MUSCULATURE ORIGINATING IN THE MEDIAL EPICONDYLE OF THE HUMERUS LITERATURE REVIEW ON ITS COMPOSITION

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ABSTRACT

The literature review of the present study demonstrated that the musculature that originates from the medial epicondyle of the humerus is of complex architecture and still difficult to understand in its entirety.

Through the analysis of articles from the last five years, we concluded that the muscles that have their origin there may present anatomical variations from 2.5% to 68% in muscle and/or tendon structure.

A report describes the presence of an accessory head of the flexor pollicis longus muscle, originating from the medial epicondyle, which did not exist in classical architecture.

This is of paramount importance in the surgical programming of this region, aiming at its integral composition and possible variations.

Keywords: Epicondyle. Medial. Humerus. Anatomy.

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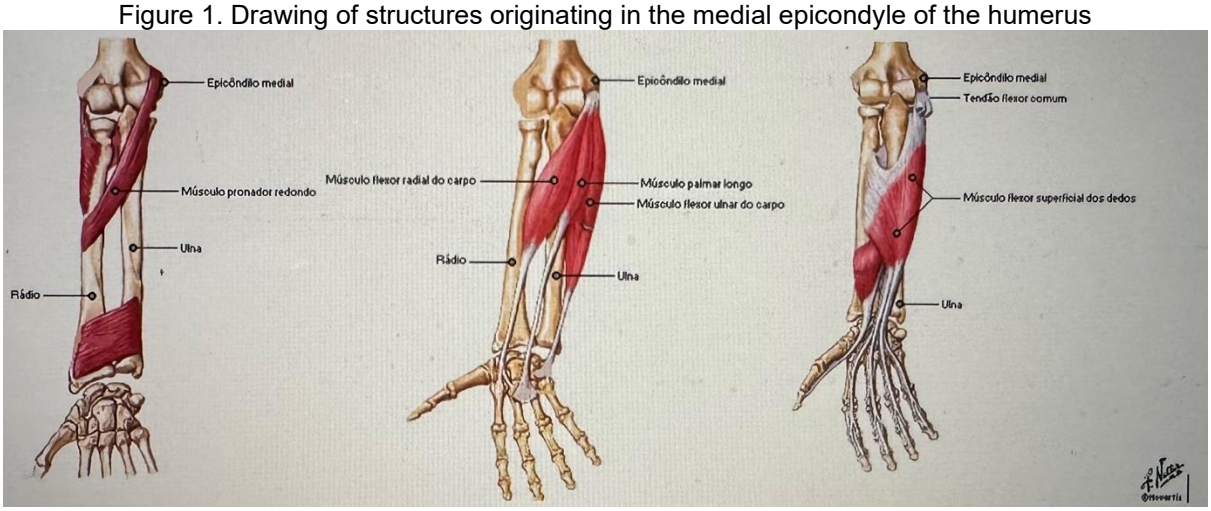
INTRODUCTION

The medial epicondyle of the humerus is an anatomical landmark where the flexor and pronator muscles of the forearm originate. They are located in the anterior compartment and are organized into three layers: superficial, intermediate and deep.

The superficial layer is composed of the pronator teres, flexor carpi radialis, palmaris longus, and flexor carpi ulnaris, all originating from the common flexor tendon, which inserts on the medial epicondyle of the humerus. This joint insertion reflects the structural importance of the medial epicondyle as an attachment point for muscles performing essential hand and forearm movements (Moore, 2024) (figure 1).

Figure 1. Drawing of structures originating in the medial epicondyle of the humerus



SOURCE: NETTER, 2019.

We will verify, through a literature review, the specific composition of the medial epicondyle of the humerus, analyzing the number of structures in this region.

In this context, the objectives of this work were:

- Collection of classic and contemporary literature that deals with the theme.
- Identification of how many and which components make up this anatomical set/region.

METHODOLOGY

The methodology of choice for the following research was a bibliographic review with an exploratory approach.

For Marconi and Lakatos (2019), bibliographic reviews are intended to put the researcher in direct contact with everything that has been written, said or filmed on the subject. Not being a mere repetition of the subject, but providing analysis of the theme from another perspective or approach, to reach new conclusions.

