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ANATOMICAL ANALYSIS OF GANTZER'S MUSCLE AND ITS POTENTIAL NEUROPATHIC CONSEQUENCES: A CASE REPORT

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ARTIGO ORIGINAL

RESUMO

Contexto: O compartimento flexor do antebraço é propenso a variações anatômicas, incluindo o músculo de Gantzer (MG) — uma cabeça acessória do músculo flexor longo do polegar (AHFPL). O MG é um músculo inconstante inervado pelo nervo interósseo anterior (NIA), exibindo uma prevalência amplamente variável (0,5-89%). Ele frequentemente se origina do epicôndilo medial do úmero ou do processo coronoide da ulna, inserindo-se muitas vezes no tendão do flexor longo do polegar. O conhecimento detalhado do MG é vital devido ao seu potencial de compressão nervosa, que pode levar à neuropatia do NIA ou à Síndrome de Kiloh-Nevin, clinicamente manifestada pela incapacidade de formar o "Sinal do Spinner". **Objetivo:** Este estudo teve como objetivo relatar a ocorrência de um músculo de Gantzer (AHFPL), descrevendo sua morfologia e morfometria em um caso específico. **Relato de Caso:** Durante uma dissecção de rotina do antebraço esquerdo de um cadáver masculino de 65 anos, foi identificado um MG com origem no epicôndilo medial do úmero e na face lateral das fibras do músculo flexor superficial dos dedos. Apresentava uma porção triangular inicial e um ventre muscular fusiforme (63,57 mm de comprimento, 10,61 mm de largura), inserindo-se no tendão do flexor longo do polegar por meio de uma lâmina tendínea retangular (29,80 mm de comprimento, 3,47 mm de largura). Suas dimensões, especialmente a largura do ventre e o comprimento do tendão distal, foram maiores que os valores médios relatados na literatura. **Conclusão:** O conhecimento aprofundado da morfometria, morfologia e relações topográficas do MG é crucial para a prática clínica e cirúrgica. Tal compreensão permite antecipar complicações, otimizar procedimentos (como fasciotomias) e aprimorar o diagnóstico diferencial de dores inespecíficas na mão e disfunções neuromusculares, garantindo assim uma abordagem diagnóstica e terapêutica mais segura e precisa.

Palavras-chave: Variação Anatômica; Flexor longo do polegar; Nervo interósseo anterior; Síndromes de compressão nervosa; Flexor superficial dos dedos; Músculo de Gantzer; Cabeça acessória do flexor longo do polegar.

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ABSTRACT

Context: The flexor compartment of the forearm is prone to anatomical variations, including Gantzer's muscle (GM) — an accessory head of the flexor pollicis longus (AHFPL). GM is an inconstant muscle innervated by the anterior interosseous nerve (AIN), exhibiting a widely varying prevalence (0.5-89%). It frequently originates from the medial epicondyle of the humerus or the coronoid process of the ulna, often inserting into the flexor pollicis longus tendon. Detailed knowledge of GM is vital due to its potential for nerve compression, which can lead to AIN neuropathy or Kiloh-Nevin Syndrome, clinically manifested by the inability to form the "Spinner's Sign." **Objective:** This study aimed to report the occurrence of a Gantzer's muscle (AHFPL), describing its morphology and morphometry in a specific case. **Case Report:** During a routine dissection of the left forearm of a 65-year-old male cadaver, a GM was identified originating from the medial epicondyle of the humerus and the lateral aspect of the flexor digitorum superficialis fibers. It presented with an initial triangular portion and a fusiform muscle belly (63.57 mm in length, 10.61 mm in width), inserting into the flexor pollicis longus tendon via a rectangular tendinous slip (29.80 mm in length, 3.47 mm in width). Its dimensions, especially the width of the belly and the length of the distal tendon, were greater than the average values reported in the literature. **Conclusion:** In-depth knowledge of GM morphometry, morphology, and topographic relationships is crucial for clinical and surgical practice. Such understanding allows for anticipating complications, optimizing procedures (such as fasciotomies), and improving the differential diagnosis of nonspecific hand pain and neuromuscular dysfunctions, thereby ensuring a safer and more precise diagnostic and therapeutic approach.

