THE DIGASTRIC MUSCLE IN HEAD AND NECK ANATOMY: A CADAVERIC STUDY WITH EMPHASIS ON VARIATIONS AND SURGICAL LANDMARKS

Dr V Sujatha[1*], Dr C Rathiga[2], Dr Ganesan Murugaperumal MD[3]

[1*]Associate Professor, Konaseema Institute of Medical Sciences & Research Foundation, Amalapuram, Andhra Pradesh, India
[2]Assistant Professor, Prathima Relief Institute of Medical Sciences, Nagunur, Karimnagar-505417, India

[3]Associate Professor, Department of Anatomy, Tagore Medical College & Hospital, Rathimangalam, Melakkottaiyur, Chennai- 600127

Abstract

Since it has three parts, the digastric muscle is involved in neck movement and regularly marks a significant area for clinicians and surgeons. Because the facial artery and its branches are close to the parotid and submandibular glands, lymph nodes and major neck arteries, a proper grasp of its structure is necessary. The study analyzed the heads and necks of 40 bodies (25 from males and 15 from females) to understand how the digastric muscle varies in size and connectivity. We traced the anterior belly along the digastric fossa to the intermediate tendon and from the tendon we traced the posterior belly to the mastoid notch. To be certain of anatomical correctness, the jaw was closed while making the measurements. The anterior and posterior bellies revealed a modest association with overall neck length. Large differences in sex were found, as males featured longer anterior bellies and intermediate tendons, while females lacked both. By contrast, there was minimal change in the consumptions of the posterior belly between males and females. The presence of anatomical variability was demonstrated by two cases that had bilateral accessory anterior bellies. Recognizing all these variations limits the probability of these masses on imaging being misinterpreted as diseases in the region below the chin or jaw. As a result, doctors are now more likely to use the digastric muscle during reconstructive flaps for treatments of lip asymmetry and oral cancer defects. Accessory muscle slips present during surgery can make the procedure easier because the surgeon has extra tissue. By using this research, doctors can more accurately examine each muscle and emphasize the clinical and surgical value of the digastric muscle's location. Learning about these features will help surgeons and radiologists treat and diagnose illnesses of the head and neck correctly.

Key words: Digastric muscle, Anatomical variations, Surgical landmarks, Head and neck anatomy, Cadaveric study

Introduction

The digastric muscle plays an important role as it stands out in the neck and is considered a suprahyoid muscle. The main duty of the suprahyoid group is to lower the jaw and stabilize and elevate the hyoid bone [1]. Found near the point where the digastric muscle's two bellies join is the submental group of lymph nodes which drain midline structures in the mouth and the tip of the tongue [2]. Both the anterior and posterior bellies of the digastric muscle mark the boundaries of the submandibular region [3]. This area includes the submandibular gland, facial vessels, facial nerve, lymph nodes, hypoglossal nerve and the carotid sheath, as well as what it wraps around [4]. There are many descriptions of the digastric muscle, mainly because it develops out of two separate embryonic arches [5]. In addition, in the anterior belly, the mandibular branch of the trigeminal nerve connects from the first pharyngeal arch. The posterior belly, on the other hand, comes from the second pharyngeal arch and is controlled by a secondary branch of the facial nerve [6]. Implementing computerized morphometric analysis on 74 human specimens, the anterior part was divided into five categories, the intermediate tendon into three and the posterior part into two which have now been combined into patterns labeled A to J [7]. Complicated classifications contribute to knowing about blood vessels and the resulting health issues. A large number of anatomical works describe the existence of extra anterior bellies of the digastric muscle [3,4,7,8]. Similar to food, these accessory slips can lead to throat upset and a foreign body feeling. Also, these adhesions can change the ability of the hyoid bone to move which may cause conditions similar to stylohyoid syndrome. Doctors frequently cut the anterior belly in platysmorrhaphy and this area is useful for reconstructive surgery after marginal mandibular branch facial nerve damage [9,10]. Since digastric muscle variations are usually asymptomatic, surgeons in maxillofacial, reconstructive and cosmetic fields should still be aware of them. Surgeons in neck contouring procedures often remove submental fat [8], so it is important to also identify and remove any extra muscle slips to get the best results. This muscle must be studied using morphometric data, since it is an important surgical landmark. Considering the neighboring bony areas allows you to connect muscle lengths to the neck structure. In-depth exploration of digastric characteristics helps avoid misidentification of unusual bumps below the jaw [11]. Even with what we know about structural variation, additional studies are needed to sharpen our morphometric analysis. As a result, this paper aims to offer detailed descriptions of morphological characteristics useful for surgeons and clinicians in this location.