After choosing the theme and preliminary research, a targeted research was carried out through a bibliographic survey, using the following databases: LILACS (Latin American and Caribbean Literature in Health Sciences), MEDLINE (Medical Literature Analysis and Retrieval System Online), SCIELO (Scientific Electronic Library Online), PUBMED (International Literature in Health Sciences). Thus, the characteristics of the research were defined to then discuss, interpret and present the results achieved.

The guiding question was: Are there variations in its composition?

For a bibliographic review of the theme, searches were carried out in printed bibliographies and digitized articles. The Anatomical Laboratory of the University of Contestado (UNC) was also used to complement and analyze its structures in loco.

The articles were collected until March 2025, preferably up to 5 years old, surveying works specifically related to the proposed theme and resulted in 6 articles.

In them, a pattern was perceived in the problem addressed, that is, the authors also had the same doubt as in the present study with the object of the research.

Understanding this subject is of great importance for physicians and professionals who work in both the field of orthopedics and radiology.

HISTORY

According to Tatsuo Sakai (2007) in his revisional article "Historical evolution of anatomical terminology from a scientific to modern" the history of *anatomical nama* can be divided into five stages.

The first is represented by the oldest extant anatomical treatises by Galen of Pergamon in the Roman Empire, where he used a limited number of anatomical terms that were essentially colloquial words in the Greek of that period. (Lydiatt, D. D.; Bucher, G. S., 2010 and Nutton, V., 2012)

The second stage, Andreas Vesalius in the early sixteenth century described anatomical structures in his book De Humani Corporis Fabrica Libri Septem known as the first modern book of anatomy, which presented magnificent details and illustrations, although he did not coin substantially any anatomical terms he developed a system that distinguished anatomy structures with ordinal numbers, Andreas Vesalius was considered, while still alive, as the creator of modern anatomy. (Lydiatt, D. D.; Bucher, G. S., 2010)

The third stage at the end of the sixteenth century, he calls it being marked by a great innovation in the development of specific anatomical terms, especially muscles, vessels and nerves. Thus marking a great advance in the anatomical nomina. The main

figures were Jacobus Sylvius in Paris and Gaspard Bauhin in Basel, Switzerland. (Lydiatt, D. D.; Bucher, G. S., 2010 and Nutton, V., 2012)

Between Bauhin and international anatomical terminology, many anatomy textbooks were written mainly in Latin in the seventeenth century, and in modern languages in the eighteenth and nineteenth centuries. (Lydiatt, D. D.; Bucher, G. S., 2010)

Faced with the diverse terminology in numerous anatomical forms and books, anatomists came together to try to create terms that were logically consistent, intelligible in themselves, clear in meaning and compact in form. (Sakai, T., 2007 and Lydiatt, D. D.; Bucher, G. S., 2010)

It took six years to reach the establishment of guidelines and it was at the ninth conference of the anatomischegessellschaft held in Basel, Switzerland that the international anatomical terminology in Latin was published as Anatomical Basel Nomina. It is important to note that each country could have the freedom to translate the official Latin terms into its own language for teaching purposes. The anatomical Basel Nomina was not a new terminology, but rather a careful selection of existing names, the product of an international group of anatomists working together. (Lydiatt, D. D.; Bucher, G. S., 2010 and o'rahilly, R., 1989)

As science progressed, the terminology was revised several times until the current Anatomical Terminology, both in Latin and English. The first English-language edition of the Eycleshymer, published in 1917, records the results of the work at the Basel Conference. In the preface, it states that they searched from 50,000 names to 5,000 structures, reducing them to 5,000. They did so, and currently, the convention has had several subsequent editions that counts 7,000 terms. (Sakai, T., 2007 and Lydiatt, D. D.; Bucher, G. S., 2010).

RESULTS AND DISCUSSION

Pronator Round Muscle

It is one of the muscles of the anterior compartment of the forearm belonging to the superficial layer. Its main action is the pronation of the forearm, in addition to assisting in the flexion of the elbow. It has two origins, the humeral head, which originates in the medial epicondyle of the humerus, and the ulnar head, which originates in the coronoid process of the ulna. Its insertion occurs on the lateral surface of the radius body, approximately in its middle portion (Moore 2024).