Keywords: Anatomical Variation; Flexor pollicis longus; Anterior interosseous nerve; Nerve compression syndromes,; Flexor digitorum superficialis; Gantzer's muscle; Accessory head of flexor pollicis longus.

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Introduction

The flexor compartment of the forearm is composed of muscles organized into two layers: a superficial one and a deep one. The muscles of the deep layer are primarily innervated by the anterior interosseous nerve (AIN), a motor branch of the median nerve (MN), and are frequently the site of various anatomical variations (GUNNAL et al., 2013; HAFEZ, 2017; ANKOLEKAR et al., 2021).

Among the muscular variations occurring in the deep layer of the forearm, the accessory head of the flexor pollicis longus (AHFPL), also known as Gantzer's muscle (GM), is particularly noteworthy. Although this structure was mentioned in the 18th century by Albinus, its detailed description is attributed to Karl Friedrich Gantzer in 1813 (HAFEZ, 2017; SHARMA et al., 2024; TORUN et al., 2022; ASGHAR et al., 2022; OLIVEIRA et al., 2022; CAETANO et al., 2015).

GM is an inconstant muscle found in the deep anterior compartment of the forearm (ARAGÃO et al., 2021; AFROZE et al., 2020). Its origin can vary: from the coronoid process of the ulna (24%-25.8%), from the medial epicondyle of the humerus (37%-43.6%), or, more rarely, from the muscular sheath of the flexor digitorum superficialis (FDS) (0.7%-15%) (ROY et al., 2015; HAFEZ, 2017; ASGHAR et al., 2022). The insertion of the GM usually occurs in the flexor pollicis longus muscle (FPL) (KIDA et al., 1989; MEDLEJ et al., 2025). The incidence of GM shows wide variation in the literature, being reported between 0.5% and 89% (ROY et al., 2015; ASGHAR et al., 2022).

The present study aims to report the occurrence of an AHFPL (GM) and to describe its morphology and morphometry.

