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Morphometric and Morphologic Characteristic of the Distal Humerus in the Contemporary Bulgarian Population

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The present study is based on a measuring of 73 distal humeri. The bone material is taken from cadavers. The bones are cut at 15 cm proximally from the distal part of the humerus. At the time of the study we determined more than 30 linear and 10 angular signs. We used five descriptive signs for our facilitation. The shown subjection is also presented in the microscopic preparations.

Key words: humerus, distal humerus, morphometry, contemporary Bulgarian population, morphology.

Introduction

The humerus is the bone of the arm. It is divided into three parts [2]. The central part is known as humeral body — *corpus humeri.* The other parts are proximal and distal ends.

The distal end of the humerus is widened and the two external edges of the *corpus humeri* pass into the *epicondyles* — rounded processes of the bone. A bigger one is the *medial epicondyle* and a lesser one — *lateral epicondyle.* The two epicondyles pass into *condyles* distally and they turn into the articular surfaces known as *trochlea* and *capitulum*. The *capitulum* is a rounded knob on the anterior and lower surface that articulates with the end of the radius. Just superior to the articular surface is the *radial fossa*, which is a depression that receives the head of the radius when the elbow is flexed. Medial to the capitulum is the *trochlea*. The *trochlea* has a concave surface, and unlike the capitulum, the trochlea continues around to the posterior surface allowing it to articulate with the ulna. Superior to the trochlea is another depression called the *coronoid* fossa, which receives part of the ulna when flexed. There is a depression at the back surface between the two condyles known as *fossa olecrani*. It receives the proximal end of the ulna, known as *olecranon ulnae*, in extension (Fig. 1, 2, 3).

From a functional point of view the end of the humerus splits in a wishbone fashion to form the two columns that support the trochlea [1]. By interconnecting with these divergent columns the terminal part of the humerus resembles a triangle. All

Fig. 1. Distal humerus — front

Fig. 2. Distal humerus — back

Fig. 3. Distal humerus—lateral

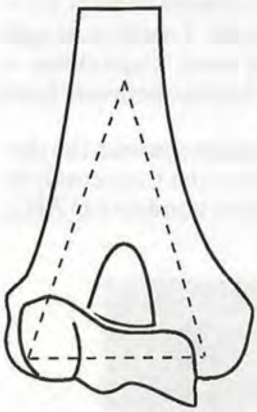

Fig. 4. Humerus — triangle

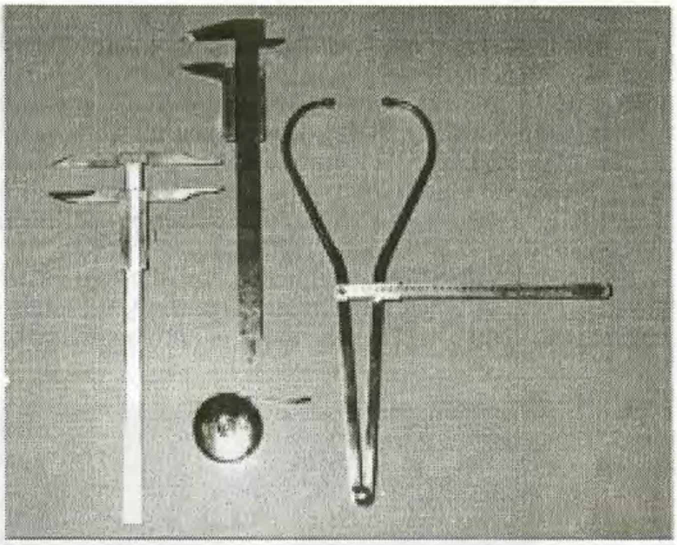

Fig. 5. Gneupell instruments

kinds of injury, which disrupt any of the three arms of this triangle, conduct to unexpected weakness of the construction and instability. Defining the distal humerus articulation as a triangle based on the trochlea ignores the capitellum. There are reasons to consider the capitellum and its articulation with the radius as a joint separate from the elbow (Fig. 4).

Mechanically, the radiocapitellar joint contributes to the function of forearm rotation and is independent of the elbow flexion and extension [3].

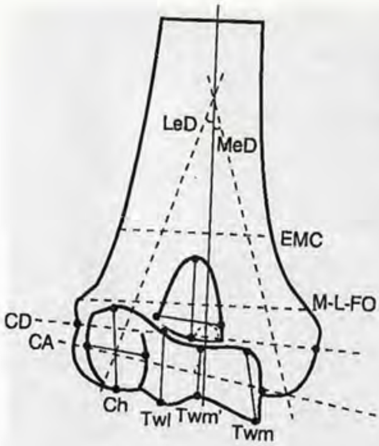

Fig. 6. Humerus — lines and angles

On viewing the distal humerus from a posterior aspect, the trochlea and its articular surface are readily appreciated to be centrally located between the lateral and medial distal humerus columns from which the trochlea is suspended.

