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Basic Anthropometric Characteristics of Wrist Bones in the Wrist Joint Complex with Os Lunatum Types I and II

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The aim of the present study is to determine the possible differences in the anthropometric characteristics of the wrist bones when they articulate in the wrist joint complex with os lunatum type I, or type II. Thirty six sets of macerated bones were studied scopically and anthropometrically after Martin, Saller (1957). 936 measurements were taken and 864 indices were calculated separately for wrist bones with os lunatum type I and type II. Wrist bones in the wrists with the lunate bone type II are bigger than those with type I. The enlargement for the proximal wrist row is mainly in proximo-distal direction, and for the distal wrist row — mainly in dorso-volar direction. The differences between the wrists with os lunatum types I and II show that there are two types wrist joint complexes: with and without hamate-lunate joint. They also differ from each other anthropometrically which also affects their biomechanics.

Key words: anthropometry, wrist bones, os lunatum, types.

Introduction

The variations of the anthropometric characteristics of the wrist bones are of great interest for the explanation of the complicated biomechanics [2, 17] of the wrist joint complex [7, 9, 11, 14]. In the last decade special attention is given to the variations of the lunate bone. This is due to its central position within the wrist joint complex. For this reason the lunate bone is often described as a "nucleus of the wrist joint" [6] or as a "key to a Roman arch" [13].

It is well known that the lunate bone has two main types — os lunatum type I and os lunatum type II [15]. In the literature there are great differences in the occurrence ratios between type I and type II os lunatum [15] — from 27:73 to 50:50 [5, 12, 16]. However, in the literature there is no data if the variations in the anthropometric characteristics of the lunate bone type I and type II correlates with the variations of the anthropometric characteristics of the other wrist bones. The research on this problem is important for the distinction of the biomechanics in the wrist joint complexes with different types of the lunate bones. The complexity of the problem deepens because of the fact that every main type of os lunatum has two corresponding sub-types [5], thus greatly enhancing the possible variations of the wrist bones.

The aim of the present study is to determine the possible differences in the anthropometric characteristics of the wrist bones when they articulate in the wrist joint complex with os lunatum type I, or os lunatum type II.

Material and Methods

Thirty six sets of macerated wrist bones form the collection of the Department of Anatomy, Histology and Embryology, Varna Medical University "Prof. Dr Paraskev Stoyanov", Varna, Bulgaria were studied following all the ethical rules of work on cadaver material. The type of os lunatum was determined scopically according the V i e g a s et al. (1990) [15] classification using magnifying glass (×3). The scopical observation of the lunate bone revealed that 16 out of 36 wrist bone sets had os lunatum type I, and 20 had type II.

Anthropometrical examination. The anthropometrical measurement included the basic anthropometric characteristics of the wrist bones — length, width and height. All the wrist bones were measured anthropometrically by the method of M a r t i n and S a l l e r (1957) [10] by using calliper-gauge with possible variation of up to 0.1 mm as follow: the length was measured in proximo-distal direction, the width — in radio-ulnar direction and the height — in dorso-volar direction. Totally 936 linear measurements were taken. In addition 864 indices were calculated, separately for the wrist bones from the wrists with the lunate bone type I and for the wrist bones from the wrists with the lunate bone type II.

Statistical analysis. The data was analyzed in Microsoft Office Excel 2000. The following statistical methods were used:

- Analysis of variance
- Nonparametric analysis (Pearson × 2)

The statistically significant differences were evaluated by the Student's t-test. The level of significance was accepted at $p<0.05$.

Results and Discussion

The anthropometrical measurements revealed that the basic metrical characteristics of the wrists with the lunate bone type I and type II differ (Tables 1-8).

The basic anthropometrical measurements of the scaphoid bone of the wrists with the lunate bone type II are greater than the same measurements of types I. The bone is greater in proximo-distal direction and in radio-ulnar direction. Index 1 is greater and indices 2 and 3 are smaller (Table 1).

T a b l e 1. Basic metrical characteristics and indices of os scaphoideum

Indicators and indices after Martin, Saller (1957)	No	Mean and standard error in the wrists with	
		os lunatum type I (n=16)	os lunatum type II (n=20)
Greatest length of os scaphoideum	1	24.63 ± 0.61	**26.42 ± 0.64***
Width of os scaphoideum	2	14.7 ± 0.40	**15.82 ± 0.49***
Greatest width of os scaphoideum	2a	15.96 ± 0.39	**17.01 ± 0.49**
Height of os scaphoideum	3	10.51 ± 0.27	**10.63 ± 0.39**
Greatest height of os scaphoideum	3a	13.13± 0.40	**13.98± 0.43**
Index length - width of os scaphoideum	1	59.78 ± 1.17	**60.11 ± 1.71**
Index length - height of os scaphoideum	2	**43.07 ± 1.56**	40.46 ± 1.43
Index height - width of os scaphoideum	3	**72.10 ± 2.37**	67.88 ± 2.53

*$p<0.05$

The basic anthropometrical measurements of the lunate bone type II are greater than the same measurements of types I. The bone is longer in proximo-distal, wider in radio-ulnar and higher in dorso-volar direction. Indices 1, 2 and 3 are greater (Table 2).

