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Anatomical Relationships at the Distal Radius and Ulna and the Articular Disc in the Wrist Joint Complex

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The present study aims at examining the extent to which the morphological characteristics of the distal *radius* and *ulna* and *discus articularis* are influenced by the different variations of the wrist joint complexes (the types and subtypes of the lunate bone and the ulna variant). Twenty cadaver complexes were studied for the type and subtype of *os lunatum* and the ulna variant and 106 macerated radial and 102 elbow bones (20 of them were taken from the studied joint complexes) were investigated for the morphological characteristics of the distal *radius* and *ulna* and *discus articularis*. It was found out that *crista transversa* was developed better at *os lunatum* subtype (+) and minus and neutral ulna variant, whereas changes in *discus articularis* were more dependent on *os lunatum* subtype (+) and ulna plus variant. The geometrical proportions of the surfaces of *radius* and *ulna* in *articulatio radioulnaris distalis* are also described.

Key words: Distal radius and ulna, discus articularis, os lunatum- types and subtypes, ulna variant.

Introduction

The interest in the morphological characteristics of the bone skeleton of the wrist joint complex (WJC) and its variations was greatly increased in the last decade [16]. Particularization of this knowledge has great practical importance for the correct interpretation of the results given by modern methods of image diagnostics, which are rapidly coming into use, and non-invasive methods for studying of carpal kinematics [1, 3, 8] as well as for dealing with numerous unclear problems of the biomechanics and pathology of the hand in the wrist area. Distal ends of the *radius* and *ulna* and of *discus articularis* (DA) are an important component of this complex. The goal of the present study is to clarify the following:

1. How does the type [17] and subtypes [4] of *os lunatum* and the ulna variant correlate with the morphological particulars of *facies articularis carpi radii* and of DA [2, 10, 14, 15, 18]?

2. What is the geometrical ratio in the joint surfaces of *radius* and *ulna* in *articulatio radioulnaris distalis* [5, 9, 10]?

Material and Methods

20 WJC from cadavers were studied scopically for:

a. Type and subtype of *os lunatum*; **b.** Ulna variant; **c.** Openings and erosions of DA.

The distal ends of 106 macerated radial 102 macerated ulnar bones (20 of them were from the studied joint complexes) were scopically studied for:

1. Presence and expressiveness of *crista transversa* [7], dividing *facies articularis carpi radii* on two fosses — radial (*fossa scaphoidea*) and ulnar (*fossa lunata*) [11] by an own scale: **a.** absent; **b.** partially present and **c.** fully present (the latter is qualified as low, average and high).

2. Geometrical rating of the angles between:

a. *facies articularis carpi radii* and *incisura ulnaris radii*;

b. *caput ulnae* and *circumferentia articularis ulnae* which were acute, right, obtuse.

Results and Discussion

In the 20 cadaver WJC 10 cases of *os lunatum* type I and 10 cases with *os lunatum* type II were detected. Only four of WJC with *os lunatum* type I had just one facet on their proximal joint surface i.e. with *os lunatum* subtype (—). The remaining 16 cases were with *os lunatum* subtype (+). 10 cases were with ulna neutral, 5 - with ulna minus and the remaining 5 — ulna plus variant. There were 6 WJC with changes in the DA.

The degree of development (Figs. 1, 2, 3) of *crista transversa* of the 106 radial bones is presented in fig 4.

Fig. 1. Absent *crista transversa*

Fig. 2. Partially present *crista transversa*

Fig. 3. Fully present *crista transversa*

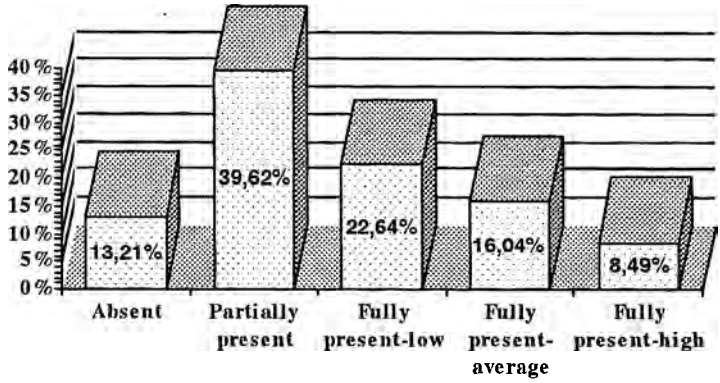

Fig. 4. Degree of development of crista transversa on facies articulairs carpi radii (n=106)

The results concerning the presence and development of *crista transversa* depending on the type and subtype of *os lunatum* and the ulna variant of the study of the 20 radial bones which are from the studied WJC, are presented in Figs. 5, 6 and 7.

