Published in final edited form as:

Surg Radiol Anat. 2018 December ; 40(12): 1429–1436. doi:10.1007/s00276-018-2110-5.

The submental arrowhead variation of the mylohyoid and anterior belly of the digastric muscles

Matthew J. Zdilla^{1,2,3}, Kelsey R. Mangus¹, Jordan V. Swearingen³, Kyle D. Miller³, H. Wayne Lambert³

¹Department of Natural Sciences and Mathematics, West Liberty University, CSC 139, P.O. Box 295, West Liberty, WV 26074, USA

²Department of Graduate Health Sciences, West Liberty University, West Liberty, WV, USA

³Department of Pathology, Anatomy, and Laboratory Medicine (PALM), Robert C. Byrd Health Sciences Center, West Virginia University School of Medicine, Morgantown, WV, USA

Abstract

Purpose—Submental anatomical variation is of clinical importance with regard to head and neck surgeries. One such anatomical variation is that of additional musculature joining the intermediate tendon of the digastric muscle to the midline of the mylohyoid musculature—a variation which this report refers to, accordingly, as an arrowhead variation. Though the arrowhead variation has been described in several case reports, it has not been subject to cross-sectional study. The purpose of this study is to determine the prevalence of the arrowhead variation.

Methods—Prevalence of the arrowhead variation was assessed in 19 cadavers via gross dissection.

Results—Two of the 19 cadavers (10.5%) were found to have arrowhead variations. The arrowhead variation was found in one male (1:11; 9.1%) and one female (1:8; 12.5%), respectively.

Conclusions—This report demonstrates that the submental arrowhead variation of the anterior digastric and mylohyoid musculature has been reported in isolated case reports since the nineteenth century. This report is the first cross-sectional study of the arrowhead variant, identifying it in approximately one in ten individuals and in both sexes. Therefore, the presence of an arrowhead variation should be regularly considered with regard to diagnosis of submental masses. Likewise, the arrowhead variation should be considered in the preoperative planning of the myriad operations performed in the submental region.

Keywords

Anatomic variation; Neck muscles; Plastic surgery; Rhytidoplasty

Matthew J. Zdilla, mzdilla@westliberty.edu.

Preliminary findings from this report were presented at the 2017 American Association of Anatomists Annual Meeting.

Conflict of interest The authors have no conflicts of interest to report.

Financial disclosure The authors have no financial contributions.

Introduction

The musculature of the submental triangle is important in a variety of head and neck surgeries. Understanding the anatomy of the region may help to differentiate normal anatomy from both variant anatomy and gross pathology. Two muscles that mark boundaries of the submental triangle, namely the anterior belly of the digastric muscle (ABDM) and the mylohyoid (MH), are particularly important with regard to operations performed in the submental region such as the digastric corset procedure for submental rejuvenation [19], injection of botulinum toxin for anterior open bite following mandibular fracture [29, 38], muscle transfer for the reanimation of the mouth after palsy of the marginal mandibular branch of the facial nerve [13, 37], muscular resection to alter the cervicomental angle [6], rhytidectomy [24], the submental artery flap [7, 35, 36], submental intubation [2, 9], and submental lipectomy [24].

The anterior digastric muscle

Variations of the digastric muscle are common, particularly with regard to the ABDM. Muscle bellies may be supernumerary (double, triple, quadruple), and exist in exotic patterns such as interwoven and fractal [15, 20, 23, 24, 27, 33, 42, 43]. These variant muscles may travel ipsilaterally or contralaterally [15, 20, 23, 24, 27, 33, 42, 43]. Likewise, variations of the ABDM may be unilateral or bilateral; however, there are more reports of unilateral variations [25]. Indeed, some variations, usually considered variants of the ABDM, connect the ABDM and mylohyoid musculature [1, 33].

The mylohyoid muscle

The mylohyoid is a triangular sheet-like muscle that attaches at the mylohyoid line of the mandible laterally, the body of the hyoid posteriorly, and a median raphe in the median sagittal plane, which, when present, stretches from the mandibular symphysis to the hyoid bone [30]. The mylohyoid is often divided into anterior and posterior parts that are separated by the sublingual gland and occasionally the stylohyoid muscle or Wharton's duct [22].

