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Study of Digastric Muscle in Brazilian Individuals

Estudio del Músculo Digástrico en Individuos Brasileños

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SUMMARY: Correct detailed description of the anatomy of the digastric muscle (DM) in different populations should be carried out to improve the teaching of anatomy, avoid misinterpretations and help to avoid intercurrences during surgical procedures in the region. The aim of this study was to carry out a study of the DM in adult Brazilian individuals. The sample consisted of 50 DM from adult individuals (22 right side and 28 left side) fixed in 10 % formaldehyde. The morphology of the DM was observed, identifying possible anatomical variations; these were characterized and classified according to the number of the muscle bellies, direction of the fibre, and points of origin and insertion. The morphometric measurements were performed using a digital calliper. Student's t-test for dependent samples was used to measure differences between sides; one-way ANOVA was used to analyse the different classifications, and the chi-squared test to analyse qualitative variables, with significance threshold of 5 %. The anterior belly of the DM was classified as Type I in 28 samples (56 %), Type II in 20 (40 %) and Type III in 2 (4 %). The mean length was 37.8 mm, width 12.1 mm and thickness 5.39 mm, with no statistically significant differences found for these variables. The intermediate tendon of the DM was classified as Type I in 31 samples (62 %), Type II in 10 (20 %) and Type III in 9 (18 %); its mean total length was 45.1 mm. The posterior belly of the DM was Type I in 50 samples (100 %), with mean length 70.8 mm and width 8.15 mm. Anatomical variations of the DM, particularly its anterior belly, in Brazilian adults are very frequent. They must therefore be carefully identified to help avoid intercurrences during surgical procedures in the region, and to help correct evaluation of swollen lymph nodes in the submental triangle.

KEY WORDS: Anatomy; Anatomical variations; Digastric muscle.

INTRODUCTION

The digastric muscle (DM) is located in the suprahyoid region; it normally has two bellies, anterior and posterior, separated by an intermediate tendon which is attached to the hyoid bone through a fibrous sheath. The muscle originates in the mastoid notch of the temporal bone and inserts into the digastric fossa of the mandible (Alves & Cândido, 2016).

The DM has been cited as an interesting option for performing a flap for the resuscitation of lower lip depression (Conley *et al*., 1982). Some authors have proposed the use of the anterior belly of the DM for the reanimation of the depressor labii inferioris muscle in cases of facial paralysis resulting from the permanent loss of the marginal nerve of the mandible (Conley *et al*., 1982; Tulley *et al*., 2000; Tan, 2002).

Anatomical variations of the DM, especially of its anterior belly, have long been reported in the scientific literature. The DM shows great variability in size, shape, and number of bellies, with most variations involving the anterior belly (Celik *et al*., 2002; Mangalagiri & Razvi, 2009). Knowledge of the anatomy of the digastric muscle and its possible anatomical variations is fundamental for correct performance of surgical procedures in the suprahyoid region (Alves & Cândido, 2016).

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Knowledge of the common patterns of anatomical variations of the anterior belly of the DM (ABDM) is fundamental in carrying out any surgical intervention or physical exploration of the submental region. As these variations are not infrequently encountered, anatomists and doctors/radiologists must familiarize themselves with them for the purposes of complete, detailed teaching, to avoid iatrogenic lesions of intimately related structures, and erroneous diagnoses of tumours in the neck region. The aim of this study was therefore to carry out a study of the DM in adult Brazilian individuals.

