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Morphological study of the anatomical variations of anterior belly of digastric muscle in Brazilian cadavers

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ABSTRACT

Background: Cases of variations in anterior belly of the digastric muscle must be carefully identified to avoid misinterpretations and assist in the correct surgical or aesthetic procedure and help in the teaching of Anatomy. The aim of this study was to describe the anatomical variations of anterior belly of digastric muscle in Brazilian cadavers.

Materials and methods: Thirty-one human heads were selected, from adult cadavers (18 to 80 years, 29 males and 2 females). The morphology of the anterior belly of the digastric muscle was observed, identifying the possible anatomical variations that were characterized and classified according to the amount of muscle bellies, fiber direction and place of origin and insertion. The morphometric measurements were performed using a digital caliper. To analyze the data obtained, photographic documentation,

anatomical description and individual morphometric description of each muscle belly were performed. The incidence of anatomical variation was obtained in percentage (%).
Results: The anatomical variation of the anterior belly of the digastric muscle was present in 6 cadavers (19.31%; 1 female and 5 male). All anatomical variations presented an accessory belly to the anterior belly. However, these accessory bellies were configured differently in the location, direction of muscle fibers and in their dimensions (length and width).
Conclusions: The gross anatomy of the anterior belly of the DM and their variations is important to assist in surgical procedures, pathological or diagnostic function. In addition, asymmetrical variations in the submental region must be carefully identified to avoid misinterpretations.
Key words: anatomy, digastric muscle, anatomical variations, morphology

INTRODUCTION

The digastric muscle (DM) is in the submental region and is a muscle that has two bellies, called the anterior belly and the posterior belly, separated by an intermediate tendon, which forms an anchorage in the hyoid bone. Its origin is characterized by the attachment of the posterior belly to the mastoid notch, at the base of the skull, and its insertion is in the digastric fossa, at the base of the mandible in the chin region. Because they have different embryological origins, their bellies have different innervation and vascularization, and the anterior belly is innervated by the mylohyoid nerve, a branch of the mandibular nerve. The submental artery and vein, branches of the facial artery and vein, are responsible for its vascularization [2]. The anterior belly lies superficial to the mylohyoid muscle [6] and its function is to elevate the hyoid bone when the infrahyoid muscles are relaxed and to lower the mandible when the hyoid bone is fixed [13].

The DM shows great variability in size, shape, and number. These variations mainly involve the anterior belly of the muscle and the number of anterior bellies or the presence of accessory bundles originating from a common tendon or the intermediate tendon [4, 9]. The anterior belly variations can be unilateral or bilateral and more rarely

being symmetrical, extending to the mandible or the mylohyoid muscle or even crossing the midline to the opposite mylohyoid or the opposite digastric fossa [3].

DM variability is of paramount importance during mobilization of the platysma myocutaneous flap in reconstructive procedures [15]. In-depth knowledge of the typical and variable anatomy of the anterior bellies is of paramount importance due to muscle use after facial nerve paralysis and submental artery flap procedures [16]. In addition, the anterior belly is used as a reference point when identifying the lingual nerve or submandibular gland duct [12].

The submental and submandibular areas are very well vascularized, and knowledge of their muscle abnormalities is essential when a myocutaneous flap is mobilized in reconstructive plastic surgery. Vascular variations can coexist and, to maintain and increase the viability of the flap, the branching pattern of the vessels must be well preserved intraoperatively [10]. Thus, cases of variations in this region must be carefully identified to avoid misinterpretations and assist in the correct surgical or aesthetic procedure and help in the teaching of Anatomy.

The aim of this study was to describe the anatomical variations of anterior belly of DM in Brazilian cadavers.

MATERIALS AND METHODS

Ethics approval

The research was analyzed and approved by the Committee of Research Ethics of the University of Campinas (Protocol number CEP-FOP-UNICAMP-CAAE 59065622.6.0000.5418).

Sample

Thirty-one human heads were selected, embedded cadaver, belonging to the Laboratory of Anatomy of the Piracicaba Dental School from University of Campinas (FOP-UNICAMP). The heads were from adult cadavers, selected at random ranging in age from 18 to 80 years and of both sexes (29 males and 2 females).