There are few reports of mylohyoid variations and even fewer reports that include photographs or morphometric data. The most diverse record of mylohyoid variation comes from Macalister [21]. Macalister has described variations of the mylohyoid that are continuous with slips of either the sternohyoid, stylohyoid, omohyoid, or mylopharyngeus (superior pharyngeal constrictor) or to have some of its fibers inserted into the digastric tendon [21]. He also reported an almost complete absence of the mylohyoid, which was replaced by the ABDM [21]. Other authors have documented variant mylohyoid musculature to have diverse insertions including the contralateral hyoid and also midway between the chin and hyoid at the geniohyoid via a dense fibrous "pseudohyoid" [28, 40]. Indeed the mylohyoid may not reach the hyoid but, rather, insert at the ABDM or geniohyoid forming mylo-digastric and mylo-geniohyoid muscles, respectively [1].

The variations of the ABDM and mylohyoid are diverse, but more prevalent in the ABDM. Although classification systems have been proposed to categorize ABDM variations, the

classification systems are not comprehensive enough to account for the wide variety of variants that have been reported [14, 33, 45].

The submental arrowhead variation of the anterior digastric and mylohyoid musculature—Review of the literature reveals numerous case studies that have reported a muscular variant connecting the midline raphe of the mylohyoid to the intermediate tendon of the digastric muscle [4, 5, 16, 26, 27, 32–34]. Williston describes a case wherein “[t]he tendon of the digastric muscles gave off two anterior bellies, one normal in size and position, the other a flattened, triangular belly, meeting its fellow in a median raphe and connected at its upper angle with the maxillary symphysis” [32]. Other accounts are largely similar to that of Williston [4, 5, 16, 26, 27, 33, 34]. Buck and Stedman note that “[t]he anterior belly is very often abnormal; not infrequently the two anterior bellies unite in the median line and completely shut out from view the mylohyoid muscles” [4].

The aforementioned arrowhead variations all share a few common features including: (1) two sheet-like muscle bellies that do not appear to have the bulk of a typical ABDM, but rather are flattened like the mylohyoid; and (2) muscle bellies oriented in the shape of an arrowhead, diverging from the mylohyoid raphe and inserting posteriorly at the intermediate tendon of the digastric muscle. Additionally, the arrowhead-shaped musculature frequently has an accessory belly that oftentimes projects from the midline of the arrowhead, to the mandible [16, 27, 33, 34]. The arrowhead-shaped musculature has also been reported to occur in conjunction with a mentohyoid muscle, in which case the “arrowhead” lies deep to the mentohyoid muscle [4].

Photographs and line drawings of the variants have also been published in case reports. References to photographs and line drawings from case reports depicting the muscular variation that this report refers to as an “arrowhead” variation may be found in Table 1.

The similarities among multiple case reports warrant a cross-sectional study of the “arrowhead” variation. Therefore, the aim of this report is to describe the prevalence of the arrowhead variation in a cross-sectional study of cadavers and to describe any arrowhead variations in detail.

Materials and methods

Nineteen cadavers from the gross anatomical laboratory at West Virginia University School of Medicine were included in the study. All cadavers were white Americans. The average age-at-death of the population was 79.3 ± 13.9 years (mean $\pm$ SD). The population sample included 8 females with an average age of 76.1 ± 17.2 years (mean $\pm$ SD) and 11 males with an average age of 81.6 ± 11.2 years. Dissections were performed by students in an anatomy course and included removal of the skin and fascia overlying the submental musculature.

Upon discovery of an arrowhead variant, digital calipers [Mitutoyo 0–8 in (0–203.2 mm) ABSOLUTE™ digimatic caliper series 500, accuracy ± 0.001 in (0.025 mm)] that were locked to a known distance of 20.00 mm were placed flush with the musculature. Photographs were taken, with the calipers in frame, using a digital camera (Canon PowerShot SX50 HS, 12.1 Megapixel). Digital pictures were then assessed with ImageJ software

(NIH) using the 20.00 mm calibration as a reference. Measurements were taken of muscle belly length, width at mid-belly, and area. Other noteworthy connective tissue structures were also measured. Fisher's exact test was performed to assess differences among sexes.

