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Lunate Bone-Types and Morphological Characteristics

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One hundred macerated lunate bones were researched for the number of the joint facets on the distal and the proximal surfaces. Four types of lunate bones were classified according to their relationship with the bones situated proximally and distally:
1. **Type I (−)** — contacting with the radius and the capitate bone — 10%.
2. **Type I (+)** — contacting with the radius, discus articularis and the capitate bone — 24%.
3. **Type II (−)** — contacting with the radius, the capitate and the hamate bone — 16%.
4. **Type II (+)** — contacting with the radius, *discus articularis*, the capitate and the hamate bone — 50%.
The metrical characteristics suggest that the type that undergoes the greatest pressure is Type II (+).

Key words: os lunatum, types, morphology, morphometry.

Introduction

The lunate bone plays an important role in the statics and biomechanics of the wrist joint complex. Some anatomical variations affect the translation of pressure from the metacarpal bones and, therefore, affect its biomechanics and pathology [6]. Different classifications of the *os lunatum* types can be found according to the method of research [2, 3, 11, 12, 13]. In this report we aim to study the different types of *os lunatum* and their morphological and metrical characteristics.

Material and Methods

One hundred macerated lunate bones were studied scopically for the number of the joint facets on the distal and the proximal surface and, metrically, after Martin-Saller [5] (10 indicators) following which a descriptive statistical analysis was made.

Results and Discussion

The scopical observations of the lunate bones revealed that 34% of them had one facet on the distal joint surface for the capitate bone (type I, according to Viegas et al. [10] and 66% of them had two facets for the capitate and the hamate bones (type II, according Viegas et al. [10] (Fig. 1, 2).

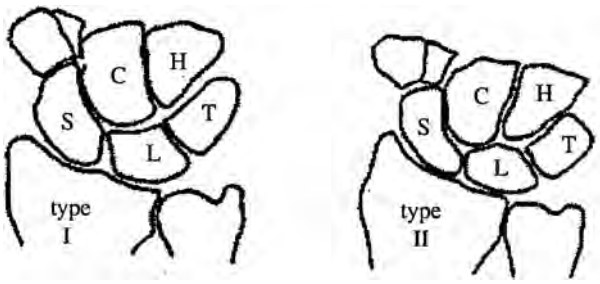

Fig.1. Lunate bone type I and II (Viegas et al., 1990)

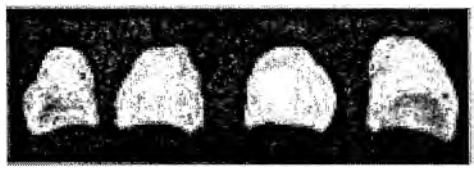

Fig. 2. Lunate bone type II

This direct research of bones excludes the probability of misdetermination of type II as type I unlike roentgenological, MRI and arthroscopy. Therefore, there is some difference in the data obtained (Table 1).

The analysis of the metrical characteristics of *os lunatum* type I and type II (Table 2) shows:

1. All measurements after Martin and Saller [5] except indicator No 6 are greater at the *os lunatum* type II. The difference is statistically significant in indicators No 1 and 7;
2. The width of the joint facet for *os capitatum* in type I is greater than the same of type II (indicator No 7a). The difference is statistically significant.
3. The width of the joint facet for *os capitatum* in type II is always greater than the width of the joint facet for *os hamatum*.

Table 1. Os lunatum types

Method	Authors. years	type I – %	type II – %
Macerated bones	**Dyankova S. (2004)**	34 %	66 %
Dissection of wrists	**Dyankova S. (unpublished data)**	44 %	56 %
	Viegas S. F. et al. (1990 a)	39.3 %	60.7%
	Viegas S. F. et al. (1990 b)	34.5 %	65.5%
	Viegas S. F. et al. (1993)	27 %	73 %
MRI and arthroscopy	**Malik A. M. et al. (1999)**	42.5 %	57.5 %
Roentgenography of wrists	**Viegas S. F. et al. (1990 b)**	46.1%	53.9%
	Tsuge S. R. Nakamura (1993)		
	Contralateral unaffected wrists of patients with trauma		42%
	Contralateral unaffected wrists of patients with Kienböck's disease		37%
	Bilateral wrists of volunteers		35%
MR arthrography	**Pfirrmann C. W. A. et al. (2002)**	50%	50%

Table 2. Measurements of os lunatum type I and type II — mean and standard error, mm

