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Morphological Characteristics of the Types of Os Lunatum and their Relation to Kienbock's Disease

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The lunate bone is a carpal bone which can be easily distinguished by its crescent outline. The bone has its role in orthopedics and the related pathologies are difficult for diagnostics. The aim of our work was to overview the morphological characteristics of the bone which have significant role in pathological conditions of the wrist, like Kienbock's disease and carpal coalition. In our research we included 40 lunate bones of unknown sex and age. As a result, we specified 4 types of lunate bone based on its relation to the surrounding bones. Type II+ was the most commonly observed type. People with this type of bone suffer from different pathological conditions significantly less often as opposed to people with the other types of lunate (type I+, I- and II-). Knowledge of the morphology of the bone plays a crucial role in the treatment of the discussed pathological conditions.

Key words: os lunatum, morphology, types, Kienbock's disease

Introduction

The wrist represents one of the most complex joints in the human organism that performs numerous movements and plays an important role in the everyday activities of every individual [3, 5, 6, 8]. The etymology of the word comes from the Greek word "luna" meaning moon, because of the crescent shape of the bone [8]. It can be easily distinguished from the other carpal bones by its deep concavity on the distal surface. Os lunatum is located in the proximal row of the carpal joint complex between os scaphoideum and os triquetrum. The bone has both intrinsic and extrinsic ligaments for attachment with the surrounding bones, such as the scapholunate ligament, lunotriquetral ligament, radiolunotriquetral, radioscapholunate and ulnolunate ligaments. The arterial blood supply comes from the branches of the dorsal radiocarpal arch and the intercarpal arch [3, 5, 6, 8].

There are 4 types of os lunatum based on its communication with the surrounding bones [1, 4]. Type I+ has two proximal facets for connection with the radius and discus articularis and one distally located facet for connection with the capitate bone. Type

I- has one proximal facet and one distal. Type II+ has two proximally located and two distally located facets for connection with os hamatum and os capitatum. Finally, type II- has one proximal and two distal facets [4]. The possible variations of the bone could cause different pathologies which very often create difficulties for diagnostics. The most common disorder of the lunate bone is its avascular necrosis, termed Kienbock's disease, characterized by death and fracture of bone due to interruption of blood supply with fragmentation and collapse of the lunate [9].

The aim of our study was to overview the possible variations of os lunatum and its role in the pathological conditions of the hand.

Materials and Methods

In the present study we examined 40 unselected human lunate bones collected at the Department of Anatomy, Histology and Embryology of the Medical University of Sofia. These bones came exclusively from Bulgarian individuals and their sex was unknown. The study was approved by the Medical Legal Office and Local Ethics Committee. The specimens were distributed in groups based on the number of facets on each surface of the bone and its communication with the surrounding bones. Ten different measurements of each type of the bone were established. Measurements were made using a digital ruler micrometer caliper 0.01 mm. The mean values and the SD for all parameters were calculated. The obtained quantitative data were demonstrated with tables. Microsoft Office Excel 2010 was used to process the data and to demonstrate the obtained results in an adequate way.

Results

From the examined specimens, 5% were type I - (**Fig. 1a, 1b**) with one facet proximally and distally and 25% were type I+ (**Fig. 1c, 1d**) with two facets proximally and one distally. The majority of the bones (53%) were type II+ **(Fig. 2a, 2b**) with two proximally and two distally located facets. Type II- (**Fig. 2 c, 2d**) with one proximal and two distal located facets was detected in 17% of cases. From the conducted measurements, we noted that only the length, the greatest width and the greatest height differed, while the other measurements remained constant (**Tables 1-4**). Furthermore, we observed that the average height of type I- was bigger than type I+ by approximately 3 mm. The average length of both types differed by approximately 1 mm and the width – by 1.25 mm. We also observed that the average length of type II+ was approximately 3 mm longer than type II-. The greatest width of type II+