MATERIAL AND METHOD

The sample consisted of 50 DM from adult individuals (22 right side and 28 left side) fixed in 10 % formaldehyde, belonging to the Laboratory of Human Anatomy of the Institute of Biological Sciences and Health of Universidad Federal de Alagoas, Brazil. Macroscopic analysis of the DM was performed by making an incision in the skin at the base of the mandible as far as the mastoid process and removing the subcutaneous tissue to expose the platysma muscle. Once this muscle had been displaced and the superficial layer of the cervical fascia removed, we could observe the ABDM and the sternocleidomastoid muscle. Excision of the insertion in the mastoid process exposed the posterior belly of the DM (PBDM). All the contents of the submandibular and submental triangles were removed to determine the Type of ABDM, PBDM and intermediate tendon of the DM (ITDM). The types of variations observed were classified using the system described by De-Ary-Pires *et al*. (2003). According to these authors, there are five possible types of ABDM: Type I – one belly originating in the inferior margin of the mandible near the symphysis; Type II – two bellies with additional slips connected to the mandible or to the mylohyoid ipsi muscle, and/or contralaterally; Type III – three bellies with extra slips connected to either the mandible or to the mylohyoid ipsi muscle, and/or contralaterally; Type IV – four bellies with additional slips connected to the mandible or to the mylohyoid ipsi muscle, and/or contralaterally; Type V – the geniohyoid muscle. The three possible Types of ITDM are: Type I – the ITDM appears to perforate the stylohyoid muscle; Type II – the ITDM is located laterally (superficial) of the stylohyoid muscle; Type III – the ITDM is located medially (deep) of the stylohyoid muscle. The two Types of PBDM are: Type I – the PBDM originates in the mastoid notch of the temporal bone; Type II – the posterior belly originates totally or partly from the styloid process and may or may not be attached by a slip either to the middle or to the inferior constrictor muscles of the pharynx. The samples were photographed with a Sony alpha-6000 camera using a Sigma 30 mm lens at F1.4. Morphometric analysis of the DM was carried out using an MTX digital calliper; the measurements were recorded in millimetres (mm) in a Microsoft Office Excel spreadsheet. The length, width and thickness of the ABDM, PBDM and ITDM were measured. To determine the total length of the intermediate tendon, the following measurements were added together: 1) the distance from its appearance in the posterior belly of the digastric muscle (PBDM) to its insertion in the hyoid bone (Distance IJ), and 2) from its presence in the hyoid bone to the anterior margin visible in the ABDM (Distance JK).

Statistical analysis. Descriptive analysis of the data was carried out to determine the means and standard deviations (SD). The data were analysed for normality using the Shapiro-Wilk test and normality graphs. The differences between sides were evaluated using Student's t-test for dependent samples. One-way ANOVA was used to analyse the different classifications, with the Bonferroni post-test. The Chi-squared test was used for the qualitative variables, with the Bonferroni adjustment. The software used for constructing the graphs was GraphPad Prism for Mac, version 9.5.1. The SPSS v.28.0 software was used, with a significance threshold of 5 %.

RESULTS

Anterior belly. For the anterior belly of the digastric muscle (ABDM), 28 samples were classified as Type I, 20 Type II and 2 Type III. Types IV and V were not identified in any case. The mean length of the ABDM was 37.8 mm (SD=5.37 mm), mean width 12.1 mm (SD=2.7 mm) and mean thickness 5.39 mm (SD=1.47 mm). No statistical differences were found between sides for length (p=0.455), width (p=0.586) or thickness (0.733) of the ABDM.

The width of Type III was significantly greater than that of Type II (p<.001) and of Type I (p<.001). No statistical differences were found for length (p=0.161) or thickness (p=0.631) between Types I, II or III (Fig. 1).

Intermediate tendon. In 62 % (n=31) of the cases, the ITDM was Type I, in 20 % (n=10) Type II and in 18 % (n=9) Type III. The mean IJ distance was 34.5 mm (SD=8.5 mm), mean JK 10.5 mm (SD=3.6 mm) and mean total length of the ITDM 45.1 mm (SD=9.4 mm). No statistical differences were found between sides for IJ (p=0.741), JK (p=0.841) or total length of the ITDM (p= 0.733). No statistically significant differences were found for IJ, JK or total length of the ITDM between Types I, II or III (Fig. 2).

Posterior belly. For the posterior belly of the digastric muscle (PBDM), only Type I was found, i.e. with insertion in the mastoid notch of the temporal bone. No sample was found with an accessory belly. The mean length of the PBDM was 70.8 mm (SD=7.85 mm) and mean width 8.15 mm (SD=2.37 mm). No statistical differences were found between sides for length (p=0.432) or width (p= 0.163) of the PBDM.

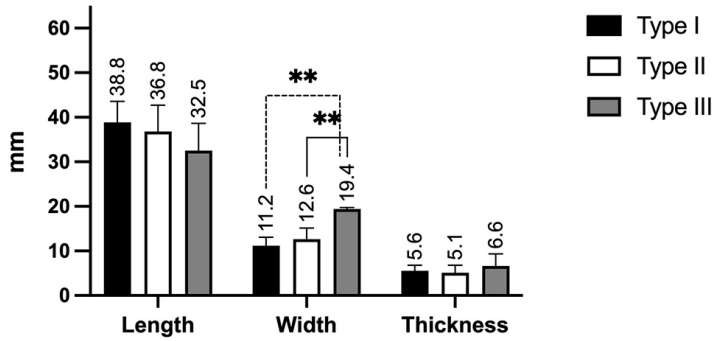

Fig. 1. Mean values and standard deviation for length, width and thickness of the anterior belly of the digastric muscle, by type. Asterisks (**) indicate statistically significant differences (p<.001).

