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Study of the Structural Variations in Musculature of Submental Region of the Neck with Emphasis on Digastric Muscle and its Clinical Implications.

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Abstract

Anatomical variation in submental region especially the digastric muscles are common& its knowledge is important for surgical purpose. The anterior belly of the digastric muscle varies greatly in its shape and size. It is important to know the variation of the digastric muscle, as it is used as a landmark in certain surgical procedures, especially for surgeons operating in the submandibular and submental region. The digastric muscle is formed by two muscle bellies: one anterior and one posterior, joined by an intermediate tendon. It is localized in the anterior cervical region. The anterior belly divides the region between the hyoid bone & the mandible into two, a lateral (submandibular) & a medial (submental triangle).This muscle participates in deglutition & mandibular movements.

30 formalin fixed cadavers were dissected, out of which 28 suprahyoid regions showed a single anterior belly of digastric muscle bilaterally, with an average length of 4.7 cm originating from the digastric fossa of the mandible and had insertions on the intermediate tendon. Anatomical variation in the anterior belly of the digastric muscles was noted in two cadaveric specimens that showed additional muscular strips unilaterally. Knowledge of the variations of the digastric muscle may prevent complications when surgery is performed in the suprahyoid region (anterior region of the neck) or during reporting of imaging techniques of the same as well as when differentiating between cervical masses.

Key Words: *Digastric muscle, Anterior belly, Accessory ant. Belly, Variations, Intermediate tendon, Suprahyoid region.*

1. Introduction

The digastric muscle is one of the suprahyoid groups of muscles present in the upper cervical region. It is characterized by two muscle bellies that are usually a single anterior and a posterior, joined together by an intermediate tendon which is attached to the hyoid bone by a fascial pulley. The posterior belly is longer than the anterior belly and is accompanied by the stylohyoid muscle. The other three suprahyoid muscles being the geniohyoid, stylohyoid and mylohyoid, are also inserted on the hyoid bone and, together with the digastric muscle, anchor this bone against the traction of the infrahyoid muscles (Lockhart *et al*.)[1]. Digastric muscle stabilizes the hyoid bone in addition to assisting in jaw movements [2]. *Anterior belly* originates from the digastric fossa on the lower border of the mandible close to the symphysis menti. It passes downward and backward resting on the mylohyoid and is inserted into the intermediate tendon. The anterior belly may cross the midline in part and very commonly seen fused with the diaphragm oris. *Posterior belly* originates from the mastoid notch at the medial surface of the mastoid process of the temporal bone, and a deep groove between the mastoid process and the styloid process, called the digastric groove. It passes downward and forward between carotid triangle below and behind and the digastric triangle above and front and is inserted into the intermediate tendon. The posterior belly may be augmented by a slip from the styloid process or arise wholly from it (Williams gray)[7]. *Intermediate tendon* is connected to the junction of the body and greater cornu of hyoid bone by means of an

inverted “U” shaped fibrous sling of deep cervical fascia (investing layer) which anchors the tendon to the hyoid bone, with bursa intervening (Lockhart *et al.*,)[1].

The digastric muscle begins to form in the fourth week of embryo development from the first and second pharyngeal arch (Moore and persuad)[4]. The myoblasts originate in the fourth somitomeres reach the first pharyngeal arch (Meckel arc), thereby beginning the development of the *anterior belly* of the digastric muscle and the mylohyoid muscle along with the mylohyoid nerve between them and hence is supplied by nerve to mylohyoid which is a branch of mandibular division of trigeminal nerve that is the nerve of first pharyngeal arch. The p*osterior belly* of the digastric muscle is formed from myoblasts migrating from the sixth somitomeres to the second pharyngeal arch (Reichert arc) and hence carrying the nerve of second pharyngeal arch, the facial nerve. (Drake et al.)[24]. The motor neurons controlling the anterior belly of digastric are present in trigeminal motor nucleus located in the lateral pontine reticular formation surrounded by a ring of premotor neurons. On the basis of jaw muscle innervations it has been divided into two cytoarchetectonic regions, namely dorsolateral and ventromedial .The ventromedialmotor neurons innervate jaw opening muscles and the dorsolateral subdivision controls the jaw closing muscles. This observation is based on the results of retrograde tracer injections in the muscles of mastication of various species (Mascaro MB)[23].