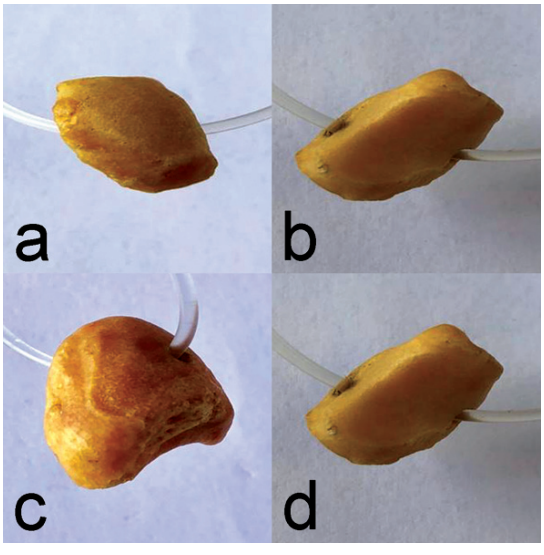

Fig. 1. Photographs of the types of os lunatum, as follows: type I- (a, b); type I+ (c, d)

was approximately 2 mm wider than that of type II-, while its greatest height was 3 mm longer than that of type II-.

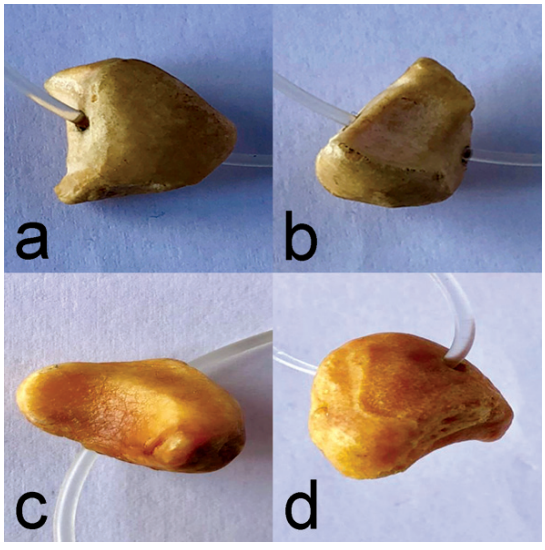

Fig. 2. Photographs of the types of os lunatum, as follows: type II+ (a, b); type II- (c, d)

Discussion

Our observations of the lunate bones revealed similar results compared to Dyankova [4], although there were some differences in the measurements. The greatest width of our specimens from each type of the bone; the greatest height of type I+ and II+; the greatest width of the proximal surface of types II+ and II- and the greatest height of the distal surface in types I+ and II- were less, compared to the measurement of those types of bones by Dyankova [4].

It appears that the number of facets on each surface has its role in the pathology. Type II+ has two facets on each side so the pressure is distributed better between them. In type I- there is one facet proximally and one distally. This type is most rarely seen and the risk of a pathological condition is bigger than the other types. In addition, the gender has its role in os lunatum's pathology as well. It is well known that men usually apply more stress on their hands than women. Thus, after years of constant pressure on the wrist, it may get damaged, which in turn may lead to development of Kienbock's disease – death and fracture of bone tissue due to interruption of blood supply with fragmentation and collapse of the lunate [3, 5, 6, 8].

Kienbock's disease was first described by Austrian radiologist Robert Kienbock in 1910 and is also called osteonecrosis, lunatomalacia, and aseptic or ischemic necrosis of the lunate [10]. The disease is more often seen in people at age 20-40 years. The symptoms include severe wrist pain, inability of wrist movement and often edema [9].

Table 1. Basic metrical characteristics and indices of os lunatum type I+

Indicators and indices	***Mean value (mm)***
Length of os lunatum	16.07
Greatest width of os lunatum	9.00
Greatest height of os lunatum	13.64
Greatest height of the proximal surface	13.28
Greatest width of the proximal surface	11.17
Greatest height of the distal surface	10.52
Width of the distal surface in the middle	5.47
Width of the joint facet for os capitatum	5.88
Width of the joint facet for os hamatum	0
Greatest depth of distal surface	1.88

Table 2. Basic metrical characteristics and indices of os lunatum type I-

Indicators and indices	*Mean value (mm)*
Length of os lunatum	15.25
Greatest width of os lunatum	10.50
Greatest height of os lunatum	16.75
Greatest height of the proximal surface	14.53
Greatest width of the proximal surface	10.36
Greatest height of the distal surface	13.58
Width of the distal surface in the middle	6.00
Width of the joint facet for os capitatum	6.00
Width of the joint facet for os hamatum	0
Greatest depth of distal surface	2.00

