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Anatomical Study of the Gantzer's Muscle in Cadaveric Specimens

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ABSTRACT

Introduction: the Gantzer's muscle (GM) is a slender, fusiform accessory muscle located in the flexor compartment of the forearm, with an incidence of 65%. Its anatomical study is of great clinical relevance, as it may compress the median (MN) and/or anterior interosseous (AIN) nerves.

Objective: to evaluate the incidence and anatomical characteristics of the Gantzer's muscle in cadaveric specimens.

Methods: the incidence, origin, insertion, innervation, topography in relation to the MN and AIN, and length of the GM were assessed in all forearms of cadaveric specimens preserved in 4% formalin solution, pertaining to the Anatomy Laboratory collection of the Department of Morphology at UFES.

Results: a total of 27 forearms were evaluated, of which 18% (n=5) presented the Gantzer's muscle. The majority had a single origin from the deep proximal part of the flexor digitorum superficialis (FDS) muscle (n=4). However, one (n=1) forearm had an origin at the medial epicondyle of the humerus in addition to the FDS origin. In most specimens (n=3), the muscle was located posterior to the MN and anterior to the AIN. The average length was 88.54 mm. All muscles studied showed similar insertions at the tendon of the flexor pollicis longus muscle and innervation by the AIN. The incidence was predominant on the left side (n=3).

Conclusion: considering the close anatomical relationship with the MN and AIN, it is suggested that the presence of the Gantzer's muscle may cause nerve compression in the forearm, with motor manifestations in the forearm and hand, as well as sensory alterations in the hand.

Keywords: Gantzer's muscle; Median nerve; Anterior interosseous nerve, Forearm.

Introduction

There are reports that Gantzer's muscle was first described by the German anatomist Bernhard Siegfried Albinus in the 18th century. In 1734, Albinus published a work entitled Historiae Musculorum Hominis, in which he described this muscle as an anatomical variation associated with the flexor pollicis longus muscle[1-3]. However, it was the German anatomist Carol F. L. Gantzer who, in 1813, provided a detailed anatomical description of this muscle in his work Dissertation on the Anatomical Variations of the Muscular, originally naming it the "accessory deep flexor muscle of the fingers" (flexor digitorum structure profundus accessory), which was later referred to eponymously as Gantzer's muscle[4].

Gantzer's muscle is an accessory, typically fusiform muscle located in the flexor compartment of the forearm and is considered an anatomical variation[4]. It has an incidence of 65% and is bilateral in most cases5,6. Its origin may vary, arising from the medial epicondyle of the humerus via the common flexor tendon, the coronoid process of the ulna, the proximal deep portion of the flexor digitorum superficialis muscle (FDS), the pronator teres muscle (PT), or the antebrachial fascia5,7. A combination of two or more origins may also occur7. Its insertion site is relatively consistent, usually attaching via a slender tendon or by merging directly with the tendon of the flexor pollicis longus muscle (FPL) or the flexor digitorum profundus muscle (FDP)[5,8,9]. Neural supply is provided by the anterior interosseous nerve (AIN) or the median nerve (MN)[6,8].

The anatomical study of Gantzer's muscle has significant clinical relevance, as it may compress the anterior interosseous nerve, leading to a rare condition known as anterior interosseous nerve syndrome[10], also referred to as Kiloh-Nevin syndrome[11]. This condition is characterized by diffuse pain in the anterior forearm and muscle weakness in the flexion of the first and second digits of the hand. Additionally, Gantzer's muscle may contribute to median nerve compression, resulting in motor impairments of the thenar compartment of the hand and sensory alterations in the lateral portion of the hand[12,13]. Therefore, surgical approaches in the flexor compartment of the forearm aims to nerve decompression due to Gantzer's

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muscle may be required as a treatment strategy[10,11]. Understanding the incidence and anatomical characteristics of Gantzer's muscle is thus essential for clinical and surgical considerations.

The aim of the present study was to evaluate the incidence and anatomical characteristics of Gantzer's muscle in cadaveric specimens from an Anatomy Laboratory.

Methods

The anterior part of 37 forearms from cadaveric specimens preserved in 4% formalin solution, pertaining to the Anatomy Laboratory collection of the Department of Morphology at UFES, was analyzed.

Cadaveric specimens where the skin, subcutaneous tissue, and fascia of the anterior compartment of the forearm were reflected, allowing the identification of all muscles in this compartment, were included in the study (n=27). Specimens with damage to the muscles and nerves of this region were excluded from the study (n=10).

After visual identification of the Gantzer muscle, the following anatomical characteristics of this structure were evaluated: origin, insertion, innervation, topography relative to the median nerve and anterior interosseous nerve, and length. The length was measured using a digital caliper (Mtx, model 316119).

Results

A total of 27 forearms were evaluated, of which 18% (n=5) presented the Gantzer's muscle, with a higher incidence on the left side (n=3). The average length of the muscles measured was 88.54 mm.

Most specimens had a single origin from the deep proximal part of the flexor digitorum superficialis muscle (n=4; Figures 1-2, 4-5). However, one (n=1) forearm exhibited an origin at the medial epicondyle of the humerus in addition to the origin at the flexor digitorum superficialis muscle (Figure 3). All analyzed muscles showed similar insertions at the tendon of the flexor pollicis longus muscle (Figures 1-5).

In 60% (n=3) of the analyzed sample, the median nerve passed anterior to the Gantzer's muscle, while the anterior interosseous nerve passed posteriorly. In 40% (n=2) of the sample, the median nerve passed posterior to the Gantzer's muscle, while the anterior interosseous nerve passed anteriorly (Figures 1-5).