Material and Methods

The present study is based on the measuring of a number of 73 distal humeri took from cadavers 30 pairs and 13 single.

The bones are cut at 15 cm proximally from the end of the distal part of the humerus.

The measurements are done by Swiss made devices — Gneupell. (Fig. 5).

We measured more than 30 linear and 10 angular signs. We also made precise cuts of 17 bones in different levels and made original printings of the cuts. We used also five descriptive signs. We made microscopic preparations of 12 different humeri and took the material for it from 10 anatomic zones-trochlea, capitellum, medial epicondyle, lateral epicondyle, medial condyle, lateral condyle, bordering zones between articular cartilage and bone and material from the three fossae (Fig. 6).

We made X-ray graphics of 34 of the humeri in antero-posterior view.

The most important linear signs are: end of the medullar canal (***EMC***), anterior-posterior diameter of the bone at a level *olecranon fossa* (***A-P-FO***), medial-lateral diameter of the bone at a level *olecranon fossa* (***M-L-FO***), transcondylar width (***TW***), medial column width (***MCW***), lateral column width (***LCW***), coronoid fossa (***CF***) — width, height and depth, olecranon fossa - width, height and depth; Trochlear length (***TL***), Trochlear width (***TW***) — at medial, median, and lateral level, Capitellum — length (***Cl***), height (***Ch***) and anterior-posterior width (***Ca-p***), lamina between fossa olecrani and fossa coronoidea (***LbF***), etc (Fig. 7, 8).

The most important angular signs are: the angle of the trochlea towards the diaphysis, known as a "carrying angle" also (***CA***), the angle between the transcondylar line and the diaphysis (***CD***), the angle of ante version of the medial condyle (***AVMC***),

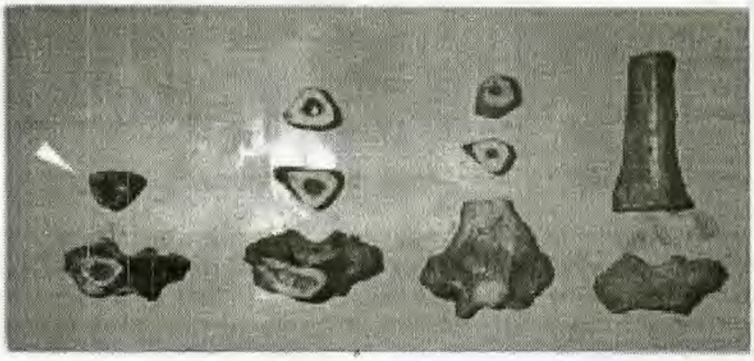

Fig. 7. The cuts

Fig. 8. The printings

the angle of ante version of the lateral condyle (*AVLC*), the angle between medial condyle (epicondyle) and the diaphysis (***MeD***), the angle between lateral condyle (epicondyle) and the diaphysis (***LeD***), etc.

Results

The linear signs are revealed in millimeters. The angular signs are in degrees.

The measurements for the linear signs are: ***EMC*** — 38,1 mm, ***AP- F-O*** — 16,67 mm, ***ML- F-O*** — 36,67 mm, ***TW*** — 60,65 mm, ***MCW*** — 10,37 mm, ***LCW*** — 13,35 mm; Coronoid fossa (***CF***) width — 12,81 mm, height — 11,1 mm, depth — 4,07 mm; Olecranon fossa width — 22,61 mm, height — 17,76 mm, depth — 9,2 mm; ***TL*** — 23,36 mm; ***TW*** — (at medial level)-25,52 mm, median — 17,1 mm, lateral — 24,42 mm; Capitellum — length —***Cl***-18,19 mm, height- ***Ch*** — 17,6 mm, and anterior-posterior width- ***Ca-p*** — 21,64 mm; Lamina between fossa olecrani and fossa coronoidea (***LbF***)-2,3 mm.

The "carrying angle" ***CA*** — 93,52 degree; ***CD*** - 83 degree; ***AVMC*** — 171,21 degree; ***AVLC*** — 181, 26 degree; ***MeD*** — 44,0 degree; ***LeD*** — 21,15 degree.

The results were counted by the methods of mathematical analyses. All the measurements were arranged in table and the help of the Microsoft Excel counted the results. It was made an independent calculation for more precise results. The data of the two calculations coincided absolutely (Table 1).

The cuts of the 17 bones are made at different levels. This was made finally because it broke the entireness of the bones. The levels in the sagittal plane are at the boundary between the medial condyle and the capitellum, between capitellum and the trochlea, and between the trochlea and the lateral condyle.