Methods

The human cadavers (25 men and 15 women) were used in an anatomical study to examine the digastric muscle and, in particular, its anterior and posterior bellies, along with its intermediate tendon. None of the cadavers had prior damage or abnormalities in the areas we studied, as their head and neck regions were intact. Specimens with odd extra digastric belly groups were not included in measuring morphometric parameters. Every specimen was dissected using the same procedure throughout the study. A cut was made across the middle of the neck, from the chin to the bottom of the breastbone (the jugular notch of the sternum), to display all the structures in the neck. Reflecting the skin downwards and laterally showed the muscles below. We moved the platysma muscle away from the top to open up the deeper layers. I took great care to remove the superficial fascia and adipose tissue covering the sternocleidomastoid muscle so that its edges were visible. The Ying and Yang connective tissues linking the anterior and posterior portions of the digastric muscle were closely studied. We started at the mandibular connection of the anterior belly and continued overlapping to its attachment at the intermediate tendon and we repeated the method for the posterior belly, beginning at the intermediate tendon and ending at the mastoid notch on the temporal bone. The muscle segments were mapped and their lengths measured by stretching a flexible thread and then checking the thread against a calibrated ruler. Every measurement was taken with the patient’s jaw closed in line with the usual way the mouth functions. All data were collected in centimeters and then statistically processed with GraphPad Prism software (version 6). Differences were studied between the two hemispheres with paired t-tests and between males and females with independent t-tests. To evaluate the connection among neck length, digastric measurement and width, we calculated Pearson correlation coefficients. Scatter plots were used to see how these associations appeared. Before beginning the study, ethical approval was received for all procedures on cadaveric specimens which were handled according to ethical standards.