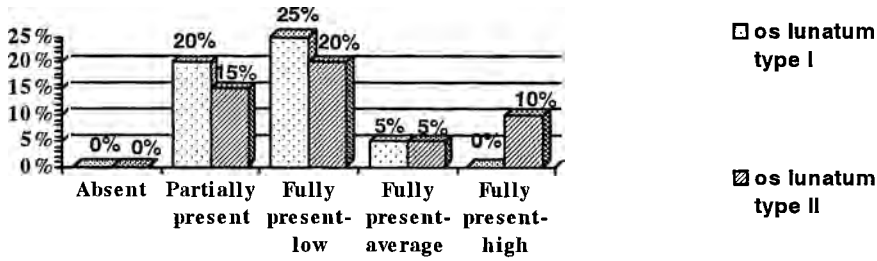

Fig. 5. Degree of development of crista transversa on facies articulairs carpi radii depending on the type of os lunatum (n=20)

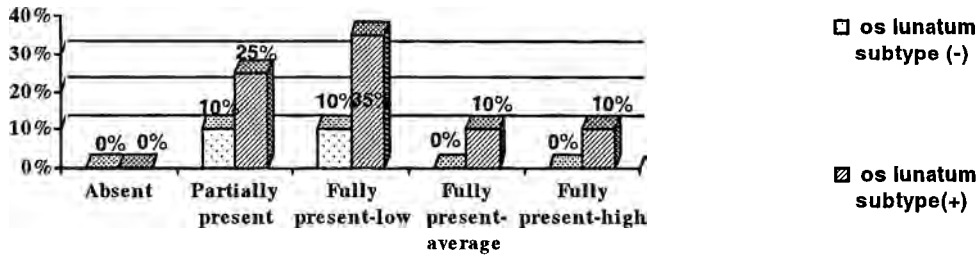

Fig. 6. Degree of development of crista transversa on facies articulairs carpi radii depending on the subtype of os lunatum (n=20)

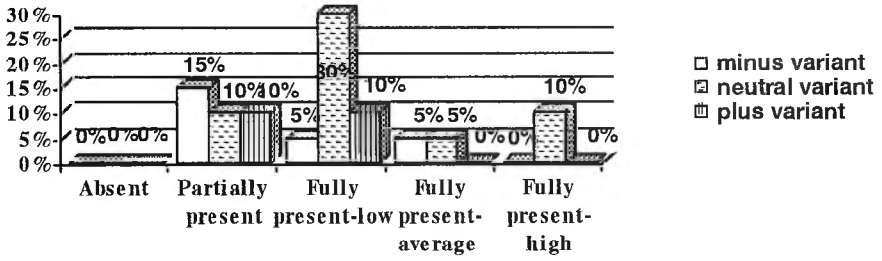

Fig. 7. Dependence of the presence of crista transversa and its development on the ulna variant

The analysis of the results showed that the presence and development of *crista transversa* is not influenced by the type of *os lunatum* but depended considerably on the subtype (+) as well as ulna neutral and minus variant [14]. Whether the cause of the presence and the height of *crista transversa* was the presence of a second facet on the proximal surface of *os lunatum* and the shorter *ulna,* or the second facet was formed because of the shorter *ulna*, is hard to tell but it is obvious that the applying of pressure in this part of the radiocarpal joint in these cases is greater.

The changes in DA depend on various factors [6, 12, 13] — ulna plus variant and a thinner DA [10], avascular central zone of DA [11]. This study detected changes in DA in joints with ulna neutral (60%) and ulna plus variant (40%) and in joints with *os lunatum* subtype (+) in 37.5% where in 87.5% of the latter erosions of the ulnar section of the proximal joint surface of *os lunatum* were observed [6, 13].

The angle between *circumferentia articularis ulnae* and the distal surface of its head is obtuse in 75 cases, right - in 26 cases and acute only in one case (Fig. 8.), whereas the angle between *facies articularis carpi radii* and *incisura ulnaris radii* is most often right - in 51 cases, obtuse - in 38 cases and acute - in 17 cases.

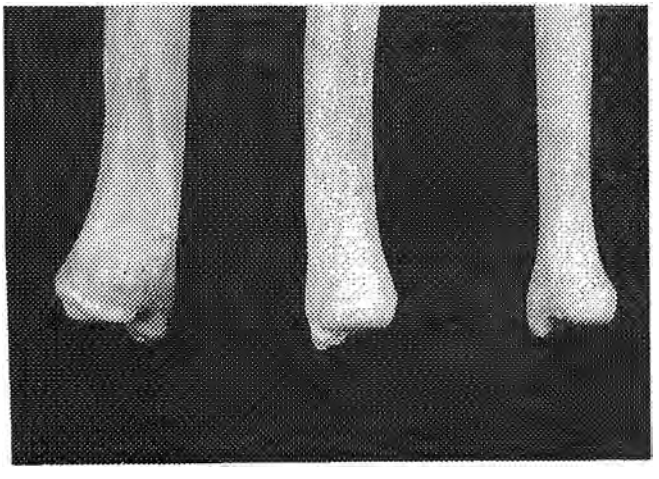

Fig. 8. Obtuse (1 and 2) and right angle (3) between *circumferentia articularis* and the distal surface of *caput ulnae*

Table 1. Dependence of the configuration of the distal ends of *radius* and *ulna* on the ulna variant.

Angle on		Cases, %	Ulna variant.		
ulna	*radius*		neutral n=10	plus n=5	minus n=5
obtuse	right	14 (70%)	6 (43%)	4(28,5%)	4(28,5%)
obtuse	right to obtuse	4 (20%)	2 (50%)	1 (25%)	1 (25%)
right to obtuse	right to acute	1 (5%)	1 (100%)	-	-
right to obtuse	right	1 (5%)	1 (100%)	-	-

The results of the present study on 20 pairs matching *ulna* and *radius* for the geometrical rating of the angles in their distal end depending on the ulna variant are presented in Table 1.

The joint surfaces described above are cylindrical in ulna neutral or plus variant whereas in ulna minus variant their configuration is conical [9, 10]. Schuurman [15] describes three types of relationships between these joint surfaces in the sagittal plane and four types in the transverse plane. The significance of these anatomical variations for the biomechanics and the pathology of the wrist is still poorly explored.

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