The digastric muscle has complex cranio-cervical dynamics; when the mandible is fixed, the digastric muscle raises the hyoid bone, and when the hyoid is fixed, the digastric muscle opens the mouth by lowering the mandible (Drake *et al.*,)[24].Variations in the development of pharyngeal arches can lead to malformations with a variety of clinical presentations. In the previous reported studies, variations were described in accordance with the classification of Zlabek[25], which considered the phylogenetic and ontogenetic development and the classification of Yamada[26], which enumerated six different types of variations in the anterior belly. Very recently, Fujimura et. al[20] put forward the proposition of a clear well understood classification of the anterior belly of the digastric muscle based on the positions of the attachments of the muscle bellies (Liquidation et al.)[27].

The digastric muscle is made use in plastic surgery, where the digastric anterior belly transfer technique is employed to restore the depressor function of the lower lip in lesions of the facial nerve after tumor resection (TAN, [28]; TERZIS and TZAFETTA[29]).This study is aimed at creating awareness in the anterior digastric muscle variations, thereby avoiding confusion with the soft tissue masses or lymphatic nodules.

2. Method

30 formalin fixed cadavers were dissected in the Department of Anatomy of various medical colleges of Nepal & India, out of which 28 suprahyoid regions of the cadavers showed a single anterior belly of digastric muscle bilaterally, with an average length and breadth of 4.7cm and 1.5cm respectively, originating from the digastric fossa of the mandible and had insertions on the intermediate tendon whereas two cadavers showed difference in the number of belly and attachment.The digastric muscles that presented anatomical variations were photographed using a Canon digital camera with a canon zoom lens 3*IS,6.2-18.6mm 1:2.8-4.9, and its bellies were measured using a universal pachymeter.

3. Result

Anatomical variations in the anterior belly of the digastric muscles were noted in two cadaveric specimens that showed additional muscular strips both unilaterally and bilaterally.

Case I: Two accessory anterior bellies on left side, one is thin, placed in the middle measuring 3.9 cm in length and 0.4cm in breadth the other being thick is medial to the first one, with a length of 5.2 cm and breadth 0.7cm were observed. The medial accessory belly arises from the mylohyoid raphe and middle one from the digastric fossa. Both the bellies are inserted by joining in common with anterior belly of the digastric muscle on the intermediate tendon.

Figure of Case I: Unilateral variation of anterior belly of digastric muscle. AS_1- Medial accessory anterior belly, AS_2- Middle accessory anterior belly, MR- Mylohyoid raphe, SG- Submandibular gland, HB- Hyoid bone.

Case II: A single accessory anterior belly on both sides with a length of 4.9 cmon right and 5.4cm on left side and equal breadth of1.5cm on both sides attached to the hyoid bone was observed.

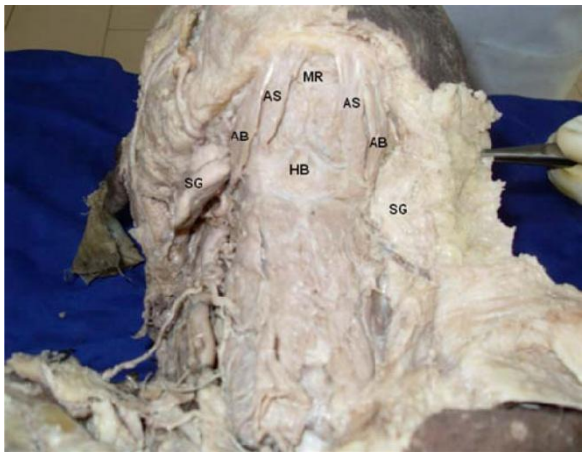

Figure of Case II: Bilateral variations of anterior belly of digastric muscle. AS-Accessory anterior belly, AB-Anterior belly, MR-Mylohyoid raphe, HB-Hyoid bone, SG- Submandibular gland.

4. Discussion

There have been descriptions of anatomical variations in the digastric muscle ever since 1847[21]. Testut[19] reported variations in the anterior belly, with the presence of a supernumerary fascicle inserted in the raphe of the mylohyoid muscle, or in the hyoid bone or the digastric fossa of the opposite side. He emphasized that this variation was frequently unilateral and constituted a "trigastric" muscle.

Despite the description in the literature that unilateral variations are more frequent [22, 3], we observed the same proportions of unilateral and bilateral variations in this study. The muscle structures derived from the first pharyngeal arch, such as the anterior belly of the digastric muscle, originate from the original mesoderm of the arch [4]. Thus, deficiency in the differentiation of this layer on oneside may be responsible for unilateral variations, or deficiencies on both sides for bilateral variations.

