Institute of Experimental Morphology and Anthropology

Acta morphologica et anthropologica, 7
Sofia • 2002

# Anatomic Variations of the Humerus in Human

*A. Katsarov, Y. Yordanov*

*Institute of Experimental Morphology and Anthropology, Bulgarian Academy of Sciences, Sofia*

To understand the variations of the anatomic structures, we need to know the normal anatomy of these structures in detail.

The anatomic terminology is exact and it is impossible to make different interpretations according to the case.

As **normal** anatomic sign we take the statistical measure of usually observed structures, typical, or representative type [1].

As **variation** we determine the capacity to vary. The act of varying or the extent to which something has varied, a measurable change or modification. Within some normal range of variance [1].

**Anomaly** — Outside the norm, inconsistency, irregularity, or abnormal. Any structure, function, or state outside the usual range of variation from the norm. In our view a precise norm has not, and probably will not, be determined [1].

The aim of the present study is to describe the normal anatomy of the humerus in human and to reveal anatomic variations in its parts and structures by literature data.

*Key words*: anatomic variations, humerus, human.

## Introduction

The humerus is the bone of the arm. It is divided into three parts [6, 7, 9, 2, 14, 16]. The central part is known as humeral body - ***corpus humeri***. The other parts are proximal and distal ends.

The proximal end of the humerus consists of the head, ***caput humeri***, and two tubercules — bigger, ***tuberculuc majus***, and lesser, ***tuberculus minus***. We can differentiate a deep narrowing between two tubercules — the intertubercular groove, ***suclus intertubercularis***. Here lies the tendon of the long head of m. biceps brachii. At the down end of that groove is situated the surgical neck, ***collum chirurgicum***, of the humerus — a place that corresponds to the epiphyseal plate of the head [3]. This is the place where is the most often situation of the fracture line in area of the proximal humerus.

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***.

Some authors believe that the trochlea and the capitullum are the articular surfaces of the condyles, but other believe that they are absolutely independent parts of the distal humerus (4,9).

According to other, exists and third opinion, that the ***capitulum*** and the ***trochlea*** are united in a complex — **capitello-trochlear complex** [15].

Both of the theories are supported by facts of the ontogenyc and phylogenic development and the processes of ossification of the humerus after the embryology development [4, 2, 15].

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*, ***fossa radialis***, which is a depression that receives the head of the radius when the elbow is flexed. Medial to the capitulum is the ***trochlea***.

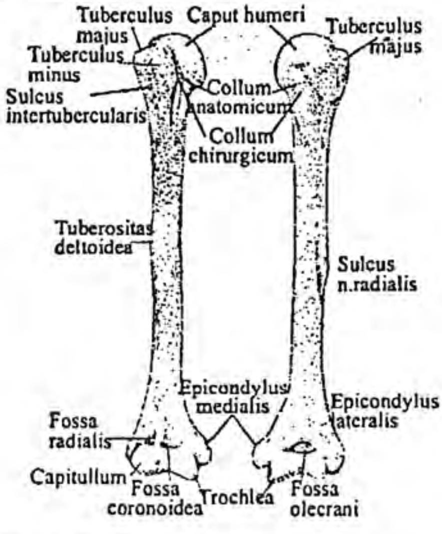


Fig. 1. The Humerus

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 *coronoid* fossa, ***fossa coronoidea***, which receives part of the ulna when flexed. There is a depression at the back surface between the two condyles known as olecranon fossa, ***fossa olecrani***. It receives the proximal end of the ulna, known as ***olecranon ulnae***, in the position of extension of the forearm.

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***. By interconnecting with these divergent columns the terminal part of the humerus resembles a triangle [8].

## Variations

One of the rare anomalies, described by Riedinger in 1900, is the congenital humeral varisation, **humerus varus congenitus** [17]. Two other scientists — Brancifortis and Goidanich, described 25 cases, according to the literature for 25 years. The deformation could be seen immediately after the birth and is bilateral.

There could be an absolute or partial absence of the **humeral head** — 0.1% [1].

The humerus may have an enlarged **deltoid process** [7].

The depth of the **intertubercular groove**, where lies the tendon of the long head of the biceps brachii muscle, may vary. It is in direct proportion with the value of the angle of its medial wall.

