clavicle are useful in predicting the risk of osteoporotic fractures. The cortical thickness is reduced in fracture cases by 33%. Most fractures occur in a subject with a combined cortical thickness of 3.5mm or less. [11] The indicies measured in present study should be taken into account while preformimg clinical procedures like intermedullary fixation and plate fixation of fracture.

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