Indicator after R. Martin and K. Saller	Indicator No	type I (n=34)	type II (n=66)
Length	1	15.62 ± 0.29*	16.35 ± 0.22*
Greatest width	2	13.24 ± 0.28	13.68 ± 0.22
Greatest height	3	16.35 ± 0.26	16.44 ± 0.28
Greatest height of the proximal surface	4	14.16 ± 0.31	14.73 ± 0.23
Greatest width of the proximal surface	5	11.93 ± 0.31	12.57 ± 0.24
Greatest height of the distal surface	6	13.16 ± 0.19	13.11 ± 0.19
Width of the distal surface in the middle	7	9.26 ± 0.17**	9.98 ± 0.13**
Width of the joint facet for *os capitatum*	7a	9.26 ± 0.17**	7.89 ± 0.11**
Width of the joint facet for *os hamatum*	7b	0	3.34 ± 0.12
Greatest depth of the distal surface	12	3.65 ± 0.10	3.81 ± 0.12

*$p<0.05$; **$p<0.0025$

The scopical observation of the lunate bones revealed that 26% of them had one facet on the proximal joint surface, and 74% of the lunate bones had two joint surfaces with margins for contact with the radial bone and *discus articularis*. Having only one facet on the proximal surface does not mean that the lunate bone does not contact *discus articularis*. In a case of adduction in the radiocarpal joint, the lunate bone is always in contact with *discus articularis* whereas, in neutral position and abduction, they would probably not contact. Zapico's results [13] for the frequency of one facet only on the proximal joint surface (30%) are similar to ours.

We can classify four types of relationships of the lunate bone with the bones situated proximally and distally, based on the present of one or two facets on the proximal and on the distal joint surfaces:

1. Lunate bone **type I (–)** — with one facet on the proximal and one facet on the distal joint surface contacting only the capitate bone — 10%.

2. Lunate bone **type I (+)** — with two borderline facets on the proximal and one facet on the distal joint surface for a contact only with the capitate bone — 24%.

3. Lunate bone **type II (–)** — with one facet on the proximal and two facets on the distal joint surface for a contact with the capitate and hamate bones — 16%.

4. Lunate bone **type II (+)** — with two borderline facets on the proximal and two facets on the distal joint surface for a contact with the capitate and hamate bones — 50% (Fig. 3).

The measurements of the four types show that Type II (–) (except indicator No 6) and Type II (+) (except indicator No 3 and No 6) are greater than the same measurements of Types I. The difference between the greatest height of the proximal surface of *os lunatum* type II (–) and (+) is statistically significant ($p<0,05$) (Table 3).

Fig. 3. Zunate bone type I (–), I (+) and II (—), II (+)

Table 3. Measurements of the os lunatum type I and type II (–) and type I and type II (+) — mean (mm)

Indicator after R. Martin and K. Saller	type I (–) (n=10)	type II (–) (n=16)	type I (+) (n=24)	type II (+) (n=50)
Length (1)	15.59	16.01	15.63	16.45
Greatest width (2)	12.92	13.77	13.38	13.64
Greatest height (3)	15.80	16.03	16.58	16.57
Greatest height of the proximal surface (4)	13.40	14.06*	14.48	14.94*
Greatest width of the proximal surface (5)	11.46	12.57	12.13	12.56
Greatest height of the distal surface (6)	13.11	12.37	13.18	13.15
Width of the distal surface in the middle (7)	9.10	10.07	9.32	9.95
Width of the joint facet for *os capitatum* (7a)	9.10	7.82	9.32	7.91
Width of the joint facet for *os hamatum* (7b)	0	3.62	0	3.25

*p<0.05

The lunate bone is subject to pressure both from the proximal and the distal direction. In specilised literature this pressure from both sides is known as "the phenomenon of the nut-cracker" [1]. The "nutcracker's phenomenon" is also considered to play an important role in the development of Kienböck's disease. The pressure varies with the anatomical type of the lunate bone. This pressure from the distal direction on the lunate bone type II comes not only from the capitate and respectively from the II-nd and III-rd metacarpal bones, but also from the hamate and respectively from the IV-th and V-th metacarpal bones. Thus there is probably a significant pressure increase on a unit area of the lunate bone type II. As the mean value of the greatest width of the proximal and the distal joint surface is lower in the lunate bone Type II (+), the pressure this type suffers is probably the greatest.

Conclusions

Our investigations suggest that the type that undergoes the greatest pressure is Type II (+).

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