The inclusion criteria were that cadaveric specimens from adult individuals were used, showing the preservation of anatomical structures in the submental region, especially the suprahyoid muscles, among which the DM is included. The exclusion

criteria were that cadaveric specimens that do not show the preservation of the suprahyoid muscles in the submental region, or that present any pathology that have the presence of a foreign body in the submental region, interfering with the anatomy of the suprahyoid muscles, were excluded.

Calibration

Initially, an anatomical study of the submental region was performed to identify the anatomy of the suprahyoid muscles and adjacent anatomical structures. After this study, the examiner identified the anterior belly of the DM and calibrated the measurements to be performed using a digital caliper (Mituyo®).

Evaluation of the morphology and the morphometry of the anterior belly of the DM

The morphology of the anterior belly of the DM was observed, identifying the possible anatomical variations that were characterized and classified according to the amount of muscle bellies, fiber direction and place of origin and insertion.

The morphometric measurements were performed using a digital caliper (Mituyo®), in which the measurements of the width (mm) and length (mm) of the anterior belly were obtained to add to the morphological descriptions.

Data analysis

To analyze the data obtained, photographic documentation, anatomical description and individual morphometric description of each muscle belly were performed. The incidence of anatomical variation was obtained in percentage (%).

RESULTS

Of the 31 cadavers evaluated, the anatomical variation of the anterior belly of the DM was present in 6 (19.31%; 1 female and 5 male). All anatomical variations presented an accessory belly to the anterior belly of the DM. However, these accessory bellies were configured differently in the location, direction of muscle fibers and in their dimensions (length and width). Anatomical variations are described below. The occurrence of each type can be seen in Figure 1.

In Figure 1, A and B show an anatomical variation of the anterior belly of the DM with the appearance of a unilateral accessory minor belly, in which its muscle fibers originate from the intermediate tendon of the DM and are obliquely directed to insert into the mylohyoid muscle raphe together with mylohyoid muscle fibers. In the total of variations found, 3 heads presented this configuration. In the heads that were found in this configuration, the accessory belly (1a) on the left side (figure 1A) had a length equal to 26.36 mm and a width equal to 6 mm. As for the main bellies, the DM anterior belly on the right side had a length of 52.62 mm and a width of 16.22 mm. And the DM anterior belly on the left side had a length equal to 54.27 mm and width equal to 20.94 mm. In figure 1-B, the accessory belly (1a) was located on the right side, with a length equal to 26.70 mm and width equal to 12.47 mm. As for the main bellies, the DM anterior belly on the right side had a length equal to 43.43 mm and a width equal to 11.42 mm. And the DM anterior belly on the left side had a length equal to 33.35 mm and width equal to 15.08 mm.

In figure 1C, a more complex configuration can be seen, in which the variation occurred bilaterally. The accessory bellies in this configuration originate in the intermediate tendon of the DM and their fibers are directed obliquely across the midsagittal plane until they reach their point of insertion at the base of the mandible on the opposite side in an extension of the digastric fossa. Both accessory bellies are superficial in relation to the mylohyoid muscle. The accessory belly 1a has a length equal to 48.16 mm and a width equal to 12.54 mm. And the accessory belly 1b has a length equal to 39.16 mm and a width equal to 8.63 mm. As for the main bellies, the DM anterior belly on the right side had a length equal to 40.23 mm and a width equal to 14.26 mm. And the DM anterior belly on the left side had a length equal to 41.16 mm and width equal to 16.11 mm.

In figure 1D, the variation was presented with the presence of accessory bellies on the right and left sides. Muscle fibers originate from the intermediate tendon of the DM and insert into the extension of the digastric fossa ipsilaterally. However, a small number of fibers can be observed originating from the intermediate tendon on the opposite side, crossing the midline in a similar way to that found in item C of Figure 1. The accessory bellies are found superficially to the mylohyoid muscle. The accessory belly 1a is 26.53 mm (length) and 6.92 mm (width). And the accessory belly 1b has a

length equal to 23.49 mm and a width equal to 4.99 mm. As for the main bellies, the DM anterior belly on the right side had a length equal to 30.17 mm and a width equal to 11.58 mm. And the DM anterior belly on the left side had a length equal to 35.68 mm and a width equal to 8.96 mm.