Unilateral anatomical variations may present greater clinical importance, since in some cases they may be responsible for asymmetry in the anterior region of the neck or even in the movement of the floor of the mouth [3] or the temporomandibular joint [5], and perhaps imbalance in the movement of the larynx. These types of asymmetry may lead to slight functional abnormalities or may even be confounded, in clinical examinations and in imaging

examinations like ultrasound, tomography and magnetic resonance, with lymph nodes, benign cervical masses like thyroglossal cysts, or neoplasia.[6]

Likewise, such conditions must be taken into consideration in surgical procedures in the neck region, especially in relation to submandibulectomy, since this muscle and its tendon are anatomical reference points during operations.The variation of the anterior belly may be double or extra slips from this belly may pass to the jaw or the raphe of the mylohyoid muscle or decussate with a similar slip on the opposite side.[7] The frequencies of anomalies of the digastric muscle are not well known. However, several studies have demonstrated variations of the anterior bellies and the fibrous sling of the digastric muscle. An abnormal digastric muscle with unilateral quadrification of the anterior belly was observed by Celik et al.[8]

Sarikcioglu et al.[9] reported an anomalous digastric muscle with three accessory bellies and one fibrous band. Anatomical variations of the anterior bellies of the digastric muscle could be significant during diagnostic and surgical procedures involving the suprahyoid region. Knowledge of the muscular irregularities of the submandibular region is important because mobilization of myocutaneus flaps in reconstructive procedures is an essential element in certainplastic surgery techniques (Guelfguat et al.)[10]

Norton [11] reported a case of bilateral occurrence of accessory digastric muscles, which inserted upon the midline raphe, decussated, and continued to rejoin the contralateral anterior bellies of the digastric muscles before their transition into the intermediate tendons. The anomaly reported in that case was symmetrical bilaterally. Furthermore, Uzun et al. [12] presented a case in which 3 anterior and posterior bellies of the digastric muscle had their normal origin and course and were joined by an intermediate tendon.

Holibkova and Machalek[13] reported two anomalies of the anterior bellies of digastric muscles. Connell and Shamoun[14] encountered excess digastric muscle bulk in several cases, observing that the large digastric muscle became apparent, bulging through the overlying platysma, when the patient was lying in the supine position with the head flexed. Aktekin et al.[15] reported bilateral and symmetrical variation of the anterior belly of the digastric muscle. Çelik et al.[8] reported that the anterior belly of the left digastric muscle had four separate insertions to an ipsilaterally enlarged digastric fossa.

Sargon and Çelik[16] found a digastric muscle with three bellies on the right. Akk›n and Özkufl[17] reported variations of the anterior belly of the digastric muscles in two cases. Their first case had two accessory bellies on both sides, both of which inserted into the right side, whereas the second case had five-segmented anterior belly. Fourteen several other studies have demonstrated variations of the anterior bellies and the fibrous sling of the digastric muscle. [18,9]

The anatomical variations observed in this study were limited to the anterior belly, as also described in other studies (Testut[19]; Sargon & Celik[22]; Andreo et al[5].; Peker et al[3].; Bergman et al.[21] ; Fujimura et al[20].; Turan-Ozdemir et al.[6]). It is important to consider the occurrence of these variations in the digastric muscle when differentiating between cervical masses and during surgical procedures on the anterior region of the neck, especially in the submental and submandibular triangles. The accessory digastric muscle affects diagnostic imaging and therapeutic procedures in head and neck surgery and must be considered in procedures involving this area.[23]

5. Conclusion

It is important to consider the occurrence of these variations in the digastric muscle when differentiating between cervical masses and during surgical procedures on the anterior region of the neck, especially in the submental and submandibular triangles. Knowledge of the variations is also essential because of the importance of the muscle in reconstructive technique such as in restoring the depressor function of the lower lip.

The present study shows description of anatomical variations in the anterior belly of the digastric muscle in two cadavers. This study also demonstrates a unilateral and bilateral anomaly of the anterior bellies of the digastric muscles, which is of clinical interest with

surgery or imaging of this region. Knowledge of such variations plays significant role in planning for neck surgeries and staging of tumors and hence affects diagnostic & therapeutic procedures.

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