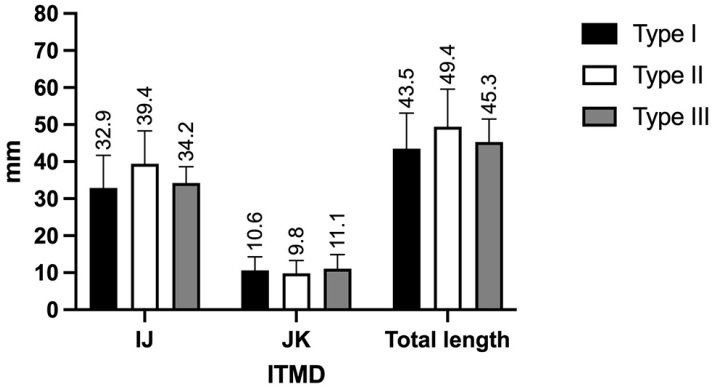

Fig. 2. Mean values and standard deviation for the intermediate tendon of the digastric muscle. ITMD: intermediate tendon of the digastric muscle; IJ: distance from its appearance in the posterior belly of the digastric muscle to its insertion in the hyoid bone; JK: distance from its presence in the hyoid bone to the anterior margin visible in the anterior belly of the digastric muscle.

DISCUSSION

Variations in the anterior belly of the digastric muscle disfigure the anatomy of the submental and submandibular triangles, which are used as critical surgical landmarks for procedures such as submental intubation, lipectomy, dissection for malignant disease, etc. (Kim *et al*., 2017). Therefore, knowledge of these anatomical variations that may be present is of great clinical importance.

Ozgur *et al*. (2007) found two median accessory digastric muscles located medially to anterior bellies of the DM, inferior to the mylohyoid muscle and deep in the platysma muscle. Aktekin *et al*. (2003) observed a symmetrical bilateral variation of the ABDM in which the accessory muscle bellies were arranged in a cross. Kyung *et al*. (2011) found three accessory bellies, two medial to the two normal anterior bellies of the DM and the third originating in the right intermediate tendon and coursing horizontally. Reyes *et al*. (2007), reported a bilateral accessory anterior belly originating in the intermediate tendon and inserted into the mylohyoid raphe. A similar observation was documented by Guambe *et al*. (2019) both unilaterally and bilaterally. Because many anatomical descriptions have been reported, different classifications have been suggested by various authors. De-Ary-Pires *et al*. (2003) carried out a computerised morphometric investigation of the digastric muscles and proposed a morphological classification with five Types for the anterior belly; three Types for the intermediate tendon; and two Types for the posterior belly of the DM. In the present study, the Types of variations observed were classified in accordance with the system described by these authors. We found a high frequency of anatomical variations of the ABDM, with 40 % of the samples classified as Type II (one accessory belly) and 4 % as Type III (two accessory bellies). Sarna *et al*. (2023), using the same classification, reported that variants of the ABDM were observed in 68.3 % of the sample; as in our study, they found that Type II and Type III were the most common variations. Sarna *et al*. (2023) reported that Type V ABDM (geniohyoid muscles) were observed in two cadavers, while only one unilateral side of a cadaver showed a Type IV ABDM. No cases of Types IV and V were found in our study.

A few variations have been described for the PBDM, indicating the styloid process as the point of insertion; this corresponds to Type II described by De-Ary-Pires *et al*. (2003). The presence of accessory bellies has also been reported. Sarna *et al*. (2023) state that the PBDM was present in all the cadavers analysed and that a lower rate of variations was observed, of 12.2 %. These authors found that in four of the 82 desiccated sides there was an accessory belly, and that all of these were inserted in the mastoid notch. According to them, all their findings fall into Type I described by De-Ary-Pires *et al*. (2003); however, they remark that this classification only describes the insertion of the muscle, since De-Ary-Pires *et al*. (2003) do not consider the possibility of an accessory belly in their

classification of the posterior belly. Sarna *et al*. (2023) therefore propose that the PBDM classification described by De-Ary-Pires *et al*. (2003) could be modified to include Type Ia and Type IIa to indicate the presence of an accessory belly. In our study, we only found Type I PBDM, and no accessory belly was found in any of the samples analysed. The PBDM is very important in clinical practice because it is an anatomical landmark in head and neck surgery. It is used to determine the courses of the accessory nerve, the internal jugular vein, the common carotid artery and the hypoglossal nerve, which must all be conserved during dissections in the neck (Ozgursoy & Kucuk, 2006). Furthermore, the PBDM is a good point of reference for locating the origin of the superior root of the ansa cervicalis (Loukas *et al*., 2007; Mwachaka *et al*., 2010).