Considering the variations found, the configuration found in item E of figure 1 was the most complex. In this situation, the variation appeared bilaterally, with different accessory bellies on each side. In addition, the main anterior belly on the left side also showed an anatomical variation.

On the left side, the main anterior belly originates from the intermediate tendon, but its fibers are directed obliquely to insert into the base of the mandible, right in the midsagittal plane. In addition, part of its fibers has insertion in the mylohyoid muscle raphe. The accessory belly on the left, at its origin, presents fibers together with the main anterior belly. However, when approaching the midsagittal plane, the group of fibers separates to insert into the mylohyoid muscle raphe. Thus, the accessory belly on the left is located posterior to the main anterior belly. On the right side, the main anterior belly did not show variation as on the left side. The accessory belly presented a different configuration from the other variations that were found. Its fibers originate in the intermediate tendon and are directed anteriorly to insert into the digastric fossa together with the main anterior belly. This accessory belly is located laterally in relation to the main anterior belly and is separated from it by a fascia. It is also observed that at its insertion, the accessory belly on this side presented a longer tendon in relation to the main anterior belly.

In item E of figure 1, the anterior belly 1a had a length equal to 24.79 mm and width equal to 12.94 mm. And the anterior belly 1b had a length equal to 33.03mm and width equal to 12.94mm. As for the main bellies, the DM anterior belly on the right side (blue) had a length equal to 34.02 mm and a width equal to 14.13 mm. And the MD anterior belly on the left side (red) had a length equal to 40.94 mm and width equal to 12.20 mm.

DISCUSSION

DM variability is of paramount importance during mobilization of the platysma myocutaneous flap in reconstructive procedures [15]. In-depth knowledge of the typical

and variable anatomy of the anterior bellies is of paramount importance due to muscle use after facial nerve paralysis and submental artery flap procedures [16]. In addition, the anterior belly is used as a reference point when identifying the lingual nerve or submandibular gland duct [12].

The knowledge of the anatomical variations of the anterior belly of the DM is also necessary for professionals who perform conservative and surgical treatments in the submental region, as well as in teaching the anatomy of this structure. Therefore, knowing the anatomical variations can facilitate diagnosis and prevent possible complications during surgical procedures [13].

The variations may also be responsible for esthetic alterations in the submental region. For example, a bulky anterior belly of the digastric muscle can contribute to an unsightly contour of the neck by giving a bulge in the submental area. By removing a good portion of the anterior belly muscle (i.e., making the anterior belly thinner), the bulge in the submental area can be minimized, thus giving the patient a better contour of the neck [5].

Regarding the variations found, ethnicity as the most frequent factor in the occurrence of these variations. Literary data show a higher prevalence of these variations in the Asian population, especially the Japanese. While in the general population a rate of 31.4% was found, in the Asian population the rate was 51.7% for the occurrence of anatomical variation of the DM [1].

Another factor responsible for variations, such as bilateral duplication of the anterior belly, may be the embryological origin, which is explained by a deficiency in the differentiation of the mesoderm of the first pharyngeal arch on both sides or by abnormal migration of the cells of the pharyngeal arch neural crest. In relation to the crossing of muscle fibers in the midline, it may be due to the proximity of the pharyngeal arches [8].

The DM is an important muscle in the neck, which pulls the mandible down to open the mouth and elevates the hyoid bone for stabilization during swallowing and is also involved in chewing and speaking. In the functional aspect, the changes may affect some DM functions. For example, in crossed anterior bellies, the difficulty of opening the mouth is suggestive. Probably, the crossing of the bellies makes it difficult for the mandible to be moved downwards.

In the supernumerary bundles, due to their proximity to the anterior belly of the digastric and mylohyoid muscles, additional force is likely to be provided to these muscles during mastication [14]. In the case of the additional belly or unilateral accessory, an imbalance can occur when elevating the hyoid bone or lowering the mandible [11]. These unilateral or bilateral muscle bundles or slips may occur because of a phylogenetic reduction of the DM or an unusual development of ontogenetic material [3].

Notably, knowing the variations found, clinicians and surgeons can make use of and must be very careful in interpreting radiographs and CT scans, as the variations may appear like soft tissue masses, especially in the unilateral type [13].

CONCLUSIONS

The gross anatomy of the anterior belly of the DM and their variations is important to assist in surgical procedures, pathological or diagnostic function. In addition, asymmetrical variations in the submental region must be carefully identified to avoid misinterpretations.

