

Bilateral asymmetry in metric features of human scapula

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The aim of the study is to perform a comparative assessment of the manifestations of asymmetry in the metric features of scapula as well as to seek for sexual differences in the direction and degree of the established asymmetry. The study includes measurements of whole scapulae and scapular fragments of 77 male and 91 female skeletons, belonging to adult individuals. Eleven directly measured features are investigated. The quantitative assessment of the bilateral asymmetry is made using the relative index of Wolanski for inter-group comparisons. All investigated metric features show bilateral differences, excepting the lower distance between *processus coracoideus* and *cavitas glenoidalis* in males.

Key words: scapula, asymmetry, metric features.

Introduction

The scarce data in the specialized literature on the asymmetry in human scapula determined the aim of this study, namely to perform a comparative assessment of the manifestations of asymmetry in the metric features of scapula as well as to seek for sexual differences in the direction and degree of the established asymmetry.

Material and methods

The anthropological investigation is performed on osteological material from archaeological excavations. The study includes measurements of whole scapulae and scapular fragments of 77 male and 91 female skeletons, belonging to adult individuals. Skeletal sex and age are determined by standard anthropological methods [1, 3, 4].

The investigation includes 11 directly measured features: Greatest breadth of *acromion scapulae* (9), GBAS; Length of *acromion scapulae* (10), LAS; Greatest length of *processus coracoideus* (11), GLPC; Length of *cavitas glenoidalis* (12), LCG; Breadth of *cavitas glenoidalis* (13), BCG; Depth of *cavitas glenoidalis* (14), DCG; Distance between *acromion scapulae* and *processus coracoideus*, DAS-PC; Upper distance between *acromion scapulae* and *cavitas glenoidalis*, UDAS-CG; Lower distance between

acromion scapulae and *cavitas glenoidalis*, LDAS-CG; Lower distance between *processus coracoideus* and *cavitas glenoidalis*, LDPC-CG. The first 6 features are measured after the methods of Martin – Saller, and the other ones are introduced by us. The reliability of established bilateral asymmetry is verified by Student’s t-test at $P < 0,05$. The quantitative assessment of the bilateral asymmetry is made using the relative index of Wolanski for inter-group comparisons [2]. The index is called Index for Asymmetry (IA): $IA = [2 \cdot (x_1 - x_2) \cdot 100] / (x_1 + x_2)$, x_1 – mean value of the feature in right scapula, x_2 – mean value of the feature in left scapula. The positive sign of IA shows right-side asymmetry and the negative one – left-side asymmetry.

The degree of bilateral asymmetry is assessed by percentile analysis according to the data of IA. The border values are set at P_{25} ($P_{25} = 0,7$ IU) and P_{75} ($P_{75} = 2,1$ IU).

Results

The study is focused on the features, characterizing *acromion scapulae*, *processus coracoideus* and *cavitas glenoidalis*, as well as the distances between these bone structures. Basic statistic data for male and female scapulae are presented in Table 1. The results confirm presence of asymmetry in almost all investigated features of the scapula. Most measurements in both sexes are greater on the right side.

In accordance with the comparative assessment of the direction of asymmetry, as a whole the features of *acromion scapulae*, *processus coracoideus* and *cavitas glenoidalis* are with right-side asymmetry (Fig. 1). The distances to the upper point of *cavitas glenoidalis* are greater in left scapulae of both sexes, with the exception of the upper distance between *acromion scapulae* and *cavitas glenoidalis*, which is slightly greater on the right side in the female scapulae. The distances to the lower part of *cavitas glenoidalis* are greater in the right scapulae, excepting the lower distance between *processus coracoideus* and *cavitas glenoidalis* in males, which has the same measurements on both right and left sides.

According to the degree of bilateral asymmetry, the features with right-side asymmetry in both sexes are mainly of a moderate degree and a low degree of asymmetry is

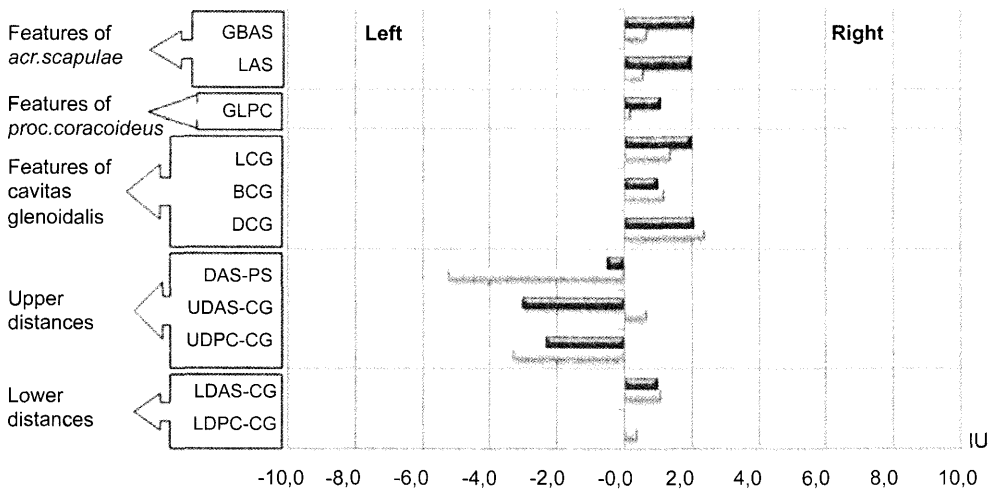


Fig. 1. Direction of the asymmetry in male and female scapulae

Table 1. Biostatistic data of measurements of male and female scapulae (n – number of pairs)