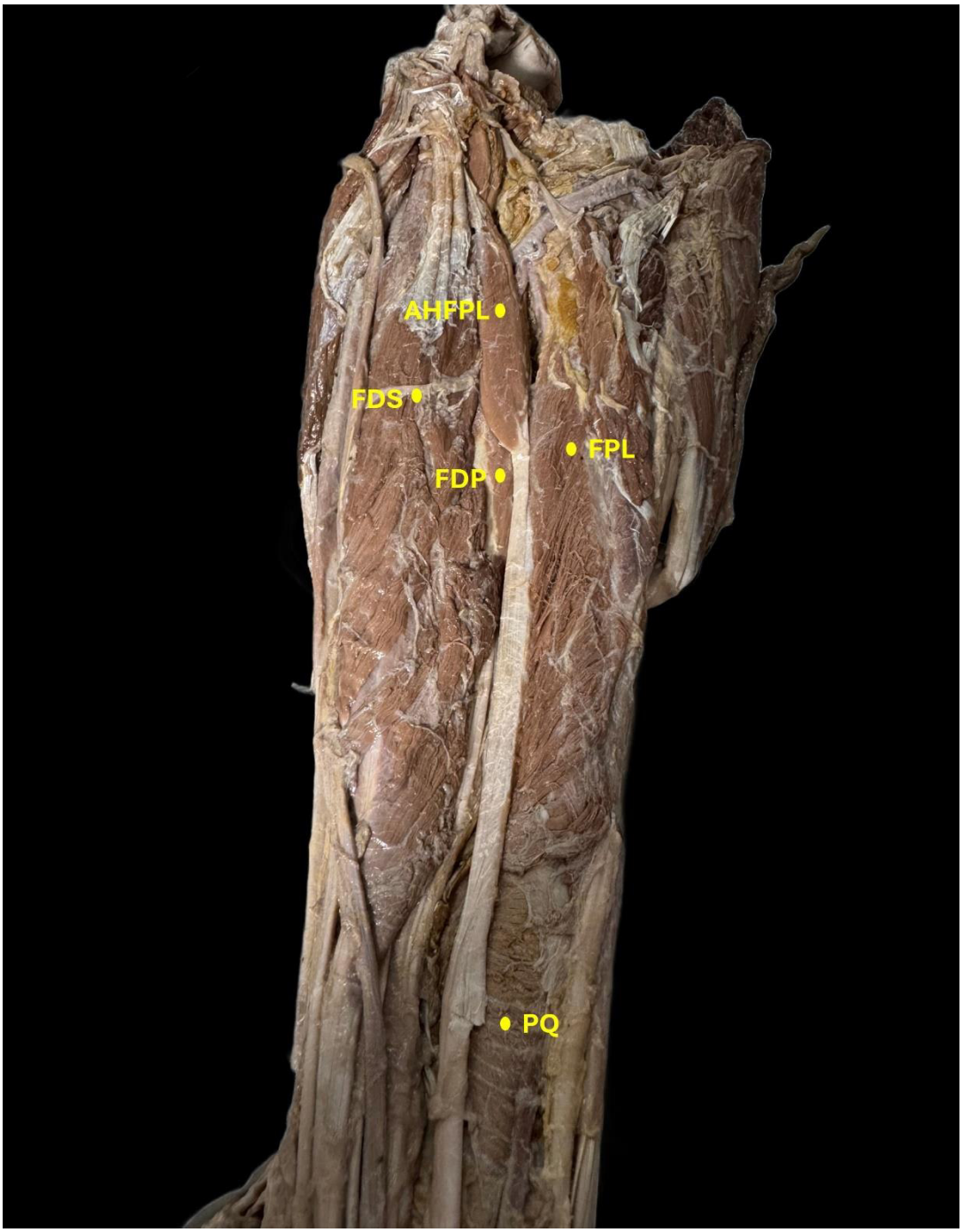
Case Report

During a routine dissection of the left forearm of an adult male cadaver, approximately 65 years of age, the flexor compartment of the forearm was explored. Following the removal and retraction of the superficial muscular planes, a supernumerary muscle was identified in the deep plane, situated between the flexor digitorum superficialis (FDS) and flexor digitorum profundus (FDP) muscles. This muscle was characterized as the AHFPL, also known as GM (**Figure** 1). It originated from the

medial epicondyle of the humerus and the lateral aspect of the flexor digitorum superficialis fibers (**Figure** 2). Its initial portion presented a triangular shape (**Figure** 2), starting narrowly and progressively widening, reaching 3.60 mm in length and 3.65 mm in maximum width. The fusiform muscle belly predominantly contained longitudinal fibers but exhibited an oblique orientation in its inferomedial third. This belly measured 63.57 mm in length and 10.61 mm in width. The muscle ran obliquely through the proximal forearm, in a superomedial to inferolateral direction, following a descending course toward the ulnar side of the flexor pollicis longus (FPL) tendo **(Figure** 1,2).

Its distal insertion, which presented a ribbon-shaped and rectangular configuration, inserted into the lateral aspect of the proximal FPL tendon, measuring 29.80 mm in length and 3.47 mm in width (**Figure** 2). From this juncture, the FPL tendon established an intimate relationship with the interosseous membrane, coursing caudally, traversing the carpal tunnel, and finally inserting into the palmar surface of the base of the distal phalanx of the thumb (**Figure** 3).