Table 2. Basic metrical characteristics and indices of os lunatum

Indicators and indices after Martin, Saller (1957)	No	Mean and standard error in the wrists with	
		os lunatum type I (n=16)	os lunatum type II (n=20)
Length of os lunatum	1	15.29 ± 0.48	**16.71 ± 0.40****
Greatest width of os lunatum	2	12.96±0.43	**14.21±0.38*****
Greatest height of os lunatum	3	16.53±0.42	**17.91±0.35*****
Index length - width of os lunatum	1	84.90±1.59	**85.16±1.46**
Index height - length of os lunatum	2	92.58±1.82	**93.27±1.19**
Index height - width of os lunatum	3	78.53±2.09	**79.31±1.38**

**p<0.025; ***p<0.0125

The basic anthropometrical measurements of the triquetral bone of the wrists with the lunate bone type II are greater than the same measurements of types I except indicator No. 3 "Greatest height of os triquetrum", which is the same with the corresponding size on wrists with the lunate bone type I. The bone is wider in radio-ulnar direction and longer in proximo-distal direction. Index 2 is greater and indices 1 and 3 are smaller (Table 3).

Table 3. Basic metrical characteristics and indices of os triquetrum

Indicators and indices after Martin, Saller (1957)	No	Mean and standard error in the wrists with	
		os lunatum type I (n=16)	os lunatum type II (n=20)
Greatest length of os triquetrum	1	17.19 ± 0.46	**17.86 ± 0.43**
Greatest width of os triquetrum	2	12.89 ± 0.38	**13.95 ± 0.44***
Greatest height of os triquetrum	3	**14.22 ± 0.45**	**14.22 ± 0.29**
Index width - length of os triquetrum	1	**134.15±3.39**	129.5±3.62
Index height - length of os triquetrum	2	121.70±2.86	**126.23±3.21**
Index width - height of os triquetrum	3	**110.59±2.51**	103.03±2.43

*p<0.05

Two lineal parameters of os pisiforme in the wrists with the lunate bone type II are greater than the same measurements of types I. The bone is higher in dorso-volar direction and longer in proximo-distal direction. Index 1 is greater and indices 2 and 3 are smaller (Table 4).

Table 4. Basic metrical characteristics and indices of os pisiforme

Indicators and indices after Martin, Saller (1957)	No	Mean and standard error in the wrists with	
		os lunatum type I (n=16)	os lunatum type II (n=20)
Greatest length of os pisiforme	1	13.94 ± 0.50	**14.2 ± 0.52**
Greatest width of os pisiforme	2	**10.18 ± 0.42**	9.85 ± 0.29
Greatest height of os pisiforme	3	9.8 ± 0.33	**10.43 ± 0.28**
Index width - length of os pisiforme	1	138.23±3.86	**144.23±2.61**
Index height - length of os pisiforme	2	**142.92±4.34**	136.09±3.21
Index width - height of os pisiforme	3	97.97±3.99	**106.80±2.63**

The basic anthropometrical measurements of os trapezium in the wrists with the lunate bone type II are greater than the same measurements of types I. The bone is bigger in all directions, but biggest in dorso-volar direction. Indices 1 and 3 are greater and index 2 is smaller (Table 5).

Table 5. Basic metrical characteristics and indices of os trapezium

Indicators and indices after Martin, Saller (1957)	No	Mean and standard error in the wrists with	
		os lunatum type I (n=16)	os lunatum type II (n=20)
Greatest length of os trapezium	1	15.4±0.38	**16.56±0.39****
Greatest width of os trapezium	2	20.27 ± 0.37	**21.28 ± 0.40***
Greatest height of os trapezium	3	15.46 ± 0.46	**16.86 ± 0.52***
Index width - length of os trapezium	1	76.02±1.41	**78.12±1.88**
Index height - length of os trapezium	2	**100.34±2.60**	99.01±2.23
Index width - height of os trapezium	3	76.53±2.54	**79.33±1.02**

*p<0.05; **p<0.025

The basic anthropometrical measurements of os trapezoideum of the wrists with the lunate bone type II are greater than the same measurements of types I. The bone is bigger in all directions, but biggest in dorso-volar direction. Indices 1 and 2 are greater and index 3 is smaller (Table 6).