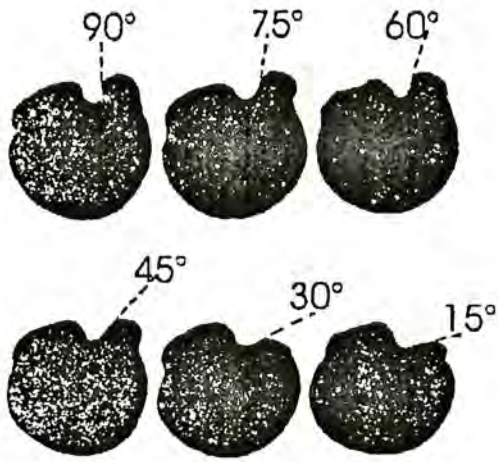


Fig. 2. Views of the upper end of the left humerus, to illustrate variations in the depth of the intertubercular groove and in the angle of its medial wall with its floor (from Hitchcock, H. H., and Bechtol. C. O.: J. Bone &Joint Surg. 1948, 30-A:263

Supracondylar process, processus supracondylaris [1, 4, 3, 11, 10, 9]. This is a small, hook-shaped process of bone, the supracondylar process, varying from 2 to 20 [4] mm in length, is not infrequently found projecting from the antero-medial surface of the body of the humerus 5 cm above the medial epicondyle. Robert Spinner et al. point out that Tiedemann first described the process in 1818, followed by Knox in 1841 and by Struthers in 1849 [1, 11].The process is joined to the epicondyle by a fibrous band (so-called ligament of Struthers) which may ossify. The process, band and shaft of the humerus form a ring or canal through which the median nerve and the brachial artery (or a branch of it) are transmitted [6]. The nerve and/or artery may become compressed causing clinical symptoms.

The process is curved downward and forward, and its pointed end is connected to the medial border, just above the medial epicondyle, by a fibrous band, which gives origin to a portion of the Pronator teres, as well and an insertion site for a portion of coracobrachialis. Sometimes the median nerve alone is transmitted through it, or the nerve may be accompanied by the ulnar artery, in cases of high division of the bra-

Fig. 3. The supracondylar process

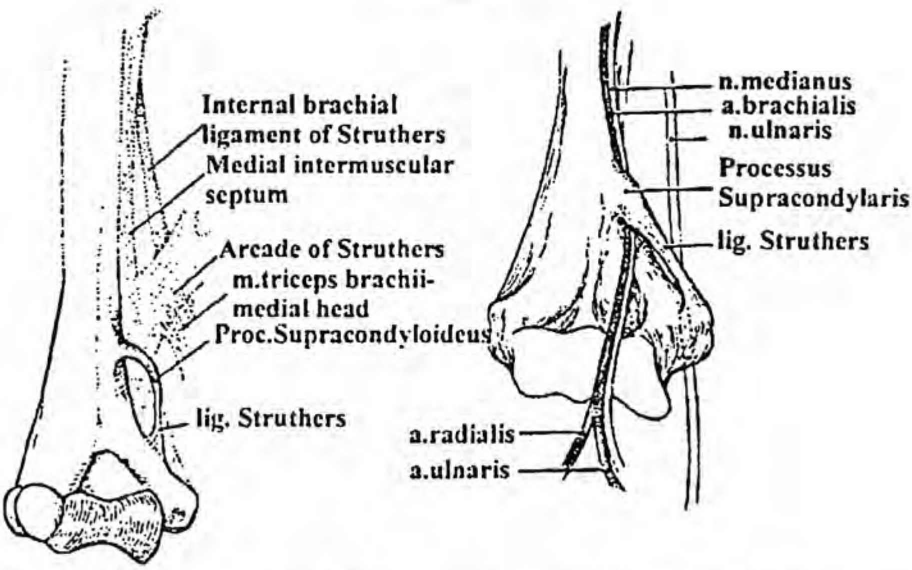


Fig. 4. Processus supracondylaris, Struthers complex – correlation to nerves and vessels

chial artery. A well-marked groove is usually found behind the process, in which the nerve and artery are lodged. This arch is the homologue of the supracondyloid foramen found in many animals, and probably serves in them to protect the nerve and artery from compression during the contraction of the muscles in this region [4].

This supracondylar process of the humerus has a reported frequency of 2.7% (J. Gruber). Adachi summarized the literature (up to 1828) and found 12 authors (not including Gruber) had studied 9620 humeri and identified supracondylar processes in 78 or 0.8% of the arms (11.10). The range of frequency in the 12 studies was 0.1-5.7%. The peoples studied included the Aino, Chinese, Koreans, Negroes, Melanesians, Australians, Japanese (including 142 stone age specimens), East Indians, Germans, French, Eskimos, Swedes, and Italians.The Struthers' complex is best represented in Predators.