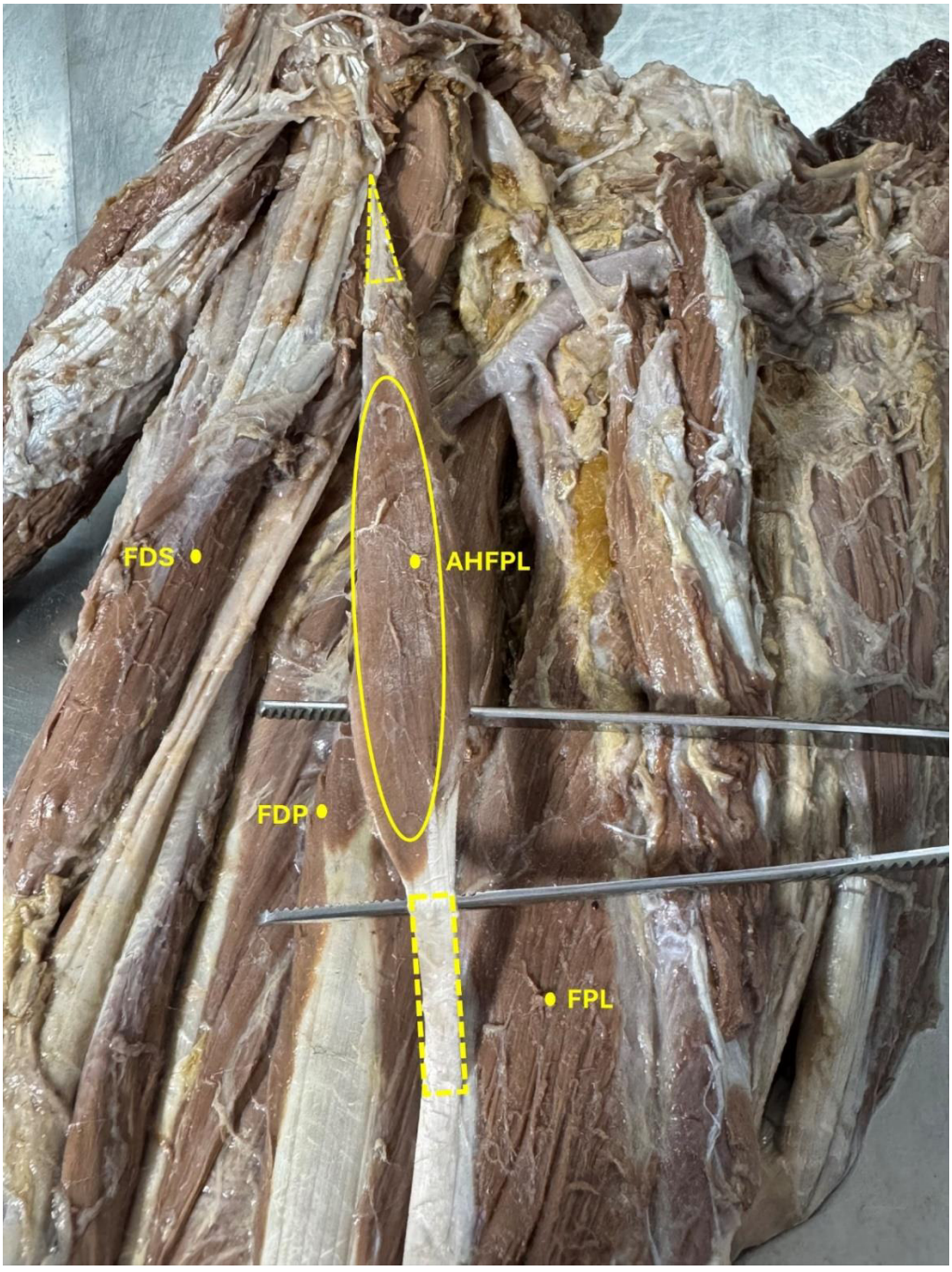
Figure 1 - Photograph showing the accessory head of the flexor pollicis longus muscle or Gantzer's muscle



Legend

AHFPL – Accessory head of the flexor pollicis longus muscle (Gantzer's muscle)**;** **FDP -** Flexor digitorum profundus muscle; **FDS -** Flexor digitorum superficialis muscle; **FPL -** Flexor pollicis longus muscle; **PQ -** Pronator quadratus muscle.