Features	Male scapulae						Female scapulae			
	n	\bar{x} right	\bar{x} left	Absolute difference	t-test	IA	n	\bar{x} right	\bar{x} left	Absolute difference
GBAS	24	48,8	47,8	1,0	0,683	2,1	26	42,2	41,9	0,3
LAS	22	41,0	40,2	0,8	0,414	2,0	27	32,6	32,4	0,2
GLPC	30	46,0	45,5	0,5	0,624	1,1	29	42,2	42,1	0,1
LCG	57	41,4	40,6	0,8	2,006*	2,0	56	36,3	35,8	0,5
BCG	56	28,8	28,5	0,3	0,749	1,0	73	25,6	25,3	0,3
DCG	45	4,9	4,8	0,1	0,522	2,1	42	4,3	4,2	0,1
DBAS-PC	15	40,4	40,6	-0,2	-0,094	-0,5	17	35,7	37,6	-1,9
UDAS-CG	24	29,7	30,6	-0,9	-0,895	-3,0	27	27,6	27,4	0,2
UDPC-CG	31	30,4	31,1	-0,7	-0,874	-2,3	32	26,9	27,8	-0,9
LDAS-CG	17	60,0	59,4	0,6	0,476	1,0	17	53,5	52,9	0,6
LDPC-CG	21	50,3	50,3	0,0	-0,021	0,0	20	45,8	45,6	0,2

* $p < 0,05$

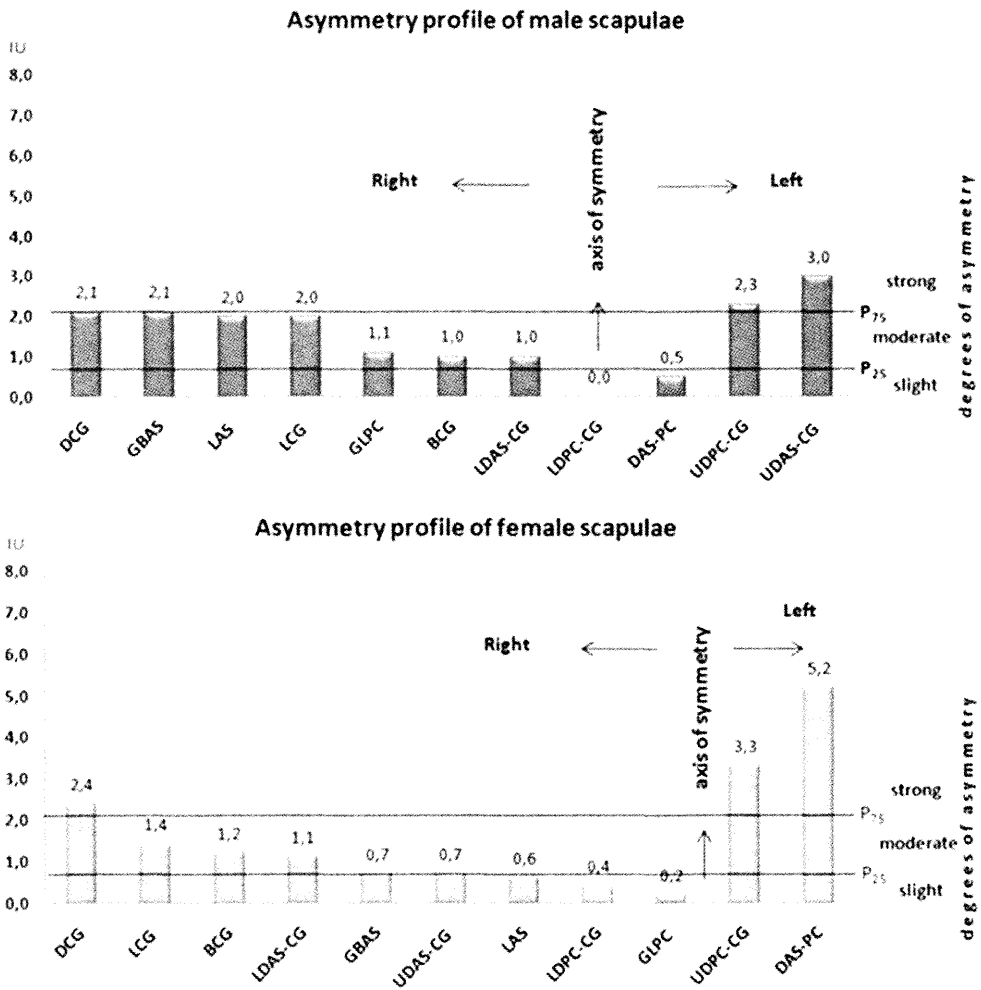


Fig. 2. Asymmetry profiles of male and female scapulae

often observed in females as well. In both sexes, the features with left-side asymmetry are predominantly of a high degree (Fig. 2).

The comparative assessment of the profiles of asymmetry shows that the right scapulae of both sexes have a vastly deeper *cavitas glenoidalis* from the left ones, and the right scapulae of males have also a wider *acromion scapulae*. Left male scapulae have greater distances from *acromion scapulae* to the upper point of *cavitas glenoidalis* in comparison with the right ones, and left female scapulae have greater distances between *acromion scapulae* and *processus coracoideus*.

Conclusions

In summary, all investigated features of the scapula show bilateral differences, excepting the lower distance between *processus coracoideus* and *cavitas glenoidalis* in

males. Some of the features show sexual differences in the direction and degree of asymmetry.

References

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