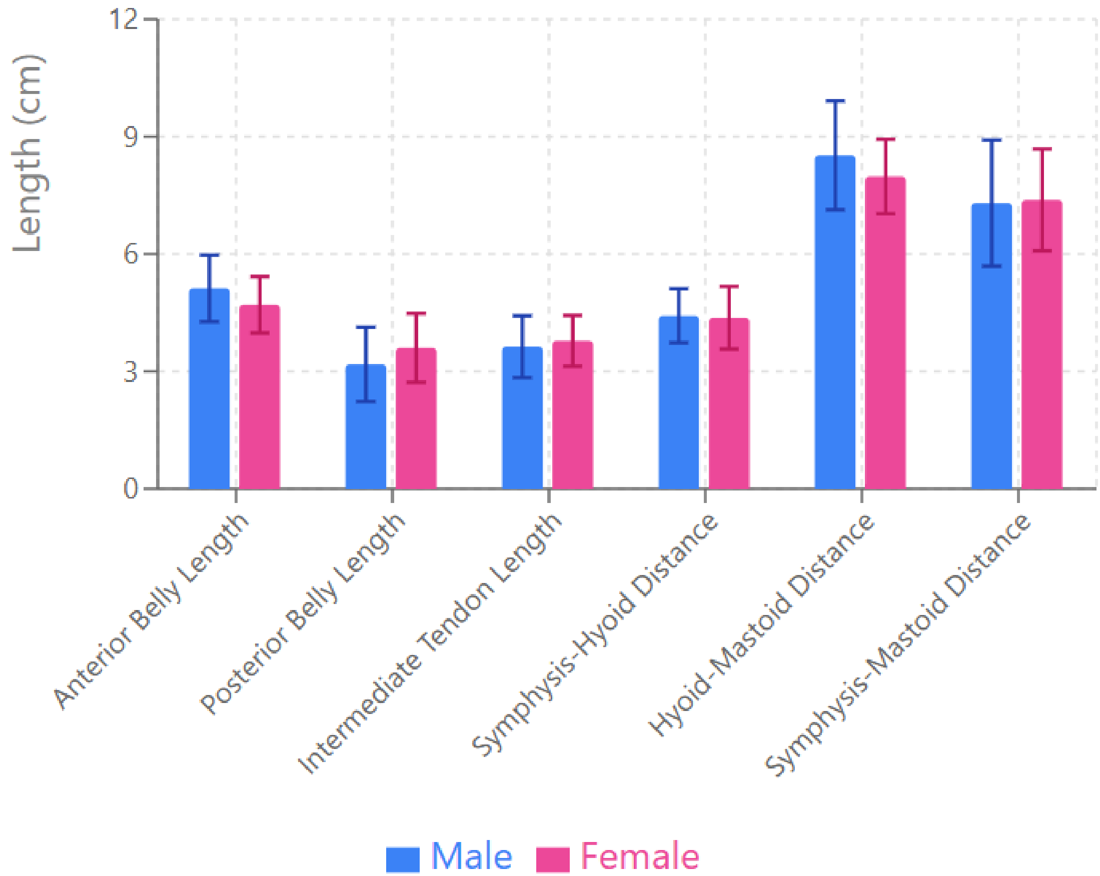
Result

The anterior belly was measurably longer in males (5.12 ± 0.85 cm) than in females (4.70 ± 0.72 cm), indicating that this muscle area varies by sex. The length from the intermediate tendon to the mastoid notch was greater in females (3.60 ± 0.88 cm) than in males (3.18 ± 0.95 cm), but the difference was not statistically important. There was also a measurable difference by sex in how long the intermediate tendon is, with females having a neurolysis length (3.78 ± 0.65 cm) that is only slightly longer than the neurolysis length (3.63 ± 0.79 cm) seen in males. Thus, we may expect small anatomical sex differences in the muscle and tendon that could modify the muscle-tendon unit's biomechanical function. Examining bony landmarks found that the symphysismenti to hyoid bone distance was equal in both males (4.42 ± 0.69 cm) and females (4.37 ± 0.80 cm). Both males and females had similar average distances from the hyoid to the mastoid (males: 8.52 ± 1.39 cm, females: 7.98 ± 0.95 cm), but the difference between groups was considered statistically insignificant. Measured from the symphysismenti to mastoid process, males' average was 7.30 ± 1.61 cm and females' was only slightly longer at 7.38 ± 1.30 cm. They determine standard morphometric measurements for the digastric muscle and areas nearby, especially pointing out how the anterior belly and intermediate tendon length can be different. Understanding these variations is necessary for good clinical and surgical control in the areas below the chin, since the digastric muscle points the way.

Table 1: Morphometric measurements related to the digastric muscle

Sl. No.	Morphometric Parameter	Male (cm) Mean ± SD	Female (cm) Mean ± SD
1	Length of the anterior belly of the digastric muscle (from digastric fossa of mandible to intermediate tendon)	5.12 ± 0.85	4.70 ± 0.72*
2	Length of the posterior belly of the digastric muscle (from intermediate tendon to mastoid notch)	3.18 ± 0.95	3.60 ± 0.88
3	Length of the intermediate tendon (where anterior belly becomes tendon and tendon ends at posterior belly)	3.63 ± 0.79	3.78 ± 0.65*
4	Distance between the symphysismenti and the hyoid bone	4.42 ± 0.69	4.37 ± 0.80
5	Distance from the hyoid bone to the mastoid process	8.52 ± 1.39	7.98 ± 0.95
6	Distance from the symphysismenti to the mastoid process	7.30 ± 1.61	7.38 ± 1.30

Figure 1: Morphometric Measurements of the Digastric Muscle, Comparison between Male and Female Measurements (Mean ± SD)