Figure 2 – Gantzer's muscle originating from the lateral aspect of the flexor digitorum superficialis muscle.



Legend

AHFPL – Accessory head of the flexor pollicis longus muscle (Gantzer's muscle); **FDP -** Flexor digitorum profundus muscle; **FDS -** Flexor digitorum superficialis muscle; **FPL -** Flexor pollicis longus muscle; **Triangle -** Proximal origin of Gantzer's muscle; **Rectangle -** Distal insertion of Gantzer's muscle.

Figure 3 – Insertion of the flexor pollicis longus muscle tendon at the base of the distal phalanx of the first digit (thumb).

Legend

AHFPL – Accessory head of the flexor pollicis longus muscle (Gantzer's muscle); **FDP** - Flexor digitorum profundus muscle; **FDS** - Flexor digitorum superficialis muscle; **FPL** - Flexor pollicis longus muscle; **PQ** - Pronator quadratus muscle; ✸ Sheath and insertion tendon of the flexor pollicis longus muscle.

Discussion

The GM represents a notable and significantly relevant anatomical variation in the deep flexor compartment of the forearm, requiring detailed understanding is crucial for clinical and surgical practice. The observation of this finding in an approximately 65-year-old male cadaver allowed for a comparative analysis of its characteristics and implications.

GM is a relatively common variation, with a reported prevalence ranging between 44.2% and 65%. This wide occurrence reinforces the importance of its recognition as a frequent anatomical feature. Regarding demographic distribution, studies indicate a higher incidence in males, with rates ranging from 24.1% to 41.1% (ROY et al., 2015; ASGHAR et al., 2022). The present case report, involving a male individual, is consistent with this observed demographic predominance in the literature.

Concerning laterality, the literature predominantly suggests a bilateral occurrence (OH et al., 2000; UYAROGLU et al., 2006; GUNNAL et al., 2013; CAETANO et al., 2015). However, BANU et al., (2024) observed a unilateral prevalence of 59.26%, demonstrating considerable variability. The current finding of GM in the left forearm corroborates the possibility of unilateral manifestation; however, the absence of contralateral limb dissection precluded the determination of its bilaterality.

For JONES et al., (1997), the explanation for the existence of such variations lies in embryogenesis, which attributes the formation of accessory muscles in the forearm to incomplete cleavage of the deep flexor mass during embryonic development. This fundamental mechanism clarifies the nature of the GM as a persistent and recurrent variation, as opposed to a sporadic anomaly.

Although comprehensive meta-analyses indicate the medial epicondyle of the humerus (43.6%) and the coronoid process of the ulna (25.8%) as the most prevalent origins of the GM (OLIVEIRA et al., 2022; BANU et al., 2024), its origin from the FDS fibers, as observed in the present study, constitutes a consistently documented variant.

The overall prevalence of the GM varies considerably in the literature. Meta-analyses report a range of 0.7% to 15% (ROY et al., 2015; ASGHAR et al., 2022), while individual studies demonstrate extreme variability, with rates that can reach 100% (FIX et al., 2024) or be as low as 2.1% (OH et al., 2000). The origin observed in our case, although not the most common, is consistent with the vast range of anatomical variations described for the MG.