Results

Of the 19 cadavers, five (5:19; 26.3%) were found to have variant anterior digastric musculature. Of the five variants, two (2:5; 40%) were found to have the arrowhead variation. Therefore, 10.5% (2:19) of cadavers included in the study were found to have arrowhead variations. The arrowhead variation was found in one male (1:11; 9.1%) and one female (1:8; 12.5%), respectively. Fisher's exact test revealed no significant differences among sexes ($p = 1.0000$). The following are descriptions of the two arrowhead variants:

Arrowhead variation 1

A 79-year-old white male was found to have with two sheet-like muscles that emerged from the intermediate tendon of the digastric muscle, bilaterally (Figs. 1, 2, 3). The muscles traveled anteriorly and inserted with their counterpart at the mylohyoid raphé. Their posterior margin formed a chevron pointed anteriorly that made a 119° angle at the midline. An additional muscle belly emerged from the mylohyoid raphé at a point half-way between the chin and the hyoid and inserted immediately to the right of the midline on the superficial aspect of the mandible. The supernumerary musculature was innervated by the mylohyoid nerve. A total of 90% of the inter-ABDM area was obscured by supernumerary muscular variation. Dimensions of the musculature are summarized in Table 2.

Arrowhead variation 2

A 92-year-old white female presented with two sheet-like muscles that emerged from the intermediate tendon of the digastric muscle, bilaterally (Figs. 4, 5, 6). Their posterior margin formed a chevron pointed anteriorly that made a 116° angle at the midline. The supernumerary musculature was innervated by the mylohyoid nerve. A total of 85% of the inter-ABDM area was obscured by supernumerary muscular variation. Dimensions of the musculature are summarized in Table 3.

Discussion

The inter-ABDM region is of particular clinical importance with regard to submental muscular medialization [19], submental intubation [2, 9], the submental artery flap [7, 35, 36], anterior digastric muscle transfer for the correction of oral deformity, rhytidectomy, and alteration of the cervicomental angle via muscle resection or lipectomy [6, 13, 24, 37]. Normal anatomy of the submental and submandibular triangles serves as a critical landmark during these surgical procedures. Therefore, anatomical variation in the suprahyoid musculature warrants more detailed characterization. This report documents that arrowhead variation has been reported in several cases over the last 100 years. The results of the original research presented in this study are unique because, in accord with the number of previously reported cases, it establishes prevalence data for the arrowhead variation.

With regard to embryological origin, the muscle mass of the first pharyngeal (branchial) arch forms the muscles of mastication (temporalis, lateral and medial pterygoid, and masseter) as well as the mylohyoid, anterior belly of the digastric, tensor tympani, and tensor veli palatini [10, 11]. The arrowhead musculature seen in this report was innervated by a terminal branch of the mandibular nerve, akin to the musculature of the first pharyngeal arch. Therefore, the arrowhead variation—a muscular bridge between first pharyngeal arch musculature (i.e., the mylohyoid and ABDM musculature) that has the same innervation (i.e., the mylohyoid nerve) as that of the first pharyngeal arch musculature, likely develops from aberrant gross muscle differentiation within the muscle mass of the first pharyngeal arch.

From a comparative anatomical perspective, the main bodies of each respective anterior digastric muscle usually contact in the midline for most of their length in primates such as *Tarsius*, *Saimiri*, *Macaca*, *Papio*, *Gorilla*, and *Pan*, as well as non-primate taxa such as *Rattus* and *Tupaia* [12]. Diogo and Wood note that in *Homo*, the ABDM does not contact its counterpart in the midline for most of its length [12]. However, this report demonstrates that midline connections do indeed occur in *Homo sapiens*, in both male and female sexes, at least with respect to supernumerary ABDM musculature. While the midline connections, noted in this study, may help to reinforce the floor of the mouth, the functional role of these supernumerary muscles require further investigation. Regardless of the functional role of the musculature, it is important to note that the presence of these anatomical variants may obscure important surgical landmarks during reconstructive procedures.