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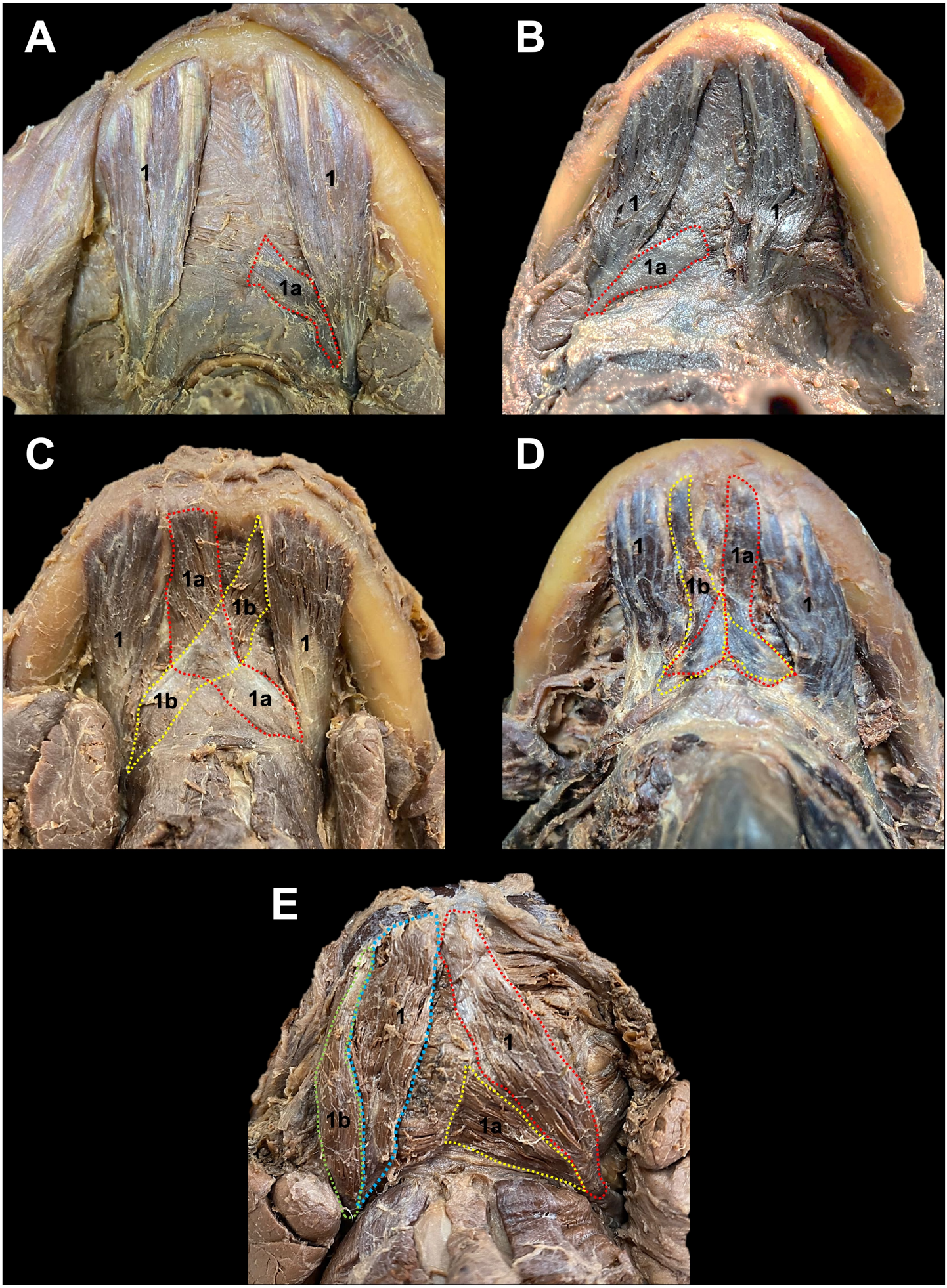
Figure 1. Photographs of the submental region with emphasis on the location of the anatomical variation of the anterior bellies of digastric muscle. Different colors delimit the belly area. 1: main anterior belly. Lowercase letters: accessory bellies.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