Morphologically, the GM observed in the study cadaver presented an initial triangular portion and a fusiform muscle belly, with a predominance of longitudinal fibers. This fusiform morphology is the most frequently reported in the literature, corresponding to a prevalence between 72% and 83.69% of variations (ROY et al., 2015; GUNNAL et al., 2013; TORUN, BALABAN, 2022). Other described forms include the slender, triangular, and papillary (OH et al., 2000; JONES et al., 1997; ROY et al., 2015). The clinical relevance of its morphology is significant, given that the fusiform and papillary forms, by virtue of their greater volume, are associated with an increased risk of nerve compression in the proximal forearm region (OH et al., 2000; SHARMA, VERMA, 2024). This compression can lead to ANI neuropathy or, in more severe cases, Kiloh-Nevin Syndrome (MUSA et al., 2021).

The GM, strategically located in the deep plane, is situated posterior to the MN in almost 99% of cases and anterior to the ANI in 62.5% of cases (ROY et al., 2015; OH et al., 2000; CAETANO et al., 2015). This specific anatomical arrangement creates a favorable scenario for nerve entrapment, a risk that significantly intensifies when the GM exhibits increased dimensions, as evidenced in our case.

This mechanical compression, often exacerbated by GM hypertrophy, results in motor paralysis of the FPL, the radial portion of the FDP, and the pronator quadratus (PQ) (CAETANO et al., 2015; MUSA et al., 2021; TORUN, BALABAN, 2022). Clinically, this condition manifests with the characteristic Spinner's Sign, in which the patient demonstrates an inability to perform the "Ok sign" digital pinch movement, accompanied by hyperextension of the distal interphalangeal joint (GURVICH et al., 2022; MUSA et al., 2021; SAXENA et al., 2013). Compression can be complete, affecting

all muscles innervated by the ANI, or incomplete, resulting in isolated paralysis of the FPL or FDP (GUNNAL et al., 2013; ASGHAR et al., 2022).

Morphometric analysis of the present case revealed that the GM had a total length of 96.97 mm, distributed among the proximal origin (3.60 mm), the muscle belly (63.57 mm), and the distal insertion tendon (29.80 mm). In the literature, the length of the muscle belly can vary significantly, from 17.20 mm to 110.0 mm (KIDA & ISHIDA, 1989; TORUN, BALABAN, 2022), with an average of 75 mm (ROY et al., 2015; GUNNAL et al., 2013; UYAROGLU et al., 2006). In contrast, the width of the muscle belly in the literature ranges from 2.0 mm to 25 mm (HEMMADY et al., 1993; OH et al., 2000), with an average of 7 mm (GUNNAL et al., 2013; OH et al., 2000). In the present case, the width of the muscle belly was 10.61 mm, a value slightly higher than the average found by GUNNAL et al. (2013) and OH et al. (2000).

In the literature, the length of the proximal tendon varies from 2.2 mm (BARROS et al., 2022) to 30 mm (SAXENA et al., 2013), with an average of 15 mm. The distal tendon, in turn, exhibits a variation from 3.5 mm to 167 mm, with an average of 8.53 mm (UYAROGLU et al., 2006; SAXENA et al., 2013; ROY et al., 2015). In the present finding, the greater width of the muscle belly and the length of the distal insertion tendon were particularly evident. This distal tendon, characterized by its rectangular morphology, coalesces into a single fascicle on the lateral aspect of the FPL tendon and projects caudally towards the carpal tunnel. The combination of these anatomical characteristics — the greater width of the muscle belly and the morphological and trajectory peculiarities of the distal tendon — may increase the potential for interaction with and compression of adjacent neurovascular structures.

Conclusion

In-depth knowledge of GM morphometry and morphology coupled with an understanding of its topographic relationships, is of crucial importance for clinical practice. This mastery enables professionals to anticipate potential complications and optimize surgical strategies in procedures such as fasciotomies and approaches to the proximal radius. Furthermore, this knowledge is fundamental in refining the differential

diagnosis of nonspecific hand pain and neuromuscular dysfunctions, ultimately leading to a more precise and safer therapeutic and diagnostic approach for patients.

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CONFLICT OF INTERESTS

The authors declare no conflict of interests.

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