Our results for the ITDM corroborate the findings of Sarna *et al*. (2023), who state that Type I was the most frequent, followed by Type II. We found Type I in 62 % of the samples, Type II in 20 % and Type III in 18 %. Sarna *et al*. (2023) say that they identified a variation in which the tendon lay inferior to the stylohyoid muscle in two of the samples analysed; we found no similar variation in our study.

For the ABDM, the width of Type III was significantly greater than that of Type II and of Type I in our study. In the dimensions of the muscle, we found similar values for the length and width of the ABDM to those reported by Sarna *et al*. (2023). On the other hand, the mean length and width found for the PBDM were greater than those reported by Sarna *et al*. (2023); in the right side samples we found mean length of 5.83 ± 1.33 cm and width of 1.13 ± 0.30 cm, while in the left side the means were 5.45 ± 1.29 cm and 1.00 ± 0.26 cm, respectively.

No statistically significant differences were found between sides for the length or width of the PBDM in the present study. For the ITDM, the mean IJ distance was 34.5 mm, mean JK 10.5 mm and mean total length 45.1 mm. No statistically significant differences were found for IJ, JK or total length of the ITDM between Types I, II and III. Our results are similar to those found by Sarna *et al*. (2023), who state that the average length of the ITDM was 4.30 ± 1.52 cm on the right and 4.13 ± 1.18 cm on the left, with no statistically significant differences between sides.

Although reports on the dimensions of the DM are very scarce in the literature, which prevents us from comparing our results with results from different populations, this information is still important since the dimensions reported may influence the decision to perform a submental flap, a practice indicated in oral cavity defects and the inferior two thirds of the face. These dimensions may influence the possibility of obtaining a suitable flap, for example of the submental artery, for the purposes of aesthetic facial restoration after facial paralysis (Faltaous & Yetman, 1996; Zwetyenga *et al*., 2007). Anatomists and health professionals must be familiar with the anatomy of the DM and its anatomical variations; working together they can align anatomy teaching with clinical practice to ensure correct physical exploration of the submental lymph nodes, as well as the safe performance of interventions in the region.

CONCLUSION

Anatomical variations of the DM, particularly its anterior belly, in Brazilian adults are very frequent. They must therefore be carefully identified to help avoid intercurrences during surgical procedures in the region, and to assist correct evaluation of swollen lymph nodes in the submental triangle.

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ALVES, N.; TORRES-VILLAR, C.; DE SOUSA-RODRIGUES, C. F. & DEANA, N. F. Estudio macroscópico y morfométrico del músculo digástrico en individuos brasileños. *Int. J. Morphol., 41(6)*:1620-1624, 2023.

RESUMEN: Con el propósito de ayudar en la enseñanza de la Anatomía se debe realizar una descripción correcta y detallada del músculo digástrico (MD), evitando malas interpretaciones y contribuyendo a evitar intercurrencias durante procedimientos quirúrgicos en la región. El objetivo de este estudio fue realizar un estudio del MD en individuos brasileños. Fueron utilizadas 50 muestras de MD de individuos adultos (22 del lado derecho y 28 del lado izquierdo) fijadas en formaldehido al 10 %. Se analizó la morfología del MD, identificando las posibles variaciones anatómicas, que fueron clasificadas según el número de vientres musculares, dirección de las fibras y lugar de origen e inserción. Para el análisis estadístico las medidas fueron realizadas con un paquímetro digital. Para el análisis estadístico fueron utilizadas las pruebas de t de Student, ANOVA de una vía para variables continuas y la prueba de chi-cuadrado con ajuste de Bonferroni para las variables categóricas. Se utilizó el software SPSS v. 28.0, considerándo umbral de significación de 5 %. El vientre anterior del MD se clasificó como Tipo I en 28 muestras (56 %), como

Tipo II en 20 (40 %) y como Tipo III en 2 (4 %). El promedio de longitud fue de 37,8 mm, la anchura de 12,1 mm y el espesor de 5,39 mm, no siendo encontradas diferencias estadísticas significativas para estas variables. El tendón intermedio del MD fue Tipo I en 31 muestras (62 %), Tipo II en 10 (20 %) y Tipo III en 9 (18 %). El promedio de su longitud total fue de 45,1 mm. El vientre posterior del MD fue de Tipo I en 50 muestras (100 %), con promedio de longitud de 70,8 mm y de ancho de 8,15 mm. Las variaciones anatómicas del MD, particularmente de su vientre anterior, son muy frecuentes en brasileños adultos, por lo que deben ser identificadas detalladamente contribuyendo a evitar intercurrencias durante los procedimientos quirúrgicos en la región y también para propiciar la correcta evaluación de las adenopatías del espacio submentoniano.

PALABRAS-CLAVE: Anatomía; Variaciones anatómicas; Músculo digástrico.

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