

## Index Characteristics of Human Clavicle

*D. Toneva\**, *S. Nikolova\**, *I. Maslarski\*\**

*\*Department of Anthropology and Anatomy, Institute of Experimental Morphology,  
Pathology and Anthropology with Museum, Bulgarian Academy of Sciences, Sofia*

*\*\*Department of Anatomy, Histology and Pathology, Faculty of Medicine, University of Sofia, Bulgaria*

The aim of the present study is to determine the sexual differences in the form and proportionality of the clavicle on the basis of its index characteristics. A total of 433 adult clavicles were investigated. Eight indexes were calculated on the basis of 9 clavicular measurements. The significance of the sexual differences is determined by Student's t-test. The index characteristics show sexual differences in the form and proportionality of the clavicle. Statistically significant differences are established in the indexes characterizing the massiveness and bending of the bone.

*Key words:* clavicle, index, sexual differences.

### Introduction

The index characteristic is an important part of the anthropometric characterization of the separate bones, which gives additional information about the differences in the form and proportionality in either sexual or bilateral aspect.

The aim of the present study is to determine the sexual differences in the form and proportionality of the clavicle on the basis of its index characteristics.

### Materials and Methods

The anthropological investigation was performed on osteological material from archaeological excavations of medieval necropoles in the territory of Northeastern Bulgaria. A total of 433 clavicles (107 right and 104 left male clavicles; 115 right and 107 left female clavicles) were investigated. The sex and age of the individuals were previously determined by standard anthropological methods. Eight indexes were calculated on the basis of 9 clavicular measurements [2, 3]. Two of the measurements are introduced by the authors. The independent-sample t-test was used in order to determine the significance of the sexual differences.

## Results

Basic statistics on the indexes of male and female clavicles are presented in **Table 1**.

**Table 1.** Basic statistics on the indexes of male and female clavicles

Indexes	Laterality	Male clavicles			Female clavicles			Sexual differences	
		n	$\bar{x}$	SD	n	$\bar{x}$	SD	t-test	p-value
Length-thickness index (6:1)	Right	96	27.0	2.6	96	25.7	2.4	3.454	0.001*
	Left	86	26.0	2.3	89	24.7	2.2	3.686	0.000*
Middle index (4:5)	Right	107	87.4	13.5	113	89.6	14.9	-1.136	0.257
	Left	103	88.5	13.3	106	90.5	14.7	-1.050	0.295
Index of the vertical diameter (4:1)	Right	96	7.5	0.9	96	7.3	1.0	1.718	0.087
	Left	87	7.4	0.9	90	7.1	1.0	2.171	0.031*
Index of the sagittal diameter (5:1)	Right	96	8.8	1.0	96	8.2	0.9	4.184	0.000*
	Left	87	8.4	0.9	89	7.9	0.9	3.888	0.000*
Index of the corpus curve (2a:1)	Right	71	20.4	2.0	83	19.4	1.8	3.025	0.003*
	Left	66	19.6	1.9	70	19.4	2.2	0.788	0.432
Index of the corpus curve I (2:3)	Right	82	8.3	2.5	94	8.5	2.5	-0.473	0.637
	Left	80	8.1	2.4	90	9.0	2.6	-2.354	0.020*
Index of the sternal curve depth	Right	67	12.5	1.7	70	12.7	1.8	-0.792	0.430
	Left	59	12.5	1.7	62	12.9	1.7	-1.316	0.191
Index of the acromial curve depth	Right	67	9.2	1.4	77	8.9	1.3	1.042	0.299
	Left	68	9.2	1.5	68	8.6	1.6	2.249	0.026*

\* – statistically significant difference

The length-thickness index /6:1/ and the middle index /4:5/ are main indexes, characterizing the massiveness of the clavicle. The length-thickness index (robustness index) has significantly greater values for both right and left clavicles of male skeletons. The greater values in the male skeletons show that their clavicles have relatively thicker *corpus clavicularae* in relation to the greatest length, i.e. they are more massive in comparison with the female bones. According to Jit and Singh [1], the length-thickness index is not useful for sex determination, but this is not confirmed by our results, showing statistically significant sexual differences at  $p \leq 0.001$ .

The middle index has greater mean values in the female clavicles. However, the sexual differences are not statistically significant. The greater values of the middle index in the female skeletons show that the vertical diameter in the middle of their clavicles is relatively greater in relation to the sagittal one, compared with the proportion between both measurements in the male clavicles.

The index of the vertical diameter /4:1/ and the index of the sagittal diameter /5:1/ determine the relative part of the vertical and sagittal diameter, respectively, in relation to the greatest clavicular length. Both indexes show greater values in favor of the male skeletons. The index of the vertical diameter has statistically significant sexual differences only in the left clavicles, whereas the index of the sagittal diameter shows very

strong sexual differences bilaterally. The results of these two indexes corroborate the greater massiveness of the male clavicles than the female ones, because both diameters in male clavicles have greater share in relation to the length.

The index of the corpus curve (2a:1) and index of the corpus curve I (2:3) characterize the curve of the clavicle corpus, according to Martin-Saller [2] and Alekseev [3], respectively. The first index represents the proportionality between the height of the corpus curve (2a) and the greatest length of the clavicle, and the second one – the relation between the height of the corpus curve (2) and the length of the curve basis.

The values of the index of the corpus curve (2a:1) are greater in the male clavicles. This means that the height of the corpus curve in male clavicles is proportionally greater in relation to the clavicular length. The sexual differences are statistically significant only on the right side. However, the index of the corpus curve I (2:3) is greater in the female clavicles, but statistically significant sexual differences are observed only in the left bones. The result shows that the curve in the female clavicles is relatively higher in relation to the length of corpus curve basis, i.e. the female clavicles have a higher curve with a shorter curve basis, compared to the male clavicles.

The index of the sternal curve depth and the index of the acromial curve depth reflect the relative part of the depths of the sternal and acromial curves in relation to the greatest clavicular length. The index of the sternal curve depth has greater values in the female clavicles, which shows the relatively deeper sternal curve in the female clavicles. The sexual differences are not statistically significant. The means of the index of the acromial curve depth are greater in the male clavicles. Statistically significant sexual differences are observed only in the left bones. The greater values in the male clavicles determine the relatively more curved acromial part of their clavicles.

## Conclusion

The index characteristics show sexual differences in the form and proportionality of the clavicle. Statistically significant differences are established in the indexes characterizing the massiveness and curve of the bone. As a whole, our results show that male clavicles are more massive with relatively bigger dimensions in the middle of the bone, more curved with a relatively deeper acromial curve in relation to the clavicular length. Female clavicles are more gracile, higher and narrower in the middle of the bone and with a relatively deeper sternal curve in relation to its length.

*Acknowledgments:* This work was supported by the European Social Fund and Republic of Bulgaria, Operational Programme “Human Resources Development” 2007-2013 framework, Grant No BG-051PO001- 3.3.06-0048 from 04.10.2012.

## References

1. **Jit, I., S. Singh.** The sexing of the adult clavicles. – Indian Journal of Medical Research, **54**, 1966, 551-571.
2. **Martin, R., K. Saller.** Lehrbuch der anthropologie in systematischer Darstellung. Band I. Stuttgart, Gustav Fischer Verlag, 1957.
3. **Алексеев, В. П.** Остеометрия. – Москва, Наука, 1966.