The arrowhead musculature is morphologically more akin to the mylohyoid, as opposed to the ABDM, in its sheet-like structure and the parallel orientation of its fibers (with the contralateral mylohyoid). Further, with regard to the size of typical, non-variant ABDM musculature, a recent report documented the average adult ABDM muscle belly length and area to be 38.7 ± 7.4 mm and 484.5 ± 101.2 mm², respectively [41]. When comparing the size of the ABDMs reported in the present study to the aforementioned averages, the ABDMs reported here were larger than average with respect to both length and area, but remained within two standard deviations of the mean. Therefore, it should be regarded that the presence of arrowhead musculature does not represent a fractioning of the typical ABDM musculature and should, rather, be considered supernumerary musculature. However, this study was limited by sample size; therefore, further research should be performed to scrutinize the aforementioned point.

With regard to kinematics, the arrowhead variation, by virtue of its blended mylohyoid and ABDM morphology would, accordingly, have similar function to the mylohyoid and ABDM. For example, the arrowhead would provide support to the floor of the mouth during the buccal phase of deglutition by resisting the depression of the floor of the mouth which results from the push of the tongue against the hard palate. Further, the arrowhead musculature would have a limited contribution to hyoid elevation, depression of the mandible (i.e., opening the mouth), and extension of the head—movements typical of the digastric muscle.

Because of the midline fusion with the mylohyoid at a shared raphé, the arrowhead variation may, at least in part, influence the spread of infection to and from the submental fascial

space. In effect, the arrowhead variation would subdivide the space into a superficial and deep compartment that would be joined posteriorly near the hyoid, and perhaps anteriorly near the mandible, where the midline junction is non-existent. Further, mylohyoid variations and the retaining ligament of the anterior digastric may further influence the spread of infection in the submental space and the pathogenesis of Ludwig angina [1, 44].

Because the arrowhead variation tethers the intermediate tendon of the digastric muscle to the mylohyoid, the arrowhead will restrict the transfer, and subsequent tethering, of the intermediate tendon to the orbicularis oris muscle in an attempt at anterior digastric muscle transfer for the correction of oral deformity [39].

In the case of the submental artery flap, there is no consensus with regard to the inclusion of ABDM musculature alone or ABDM together with the mylohyoid. Therefore, the presence of an arrowhead variation may influence which muscle tissues, if any, are included with the flap. Because normal submental anatomy provides an important landmark during such procedures, the presence of the arrowhead variation may potentially lead to surgical disorientation and complications. A detailed knowledge of the arrowhead variation could therefore help guide contingency plans when variations are encountered intraoperatively. Furthermore, because there are no well-established screening methods for identifying submental musculature variation, understanding both the anatomy and prevalence of these variations can help minimize surgical complications. Indeed, there is an incongruence between identification of submental muscular variations between imaging studies (i.e., ultrasonography, computed tomography, and magnetic resonance imaging) and direct observation via dissection, thus underscoring the importance of improved screening methods and a presence of mind to anticipate ABDM and mylohyoid variations intraoperatively [39].

As described previously, the arrowhead variant likely represents supernumerary musculature rather than fractioning of the normal ABDM. The variant musculature may be identified via imaging procedures. Prior studies have misinterpreted accessory musculature as pathology. For example, Bonala et al. reported a case in which an accessory muscle belly of the ABDM was clinically misdiagnosed as a pathological mass, but later correctly identified as variant musculature using ultrasound, CT, and MRI [3]. The differential diagnosis for submental and submandibular space masses includes abscess, plunging ranula, branchial cleft cyst, thyroglossal duct cyst, hematoma, lymphadenopathy, and benign or malignant tumors [3, 8, 17, 18, 31], but less commonly includes variant digastric musculature. Therefore, a detailed understanding of variants such as the arrowhead variation broadens the differential diagnosis in the clinical and radiological interpretation of submandibular masses. Inclusion of the arrowhead ABDM/mylohyoid muscular variations in the differential diagnosis of submental masses will aid in minimizing unnecessary biopsies or surgical interventions.