In all specimens, the Gantzer's muscle was innervated by the anterior interosseous nerve.

Figure 1. Anterior region of the forearm 1: Gantzer's muscle (yellow arrow) located anterior to the anterior interosseous nerve (blue arrow), originating from the deep part of the flexor digitorum superficialis muscle (orange arrow) and inserting into the flexor pollicis longus muscle (green arrow).

Figure 2. Anterior region of the forearm 2: Gantzer's muscle (yellow arrow) anterior to the anterior interosseous nerve (blue arrow), originating from the deep part of the flexor digitorum superficialis muscle (orange arrow) and inserting into the flexor pollicis longus muscle (green arrow).

Figure 3. Anterior region of the forearm 3: Gantzer's muscle (yellow arrow) anterior to the anterior interosseous nerve (blue arrow), originating from the deep part of the flexor digitorum superficialis muscle (orange arrow) and the medial epicondyle of the humerus (not shown in the image), inserting into the flexor pollicis longus muscle (green arrow).

Figure 4. Anterior region of the forearm 3: Gantzer's muscle (yellow arrow) posterior to the anterior interosseous nerve (blue arrow), originating from the deep part of the flexor digitorum superficialis muscle, which has been retracted (orange arrow), and inserting into the flexor pollicis longus muscle (green arrow).

Discussion

Our results showed the presence of the Gantzer's muscle in only 18% of our sample; however, the literature reports much higher incidences, such as those by Oliveira *et al*. (2022) with 50%, Fix *et al*. (2024) with 62%, and Caetano *et al*. (2015) with 68%, confirming that the presence of this muscle is quite common, classifying it as an accessory muscle rather than an inconsistent one[14,15,6].

The analysis of the origin of the Gantzer's muscle in the literature shows a predominant origin along with the flexor digitorum superficialis muscle[7,8]. Which aligns with our findings, where 80% originated from this same muscle. Regarding insertion, it is observed in most studies along with the flexor pollicis longus muscle, which agrees with 100% of our sample[16,7].

The median nerve's primary branch in the forearm is the anterior interosseous nerve, which arises at the distal part of the cubital fossa and is responsible for innervating the flexor digitorum profundus, flexor pollicis longus, and pronator quadratus muscles[17].

Median nerve neuropathies originating in the forearm are common, and identifying the source of nerve compression is the first step for appropriate treatment[18]. In the present study, the median nerve was found posterior to the Gantzer muscle in two specimens. Thus, this muscle forms a "muscular bridge" that could lead to compression of the median nerve, resulting in clinical manifestations such as motor alterations in hand flexion, pain in the anterior forearm region, and sensory disturbances in the hand due to involvement of the palmar cutaneous branch of the median nerve[18].

Although less common, the anterior interosseous branch of the median nerve may be compressed in the forearm, causing anterior cutaneous nerve syndrome, as mentioned earlier[10,19]. In this investigation, most of the specimens studied had the Gantzer's muscle located anterior to the anterior cutaneous nerve (figures 1-3), which may predispose to compression of the anterior cutaneous nerve both at rest and during muscle contraction. In such cases, motor neuropathy may occur, characterized by diffuse pain in the anterior forearm and weakness of the flexor digitorum profundus, flexor pollicis longus, and pronator quadratus muscles.

It is important to note that both anterior cutaneous nerve syndrome and median nerve neuropathy caused by the Gantzer's muscle can be confused with pronator teres syndrome. However, this syndrome occurs due to median nerve compression by the pronator teres muscle, as the nerve passes between the heads of this muscle when entering the cubital fossa[12]. Although clinical symptoms are similar, differential diagnosis is crucial since treatment varies depending on the anatomical structure causing neuropathy[20].

Despite topographical differences between the Gantzer's muscle and the median and anterior interosseous nerves in the forearms evaluated in this study, all specimens exhibited innervation by the anterior cutaneous nerve, which corroborates the findings of most [21,6,8,16].

Regarding form, all specimens showed the Gantzer's muscle with a fusiform form, consistent with most previous studies[15,16]. Although less common, slender, triangular, and strap-like (arc) forms can also be observed[21,22,8,9].

Limitations of the Study

In our study, it was not possible to establish a relationship between the presence of the Gantzer's muscle and sex since we analyzed disarticulated limbs, but all of our cases were observed on the left side. We noted that the correlation with sex was also a challenge for many other studies, but bilaterality was described in 88.3% of the samples by Oliveira *et al*.[14], and in the study by Fix *et al*.[15], 50% were bilateral, with a higher prevalence in females (76.4%).

We used a digital caliper, which provided an average length of 88.54 mm between the muscles analyzed. Although we used the first visible portion of the muscle at its proximal end and the last visible portion at its distal end as reference points, evaluating muscle length with the digital caliper provides a benchmark for average size, but we observed that there may not be high accuracy with this method of measurement. Fix and colleagues also used a digital caliper; however, they measured the tendons of the Gantzer's muscles[15].

Conclusion

Considering the close anatomical relationship with the median nerve and anterior cutaneous nerve, it is suggested that the Gantzer's muscle (GM) may cause nerve compression in the forearm, with motor manifestations in the forearm and hand, as well as sensory alterations in the hand. Therefore, for the adoption of appropriate treatment, clinical evaluation of nerve-related manifestations in the forearm and hand must consider the possibility of involvement of the Gantzer's muscle.

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Mini Curriculum and Author's Contribution

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