Table 3. Basic metrical characteristics and indices of os lunatum type II+

Indicators and indices	*Mean value (mm)*
Length of os lunatum	16.72
Greatest width of os lunatum	12.18
Greatest height of os lunatum	15.90
Greatest height of the proximal surface	14.36
Greatest width of the proximal surface	11.00
Greatest height of the distal surface	11.21
Width of the distal surface in the middle	9.71
Width of the joint facet for os capitatum	6.11
Width of the joint facet for os hamatum	2.44
Greatest depth of distal surface	2.10

Table 4. Basic metrical characteristics and indices of os lunatum type II-

Indicators and indices	*Mean value (mm)*
Length of os lunatum	14.00
Greatest width of os lunatum	10.00
Greatest height of os lunatum	13.00
Greatest height of the proximal surface	14.23
Greatest width of the proximal surface	11.88
Greatest height of the distal surface	10.00
Width of the distal surface in the middle	6.75
Width of the joint facet for os capitatum	4.57
Width of the joint facet for os hamatum	1.93
Greatest depth of distal surface	2.30

The disease is a big challenge for diagnostics not only because it is rarely observed, but also because of its unclear etymology [11]. Early diagnostics is very important for the proper treatment of the condition and may prevent progression of the necrosis and bone collapse [9]. Another condition associated with the lunate bone is the so called carpal coalition – abnormal fusion of two or more carpal bones during the embryonal development. This is a congenital disease seen in otherwise healthy people and may occur as part of a syndrome, such as Turner's and Holt-Oram syndromes [2]. This disease is often found after radiographic evaluation following trauma [7].

Conclusion

Pathological conditions of the lunate bone are commonly seen in the dominant wrist. People with type II+ suffer significantly less often, because of the two proximally and two distally located facets between which the pressure is distributed better. The anatomical features, the age relation and gender are all associated with os lunatum pathology.

References

1. **Bain, G. I., S. B. M. MacLean, C. J. Yeo, E. Perilli, D. M. Lichtman.** The etiology and pathogenesis of Kienböck disease. – *J. Wrist Surg.*, **5,** 2016, 248-254.
2. **DeFazio, M. V., B. J Cousins, R. A. Miversuski, R. Cardoso.** Carpal coalition: a review of current knowledge and report of a single institution's experience with asymptomatic intercarpal fusion. – *Hand (New York)*, **8,** 2013, 157-163.
3. **Dyankova, S.** Anthropometric characteristics of wrists joint surfaces depending on lunate types. – *Surg. Radiol. Anat*., **29,** 2007, 551-559.
4. **Dyankova, S.** Lunate bone-types and morphological characteristics. – *Acta Morphol. Anthropol.,* **10,** 2005, 304-308.
5. **Dyankova, S., G. Marinov.** Basic anthropometric characteristics of wrist bones in the wrist joint complex with lunatum types I and II. – *Acta. Morphol. Anthropol.*, **12,** 2007, 193–198.
6. **Dyankova, S., G. Marinov.** Comments about the hamate facet of the lunate: a radiographic study in an Arab population from Bahrain. – *Surg. Radiol. Anat.*, **29,** 2007, 181.
7. **Gottschalk, M. B., M. Danilevich, H. P. Gottschalk.** Carpal coalitions and metacarpal synostoses: a review. – *Hand (New York)*, **11,** 2016, 271-277.
8. **Kamburov, D. G. Marinov, S. Dyankova.** Anatomical features of os lunatum: significance in the wrist joint statics and mechanics. – *Scr. Sci. Med.,* **30**, 1998, 49-55.
9. **Kulhawik, D., T. Szałaj, M. Grabowska.** Avascular necrosis of the lunate bone (Kienböck's disease) secondary to scapholunate ligament tear as a consequence of trauma – a case study. – *Pol. J. Rad.*, **79,** 2014, 24-26.
10. **Omor, Y., I. Nassar, A. Ajana, N. Moatassimbillah.** Kienböck's disease: a case report. – *Pan. Afr. Med. J.*, **22,** 2015, 246.
11. **Squitieri, L., E. Petruska, K. C. Chung.** Publication bias in Kienbock's disease: a systematic review. – *J. Hand Surg.*, **35,** 2010, 359-367.