The pronator teres muscle normally has two heads of origin: one humeral, which inserts into the medial epicondyle of the humerus, and another ulnar. However, variations

such as absence of the ulnar head, fusion with neighboring muscles, and atypical path of the median nerve between or through the heads are relatively common. Studies show that the median nerve can cross different paths between muscle heads, increasing the risk of compression (Caetano et al., 2017). They reported that in about 14% of the cases the ulnar head was absent, and that variations in the site of origin of the humeral head were also present. (Zhou et al., 2023), in a study with 40 cadavers, observed variations in two limbs (2.5%), including accessory head and anomalous insertion associated with the superficial flexor of the fingers.

According to Caetano et al. (2017), the anatomical variations of the pronator teres muscle and its relationship with median nerve compression syndromes. The authors observed variations in the presence and development of the humeral and ulnar heads, with cases in which the median nerve passed through the muscle tissue or was located posterior to both heads. Such variations can reduce the nerve's passage space, predisposing it to compressions and neuropathies. The study highlights the importance of detailed examination of regional anatomy for the prevention and treatment of nerve compressions. Understanding these variations is crucial for surgeons and clinicians working in the elbow and forearm region.

Palmaris Longus Muscle

As reported by Moore (2024) a superficial muscle of the anterior compartment of the forearm, its main action is to flex the hand at the wrist and tense the palmar aponeurosis. Its origin is the medial epicondyle of the humerus, through the common tendon of the flexors. Insertion occurs in the palmar aponeurosis and on the distal aspect of the retinaculum of the flexor muscles.

The palmaris longus muscle is the muscle with the highest rate of anatomical variations between the flexors originating in the medial epicondyle. It can present from complete absence, duplication of tendons, accessory bellies or fusion with neighboring muscles. (Olewnik et al., 2017) proposed a new classification for these variations, including types with two bellies, anomalous insertions, and aberrant paths in relation to the median nerve. (Zhou et al., 2023) reported absence in 20% of dissected limbs (16 of 80), with 12.5% being unilateral and 7.5% bilateral. In 2.5% of the cases, the muscle was present, but with an anomalous origin in the fascia of the forearm.

Flexor Carpi Ulnaris Muscle

According to Moore (2024) it is a superficial muscle of the anterior compartment of the forearm, with two heads of origin. The humeral head originates from the medial epicondyle of the humerus through the common flexor tendon, while the ulnar head originates from the olecranon and posterior margin of the ulna. Its insertion occurs in the pisiform bone, hook of the hamate and base of the fifth metacarpal, through the pisoganchosus and pisometacarpal ligaments. The main action of the muscle is to flex and adduct the hand into the wrist.

The flexor carpi ulnaris may present variations mainly in its ulnar head, with reports of duplicate bands and the presence of accessory bellies. (Olewnik et al., 2021) identified a duplicity in the bands of origin of the ulnar head, with possible impact on neurovascular structures. (Zhou et al., 2023) observed variations in 5% of limbs, including anomalous origins in the fascia of the forearm and olecranon, as well as accessory heads in 10% of cases.

Flexor Carpi Radialis (FRC)

According to Moore (2024) it is a superficial muscle of the anterior compartment of the forearm, its origin is the medial epicondyle of the humerus, through the common tendon of the flexor muscles. It inserts at the base of the second metacarpal, with possible extension to the base of the third metacarpal. The main action of the muscle is to flex and abduct the hand at the wrist.

Anatomical variations of the flexor carpi radialis (CRF) are less frequent. (Zhou et al., 2023) reported accessory heads in 3 limbs (3.75%) originating from the coronoid process of the ulna, classifying them into four types, according to connections with structures such as bicipital aponeurosis, pronator teres, biceps, and coracobrachialis.