In conclusion, numerous operations are performed in the submental region; therefore, any muscular variation, especially that which may occur, as this report has found, in approximately one in ten individuals, is of clinical importance. This report has demonstrated that the arrowhead variation of the anterior digastric and mylohyoid musculature has been reported in isolated case reports since the nineteenth century. The arrowhead variation is relatively common and, therefore, should be regularly considered with regard to diagnosis of

submental masses. Likewise, the arrowhead variation should be considered in the preoperative planning of the myriad operations performed in the submental region.

Acknowledgements

Funding for this project came from the WV Research Challenge Fund [HEPC.dsr.14.13] and [HEPC.dsr.17.06], the NASA WV Space Grant Consortium, and a WVU-INTRO grant. The authors would like to acknowledge the West Virginia Anatomical Board, the WVU Human Gift Registry, and most importantly, those individuals who gifted their bodies for the advancement of science and education, without whom, this research would not have been possible.

References

1. Bender-Heine A, Zdilla MJ (2018) Variation of the mylohyoid: implications for Ludwig angina, cervical contouring, and digastric muscle transfer. *Surg Radiol Anat* 40:221–225 [PubMed: 28478605]
2. Biglioli F, Mortini P, Goisis M, Bardazzi A, Boari N (2003) Submental orotracheal intubation: an alternative to tracheotomy in transfacial cranial base surgery. *Skull Base* 13:189–195 [PubMed: 15912177]
3. Bonala N, Kishan TV, Sri Pavani B, Murthy PV (2015) Accessory belly of digastric muscle presenting as a submandibular space mass. *Med J Armed Forces India* 71(Suppl 2):S506–S508 [PubMed: 26858485]
4. Buck AH, Stedman TL (1917) A reference handbook of the medical sciences: embracing the entire range of scientific and practical medicine and allied science, vol 8 William Wood and Co., New York, p 578
5. Buffoli B, Lancini D, Ferrari M, Belotti F, Nicolai P, Tschabitscher M, Rezzani R, Rodella LF (2016) Symmetrical anatomical variant of the anterior belly of the digastric muscle: clinical implications. *Folia Morphol* 75:122–126
6. Connell BF, Shamoun JM (1997) The significance of digastric muscle contouring for rejuvenation of the submental area of the face. *Plast Reconstr Surg* 99:1586–1590 [PubMed: 9145126]
7. Curran AJ, Neligan P, Gullane PJ (1997) Submental artery island flap. *Laryngoscope* 107:1545–1549 [PubMed: 9369405]
8. Dalgic A, Karakoc O, Karahatay S, Hidir Y, Gamsizkan M, Birkent H, Gerek M (2013) Submandibular triangle masses. *J Craniofac Surg* 24:e529–e531 [PubMed: 24036836]
9. Das S, Das TP, Ghosh PS (2012) Submental intubation: A journey over the last 25 years. *J Anaesthesiol Clin Pharmacol* 28:291–303 [PubMed: 22869933]
10. Das S, Ghafar NA, Othman F, Kamaruddin A, Suhaimi FH (2014) Anomalous belly of digastric muscle: Gross anatomy with clinical implications. *MEJSR* 21:733–735
11. De-Ary-Pires B, Ary-Pires R, Pires-Neto MA (2003) The human digastric muscle: patterns and variations with clinical and surgical correlations. *Ann Anat* 185:471–479 [PubMed: 14575275]
12. Diogo R, Wood B (2011) 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* 219:273–359 [PubMed: 21689100]
13. Edgerton MT (1967) Surgical correction of facial paralysis: a plea for better reconstructions. *Ann Surg* 165:985–998 [PubMed: 6026317]
14. Fujimura A, Onodera M, Feng XY, Osawa T, Nara E, Nagato S, Matsumoto Y, Sasaki N, Nozaka Y (2003) Abnormal anterior belly of the digastric muscle: a proposal for the classification of abnormalities. *Anat Sci Int* 78:185–188 [PubMed: 14527134]
15. Harvey JA, Call Z, Peterson K, Wisco JJ (2015) Weave pattern of accessory heads to the anterior digastric muscle. *Surg Radiol Anat* 37:1001–1004 [PubMed: 25501489]
16. Karunakaran I, Dhingra R, Dhar P (2013) Accessory digastric and mylohyoid muscles—a case report. *Int J Anat Var* 6:179–181
17. Kongmebhol P (2015) Head and neck In: Peh WCG (ed) *Pitfalls in diagnostic radiology*. Springer, New York, pp 247–276