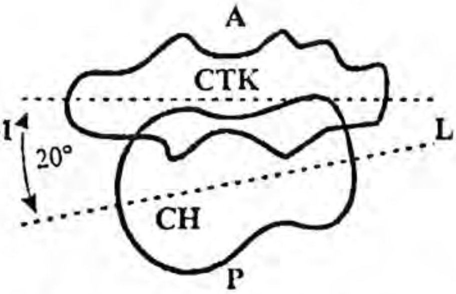


Fig. 5. Spatial correlation between the proximal and the distal humerus — a view from above
*A* — anterior; *B* — posterior; *M* — medial; *L* — lateral; *CTM* — capitello-trochear complex; *CH* — humeral head

The ***olecranon fossa*** of the humerus is occasionally perforated to form a ***supratrochlear foramen*** or **septal aperature** [4]. **Septal aperatures** may occur in 4-13% of individuals, more frequently on the left side and in females. Racial variations of 4.1-58% have been reported. In an examination of 1744 arm bones, Trotter found septal apertures in 4.2% of whites and 12.8% of American Negroes [7].

There could be an existence of a sesamoid bone, found in the tendon of insertion of the triceps muscle [5].

The spatial correlation between the proximal and the distal parts of the humerus may vary from 15° to 24° [1]). Normal value of this angle is 20°.

## Discussion

As a diversion of the norm, the variations of the humerus are rare and excite interest with discovering of every new case. Although the contemporary technical achievements, such as CT-scanning, MRI or the bone scintigraphy, the discovery of the anatomic variations is difficult and in the most cases accidentally.

The above-described variations have different presentation in the human population. According to the data these signs could vary in man and women, racial, right or left side. Its discovering could be difficult in live individuals, especially if there do not exist any clinical symptoms. For example, the supratrochlear foramen, when present, may be closed in life by a membrane. It is more common on the left than the right and more common in females than males.

The bone morphology and morphometry could not distinguish extremely because it responds to the function — the different movements in the nearest joints, lifting or weight-bearing.

Some authors admit that the most of the variations are atavistic signs, found in remote ancestors. Others believe that it could be some defect in the ontogenetic development.

The morphologic evidences support both of the theories and prove the connection of the human with other biological species and his ancestors.

The knowing of the anatomic variations is of a great importance either for the Orthopaedic surgeons and anatomists or for the anthropologists, who describe and classify the normal morphologic variations of the bones in human.

## References


1. B e r g m a n, R., A. A f i f i, R. M i y a u c h i. Illustrated Encyclopedia of Human Anatomic Variation: Opus V: Skeletal System, Electronic edition.
2. C l e m e n t e, C. Clemente Anatomy: A Regional Atlas of the Human Body, 4th edition, Lippincott, Williams & Wilkins, 1997, 83-192.
3. G r a n t, J., C. B o i l e a u. Grant's Atlas of Anatomy. 9th edition. Springer, 1991, 299-482.
4. G r a y, H. Anatomy of the Human Body. Philadelphia: Lea & Febiger, Renewed 20th edition, 1996,123-157.
5. J a c o b s o n, K. Hughston Clinic Sports Medicine book. Williams & Wilkins, 1995, 305-348.
6. M c M i n n, R. M. H., R. T. H u t h c h i n g s. McMinnColor Atlas of Human Anatomy. 4th edition. Mosby-Year Book, 1998.
7. M o o r e, K., A. D a l l e y. Clinically oriented anatomy. **II**. Appleton & Lange, QS 4 M, 1999, 822-953.
8. M o r r e y, BF. Anatomy of the elbow joint. — In: Morrey BF (ed.). The Elbow and its Disorders, Philadelphia, W. B. Saunders, Co., 1995, 16-52.
9. S o b o t t a, J. Atlas of Human Anatomy, 12th English edition, Lippincott, Williams & Wilkins, 1996, 120-204.
10. T e r r y, R. J. New data on the incidence of the supracondyloid variation. — Am. J. Phys. Anthropol., 9, 1926, 265-270.
11. T e r r y, R. J. A study of the supracondyloid process in the living. — Am. J. Phys. Anthropol. 4, 1921, 129-139.
12. T r o t t e r, M. Septal apertures in the humerus of American Whites and Negroes. — Am. J. Phys. Anthropol., **34**, 1919, 213-217
13. W a l t e r, J. Basic atlas of sectional anatomy with correlated imaging. Lippincot, Williams & Wilkins, 1998, 65-109.
14. В а н к о в, В., Г. Г ъ л ъ б о в. Анатомия на човека. С., Медицина и физкултура. 1990,125-185.
15. К а ц а р о в, А. Морфометрична и морфологична характеристика на дисталния хумерус у съвременния българин. — Acta mporphologica et anthropologica, **6**, 2001, 98-103.
16. С и н е л ь н и к о в, Р. Д. Атлас анатомии человека, Второе издание. **I**. М., Госуд. Изд. Мед. Лит. 1963, 122—125.
17. Х о л е в и ч, Я. Клинична ортопедия. С., Медицина и физкултура. 1988, 20—22.