The levels at the transversal plane are defined by distance. It is measured in millimeters from the distal end of the articular cartilage — 5mm, 10 mm, 15 mm, 20 mm,

T a b l e 1. Extract from Microsoft Excel table with the results.

L/r	Age	Sex	EMC	A-P-F O	M-L-FO	CFw	CFh	CFw	TW	LbF	TL	TWm	TWl	Cl	Capitullum
l	55	m	42	18	38	18	15	6	61	4	27	26	26	18	16
l	87	f	41	13	30	13	9	5	55	1	22	23	22	15	14
l	75	m	33	14	36	11	10	3	57	1	22	25	27	17	16
r	36	f	31	16	36	11	oss5	5	59	2	22	29	24	19	14
r	76	f	37	13	33	8	6	3	56	3	20	24	21	16	15

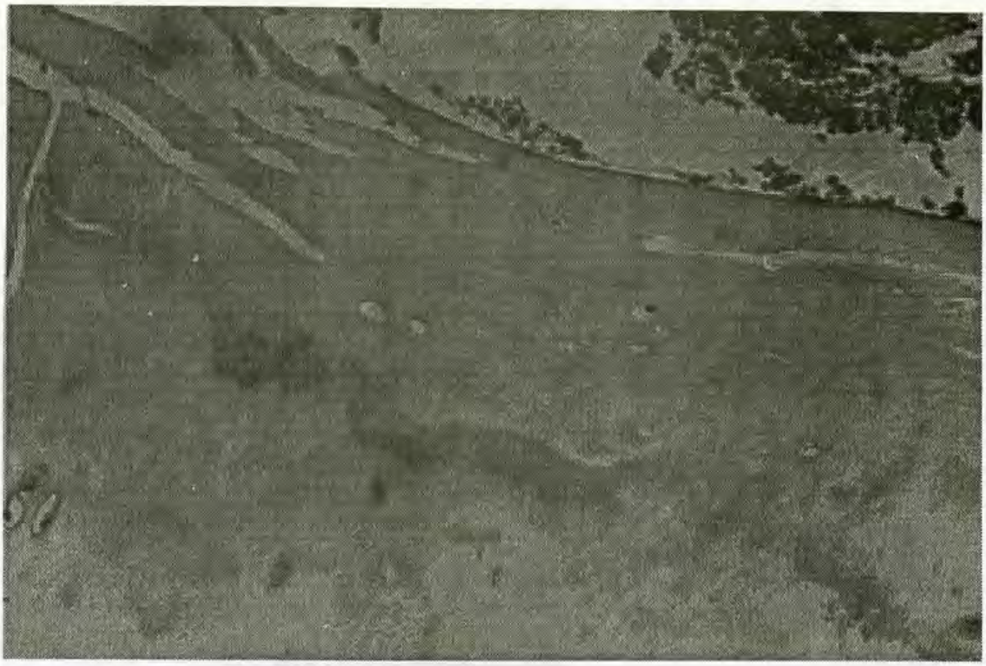

Fig. 9. Microscopic view of the trochlea

25mm, 30mm, and 35mm. A series of 5 cuts were made at the distal part of the humeral diaphysis at a distance of 8 millimeters.

Discussion

As a conclusion, having in mind the shown results, we can say that the distal humerus could be scrutinized as a conglomerate of four different structures — lateral column (lateral condyle and epicondyle), medial column (medial condyle and epicondyle), trochlea and capitellum and two zones formed by the enclosing of the mentioned above structures — the coronoid fossa — at the anterior surface and the olecranon fossa — at the posterior surface.

The bone morphology of these zones responds to their function — the different movements in the elbow joint.

The microscopically viewed difference in the structure of these zones is expressed in more bone substance with less extracellular space in the zones with higher pressure and intensive movements — the core of the capitellum and the trochlea.

Note that when the elbow is fully extended, in anatomical position, the forearm does not line up with the arm, but deviates laterally. This is known as the "carrying angle" described above. It is due to a fact that the trochlea extends farther distally to the capitellum.

We can mention that we measured left and right humeri of 4 days old new born and right humerus of 4 weeks old baby and made microscopic preparations. Our idea is to collect more material of such humeri as a basement of our bigger and more profound work and to connect it with some histological results.

We have made also and preparations for electronic microscopy but we will include them in our next study.

The picture below is showing the microscopic view of the trochlea, of 55 years old male, viewed as N1 at the table of the results.

As a conclusion we could say that our study reveals in detail the morphometric characteristic of the distal humerus and could be of assistance for future clinical or research work (Fig. 9).

References

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