Discussion

Even though double-headed anterior digastric muscles are unusual, doctors stress that spotting this variation helps stop them from being misdiagnosed as tumors in throat or mouth scans [12]. Based on work by Zdilla and others involving 35 specimens [13], males demonstrated stretchier muscles along the left side of their bodies [1]. They found that muscle bellies and intermediate tendons on the same side changed in a similar way with posture changes and no major relationship was seen between the lengths of the belly and the tendon. The anterior bellies of males were found to be longer and their intermediate tendons were similar in length to those of females, whereas the right posterior belly was clearly longer than the left in all subjects. In their categorization, De-Ary-Pires and colleagues [7] referred to digastric muscles as A, B, C, all the way to J. Most specimens in this study matched pattern A, since in previous studies pattern A has been the most common, affecting roughly 66% of all cases. The researchers found that shortening one belly caused the other to lengthen, so neck length varied according to belly changes. Earlier investigations found that the thickness of the digastric muscle as measured by ultrasound is generally about 10% less than that recorded by MRI, yet both methods had a strong relationship. An additional link of muscle between the left and right anterior bellies at the hyoid bone has been recorded by Kalniev et al. [16]. Ozgur et al. [17] revealed a unique case marked by four entrapped anterior bellies plus accessory median digastric muscles on both sides. One study mentioned two extra muscles positioned medially to the normal anterior belly which join at the mylohyoid raphe [18] and another described three extra bundles joined by a fibrous band to the same region [19]. As noted by Singh et al. [20], in certain cases, only one anterior surface of the accessory muscles was formed and the authors observed variations connected to mylohyoid raphe and digastric muscles. A transverse band of muscle was described by Yamazaki et al. [21] which connects the intermediate tendons on both sides. Holibková et al. noted that there are medial and lateral heads in accessory muscles and while the lateral attaches partly to the hyoid bone through the intermediate tendon, the medial head may sometimes be asymmetrical. Bilateral additional branches from the mylohyoid raphe that insert into the side tendons are described by Peker et al. This analysis included two cases with bilateral accessory anterior bellies, where, for the first, the accessory bellies were found medially and connected to the hyoid bone and for the second, they began laterally and attached to the intermediate tendon. Since oral cavity carcinomas often spread to cervical lymph nodes, it is difficult for radiologists to see the tumors clearly using current imaging methods. Confusing muscle anomalies with tumors can result in the wrong diagnosis [10, 13, 15]. While the digastric muscle is sometimes needed in reconstructive surgeries such as pedicledsubmental flaps, its use is common after oral cancer surgery because it helps the surgical wound heal successfully. Having accessory muscle slips can give extra tissue to help the reconstruction succeed [24, 25]. It is necessary to know how large and what shape the digastric muscle is before surgical planning. The growing importance of maxillofacial, reconstructive and aesthetic surgery means knowing about the digastric muscle and its variations is necessary. Good medical outcomes rely on correctly noticing and treating supernumerary muscle bellies. Noticing these differences allows clinicians to tell the difference between healthy muscles and possible abnormal growths or lymph nodes in the area below the chin which could avoid unnecessary surgery[11].

Conclusion

The digastric muscle sits above the hyoid bone and is important for neck movement; surgeons and clinicians depend on it as an anatomical reference point. It was clear from studying numerous examples that the size and position of the anterior belly, posterior belly and intermediate tendon can change, as can their relationship to neighboring bone parts. The results point out that males have longer anterior bellies and intermediate tendons while females do not. The length of the posterior belly differed only slightly by sex, but the difference was not significant. Because these subtle differences are important, it is vital for clinicians to consider each case individually before treatment. Furthermore, finding accessory muscles lying in front of the digastric in two of our cases shows that the muscle can be different in anatomy. The presence of these variations can make it difficult to tell apart normal muscle from problems such as lymph nodes or masses around the submental and submandibular regions, so radiologists and technicians need to be very accurate. Recognizing these variants properly helps doctors prevent wrong diagnoses and prevent surgical procedures that could endanger patients. Consequently, it is necessary to study these details thoroughly during imaging and before carrying out surgery. Not only does the digastric muscle help with diagnosing, but doctors also use it more in cosmetic and reconstructive procedures. It can be used from the submental area and successfully treat lower lip nonbalance or loss of tissue from oral cancer. Even small accessory muscles can give tissue that assists in successful surgical repair. With these measurements, surgeons can guide their flap design more precisely, predict outcome and reduce the possibility of postoperative problems. Because of progress in maxillofacial, reconstructive and aesthetic surgery, surgeons need to know anatomy and have excellent technique. All kinds of digastric muscle variations, typical or not, need to be recognized by everyone. It is important to review patients well before surgery and closely watch during surgery to manage extra muscle bellies. When pediatrics is this precise, surgeries are more effective, operations are quicker and patients recover more easily. All in all, the study fills a gap by explaining how the digastric works, including its anatomy, so that readers can use this information for learning and patient care. Unmarrying imaging techniques with morphometric metrics could give clinicians more precise ways to determine a diagnosis and surgical strategy for patients with head and neck diseases..

References

1.Standring S, Gray H. Gray's anatomy: the anatomical basis of clinical practice. 40th ed. Churchill Livingstone; 2008.

2.Tortora GJ, Derrickson B. Principles of anatomy and physiology. 12nd ed. Guanabara Koogan; 2010.