Flexor Digitorum Superficialis (FSD)

According to Moore (2024) it is classified as an intermediate muscle of the anterior compartment of the forearm, it has two heads of origin: the humeroulnar head, which originates from the medial epicondyle of the humerus and the coronoid process of the ulna, and the radial head, which originates from the upper half of the anterior face of the radius. The muscle divides into four tendons that pass through the carpal tunnel and insert on the lateral surfaces of the middle phalanges of the four medial fingers (2nd to 5th fingers). Its main action is to flex the middle phalanges at the proximal interphalangeal joints of the four

medial fingers; It also assists in flexion of the proximal phalanges at the metacarpophalangeal joints and flexion of the hand at the wrist.

The radial and humeral heads of the DSF were present in 100% of the limbs, whereas the ulnar head was identified in only 32% of them, being absent in 68%. The arch was presented in four formats: fibrous (64% of the cases), muscular (22%), transparent - allowing visualization of the nerve by translucency (8%) - and irregular, with discontinuity between the fibers (6%). The measurements revealed a mean position of the arch at 7.5 cm from the medial epicondyle and a mean length of 4.2 cm. In all specimens, the arch was in direct contact with the median nerve, without any interposed space, reinforcing its potential role in the pathogenesis of compression syndromes. These findings highlight the importance of recognizing this anatomical variation both in a diagnostic and surgical context (Caetano etal., 2018).

In the study, the authors reported the coexistence of five extra-occlusive accessory flexor muscles, capable of flexing all the digits of the hand. The presence of an accessory of the flexor pollicis longus, as well as differentiated heads of the flexor digitorum profundus, which originate close to the medial epicondyle, was verified. These variations demonstrate unusual anatomy, suggesting a potential impact on motor function and wrist stability. Morphometric analysis indicated differences in the isometric strength of accessory muscles compared to typical muscles. The results underscore the importance of knowing the variations for the diagnosis of compression syndromes and surgical planning (Zhou et al., 2023).

Other Variations

According to Olewnik et al. (2021), two muscle variations in the elbow associated with the anterior interosseous nerve were identified. The first variation was the presence of an accessory head of the flexor pollicis longus, originating from the medial epicondyle, which may predispose to nerve compression. The second variation described a duplicity in the bands of origin of the ulnar head of the pronator teres, with potential implications on the course of the ulnar artery. These anatomical anomalies reinforce the importance of recognizing muscle variations in the elbow region. The study shows that such variations can affect neurovascularization and require special care in surgical procedures and diagnostic imaging.

The research investigated the variations of the pronator teres muscle in a population from Central Europe, evidencing differences in the presence and development of its ulnar head. In 86% of the cases, the muscle had both heads (humeral and ulnar), with the

median nerve passing predominantly between them. In cases in which the ulnar head was absent or poorly developed, there was an alteration in the path of the nerve, increasing the risk of compression. The variation in the origin of the humeral head, when associated with the ulnar head, also showed a correlation with the thickness of the median nerve and the length of the forearm. Such data are clinically relevant, especially for the diagnosis and management of pronator syndrome.

As a didactic summary of the bibliographic research we have the exhibition (Chart 1)

Chart 1: Comparison of Classical Anatomy with current bibliographic survey

Musculature originating in the medial epicondyle	Classical Anatomy	Bibliographic Survey
Pronator Round (PR)	Unique	-Absence of ulnar head -Hypoplasia/fibrous fusion of the ulnar head
Flexor carpi radialis (FRC)	Unique	-Type A: accessory head originating from bicipital aponeurosis -Type B: accessory head connected to the round pronator -Type C: accessory head connected to the biceps/coracobrachial -Type D: two accessory heads (aponeurosis + pronator teres)
Long palmar (PL)	Unique	-Congenital absence -Duplication of the tendon -Multiple wombs -Atypical inserts
Flexor carpi ulnaris (FUC)	Unique	- Duplicate bands Headheads accessories -Anomalous origin -Accessory heads in 10% of members
Flexor digitorum superficialis (FSD)	Unique	- Ulnar head absent
Accessory belly of the flexor pollicis longus (VAFLP)	It didn't exist	-Recent report

CONCLUSION

The literature review of the present study demonstrated that the musculature that originates from the medial epicondyle of the humerus is of complex architecture and still difficult to understand in its entirety.

Through the analysis of articles from the last five years, we concluded that the muscles that have their origin there may present anatomical variations from 2.5% to 68% in muscle and/or tendon structure.

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