Table 6. Basic metrical characteristics and indices of os trapezoideum

Indicators and indices after Martin, Saller (1957)	No	Mean and standard error in the wrists with	
		os lunatum type I (n=16)	os lunatum type II (n=20)
Greatest length of os trapezoideum	1	11.51±0.39	**12.74±0.47***
Greatest width of os trapezoideum	2	13.89±0.31	**15.12±0.32****
Greatest height of os trapezoideum	3	16.11±0.3	**17.67±0.29*****
Index width - length of os trapezoideum	1	83.11 ± 2.60	**85.05 ± 3.82**
Index height - length of os trapezoideum	2	71.40 ± 1.72	**72.18 ± 2.31**
Index height - width of os trapezoideum	3	**86.30 ± 1.43**	85.74 ± 1.28

*p<0.05; **p<0.0125; ***p<0.0025

The basic anthropometrical measurements of os capitatum of the wrists with the lunate bone type II are greater than the same measurements of types I. The bone is bigger in all directions, but biggest in dorso-volar direction. Indices 4, 5 and 6 are greater (Table 7).

Table 7. Basic metrical characteristics and indices of os capitatum

Indicators and indices after Martin, Saller (1957)	No	Mean and standard error in the wrists with	
		os lunatum type I (n=16)	os lunatum type II (n=20)
Greatest length of os capitatum	1	21.99 ± 0.43	**23.06 ± 0.43***
Greatest width of os capitatum	2	13.82 ± 0.28	**15.0 ± 0.45****
Greatest height of os capitatum	3	18.44± 0.33	**19.63± 0.43****
Index length - width of os capitatum	4	63.06 ± 1.32	**64.94 ± 1.38**
Index length - height of os capitatum	5	84.07 ± 1.44	**85.17 ± 1.20**
Index height — width of os capitatum	6	75.28 ± 1.90	**76.51 ± 1.96**

*p<0.05; **p<0.025

The basic anthropometrical measurements of os hamatum of the wrists with the lunate bone type II are greater than the same measurements of types I. The bone is bigger in all directions, but biggest in dorso-volar and radio-ulnar direction. Indices 1 and 3 are greater and index 2 is smaller (Table 8).

Table 8. Basic metrical characteristics and indices of os hamatum

Indicators and indices after Martin, Saller (1957)	No	Mean and standard error in the wrists with	
		os lunatum type I (n=16)	os lunatum type II (n=20)
Greatest length of os hamatum	1	20.79±0.59	**21.52 ± 0.46**
Greatest width of os hamatum	2	14.82±0.24	**16.4±0.39*** **
Greatest height of os hamatum	3	20.88±0.40	**23±0.43*** **
Index length - width of os hamatum	1	71.91 ± 1.76	**76.63 ± 2.05**
Index height - length of os hamatum	2	**99.46 ± 1.60**	93.88 ± 1.99
Index height - width of os hamatum	3	71.22 ± 1.30	**71.27 ± 0.95**

***p<0.0025

In conclusion our data present that:

1. Wrist bones of the lunate bone type II:

A. The basic anthropometrical measurements of the wrist bones are greater except indicator No 3 "Greatest height of os triquetrum", which is the same with the corresponding size on wrists with the lunate bone type I and indicator "Greatest width of os pisiforme" which is greater in wrists with the lunate bone type I.

B. Differences in the measurements in "A" are in the following directions:

— In os scaphoideum — mainly in proximal — distal and radio — ulnar direction;
— In os lunatum is greater in all direction;
— In os triquetrum — mainly in radio — ulnar and proximal — distal direction;
— In os pisiforme — mainly in dorso-volar and proximal — distal direction;
— In os trapezium — mainly in dorso-volar and proximal — distal direction;
— In os trapezoideum — mainly in dorso-volar direction;
— In os capitatum - mainly in dorso-volar and radio — ulnar direction;
— In os hamatum- mainly in dorso-volar and radio — ulnar direction.

2. The significant anthropometric differences of the wrist bones according to the type of os lunatum in the corresponding wrist joint complex give us the reason to distinguish them in two types:

— with lunate-hamate joint;
— without lunate-hamate joint.

Each type has a specific biomechanics and therefore a specific pathology.

The enlargement of the wrist bones of the wrists with os lunatum type II for the proximal wrist row is mainly in proximo-distal direction, and for the distal wrist row — mainly in dorso-volar direction.

The anthropometric differences between the wrists with os lunatum types I and II show that all the wrist bones with the presence of hamato-lunate joint are larger than those without it. This fact is very important, because these differences can affect the biomechanics, as well as pathology of the wrist bones and the wrist joints. Because of this the future examinations of the differences in the wrist joints with os lunatum types I and II can contribute for the better understanding of a biomechanics and the pathophysiology of the diseases in the wrist, which in very important in occupational and recreational human activities [1, 2, 3, 4, 8].

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