3.Widmalm SE, Lillie JH, Ash MM., Jr Anatomical and electromyographic studies of the digastric muscle. J Oral Rehabil. 1988;15:3–21.

4.Liquidato BM, Barros MD, Alves AL, Pereira CSB. Anatomical study of the digastric muscle: variations in the anterior belly. Int J Morphol. 2007;25:797–800.

5.Moore KL. Clinically oriented anatomy.3rd ed. Williams & Wilkins; 1992.

6.Diogo R, Wood B. Soft-tissue anatomy of the primates: phylogenetic analyses based on the muscles of the head, neck, pectoral region and upper limb, with notes on the evolution of these muscles. J Anat. 2011;219:273–359.

7.De-Ary-Pires B, Ary-Pires R, Pires-Neto MA. The human digastric muscle: patterns and variations with clinical and surgical correlations. Ann Anat. 2003;185:471–9.

8.Connell BF, Hosn W. Importance of the digastric muscle in cervical contouring: an update. AesthetSurg J. 2000;20:12–6.

9.Tan ST. Anterior belly of digastric muscle transfer: a useful technique in head and neck surgery. Head Neck. 2002;24:947–54.

10.Conley J, Baker DC, Selfe RW. Paralysis of the mandibular branch of the facial nerve.PlastReconstrSurg. 1982;70:569–77.

11.Ozgursoy OB, Kucuk B. Unique variation of digastric muscle: a confusing landmark for head and neck surgeons. ActaOtolaryngol. 2006;126:881–3.

12.Norton MR. Bilateral accessory digastric muscles. Br J Oral Maxillofac Surg. 1991;29:167–8.

13.Zdilla MJ, Pancake AR, Lambert HW. Morphometrics of the anterior belly and intermediate tendon of the digastric muscle: sexual dimorphism and implications for surgery. J Craniofac Surg. 2016;27:1321–6.

14.Macrae PR, Jones RD, Myall DJ, Melzer TR, Huckabee ML. Cross-sectional area of the anterior belly of the digastric muscle: comparison of MRI and ultrasound measures. Dysphagia. 2013;28:375–80.

15.Sargon MF, Onderoğlu S, Sürücü HS, Bayramoğlu A, Demiryürek DD, Oztürk H. Anatomic study of complex anomalies of the digastric muscle and review of the literature. Okajimas Folia AnatJpn. 1999;75:305–13.

16.Kalniev M, Krastev D, Krastev N, Vidinov K, Veltchev L, Apostolov A, Mileva M. A rare variation of the digastric muscle.Clujul Med. 2013;86:327–9.

17.Ozgur Z, Govsa F, Ozgur T. Bilateral quadrification of the anterior digastric muscles with variations of the median accessory digastric muscles. J Craniofac Surg. 2007;18:773–5.

18.Kyung DS, Lee JH, Lee YP, Kim DK, Choi IJ. Bilateral variations of the head of the digastric muscle in Korean: a case report. Anat Cell Biol. 2011;44:241–3.

19.Sarikcioglu L, Demir S, Oguz N, Sindel M. An anomalous digastric muscle with three accessory bellies and one fibrous band.SurgRadiol Anat. 1998;20:453–4.

20.Singh Z, Kaur G, Kaur A. A variant digastric muscle.Int J Anat Var. 2011;4:120–2.

21.Yamazaki Y, Shibata M, Ushiki T, Isokawa K, Sato N. Bilateral, asymmetric anomalies of the anterior bellies of digastric muscles. J Oral Sci. 2011;53:523–7.

22.Holibková A, Machálek L. A report on anomalies of digastric muscle.ActaUnivPalackiOlomucFac Med. 1999;142:57–9.

23.Peker T, Turgut HB, Anil A. Bilateral anomaly of anterior bellies of digastric muscles. SurgRadiol Anat. 2000;22:119–21.

24.Faltaous AA, Yetman RJ. The submental artery flap: an anatomic study. PlastReconstr Surg. 1996;97:56–60. discussion 61–2.

25.Connell BF, Shamoun JM. The significance of digastric muscle contouring for rejuvenation of the submental area of the face.PlastReconstr Surg. 1997;99:1586–90.

26.Kim SD, Loukas M. Anatomy and variations of digastric muscle. Anat Cell Biol. 2019;52:1–11.