18. Kurabayashi T, Nakamura S, Ogura I, Sasaki T (2003) The sublingual and submandibular spaces. *Oral Radiol* 19:28–34
19. Labbé D, Giot JP, Kaluzinski E (2013) Submental area rejuvenation by digastric corset: anatomical study and clinical application in 20 cases. *Aesthetic Plast Surg* 37:222–231 [PubMed: 23435506]
20. Larsson SG, Lufkin RB (1987) Anomalies of digastric muscles: CT and MR demonstration. *J Comput Assist Tomogr* 11:422–425 [PubMed: 3571582]
21. Macalister A (1875) Macalister on muscular anomalies in human anatomy. *Trans R Ir Acad* 25:34
22. Malpas P (1926) Anomalies of the Mylohyoid Muscle. *J Anat* 61:64–67 [PubMed: 17104127]
23. Ozgur Z, Govsa F, Celik S, Ozgur T (2010) An unreported anatomical finding: unusual insertions of the stylohyoid and digastric muscles. *Surg Radiol Anat* 32:513–517 [PubMed: 19763380]
24. Ozgur Z, Govsa F, Ozgur T (2007) Bilateral quadrification of the anterior digastric muscles with variations of the median accessory digastric muscles. *J Craniofac Surg* 18:773–775 [PubMed: 17667663]
25. Peker T, Turgut HG, Anil A (2000) Bilateral anomaly of anterior bellies of digastric muscles. *Surg Radiol Anat* 22:119–121 [PubMed: 10959680]
26. Reyes G, Contreras C, Ramirez LM, Ballesteros LE (2007) The digastric muscle's anterior accessory belly: case report. *Med Oral Patol Cir Buccal* 12:e341–e343
27. Sargon MF, Ondero lu S, Sürücü HS, Bayramo lu A, Demiryürek DD, Oztürk H (1999) Anatomic study of complex anomalies of the digastric muscle and review of the literature. *Okajimas Folia Anat Jpn* 75:305–313 [PubMed: 10217948]
28. Sehirli U, Cavdar S (1996) An accessory mylohyoid muscle. *Surg Radiol Anat* 18:57–59 [PubMed: 8685814]
29. Seok H, Park YT, Kim SG, Park YW (2013) Correction of post-traumatic anterior open bite by injection of botulinum toxin type A into the anterior belly of the digastric muscle: case report. *J Korean Assoc Oral Maxillofac Surg* 39:188–192 [PubMed: 24471041]
30. Standring S (2008) Gray's anatomy: the anatomical basis of clinical practice, 40th edn. Churchill-Livingston/Elsevier, New York, p 600
31. Ural A, Imamo lu M, Umit I ık A, Bahadır O, Bekta D, Cobano lu B, Cobano lu U (2011) Neck masses confined to the submental space: our experience with 24 cases. *Ear Nose Throat J* 90:538–540 [PubMed: 22109923]
32. Williston SW (1890) The sternalis muscle. *Proc Acad Nat Sci Phila* 41:41
33. Yamada S (1935) Beobachtungen über den venter anterior des musculus digastricus manibulae bei japanischen erwachsenen und foeten. *Kaibogaku Zasshi* 8:303–329
34. Yamazaki Y, Shibata M, Ushiki T, Isokawa K, Sato N (2011) Bilateral asymmetric anomalies of the anterior bellies of the digastric muscles. *J Oral Sci* 53:523–527 [PubMed: 22167040]
35. Yilmaz M, Menderes A, Barutçu A (1997) Submental artery island flap for reconstruction of the lower and mid face. *Ann Plast Surg* 39:30–35 [PubMed: 9229089]
36. Zdilla MJ (2014) Exclusion of musculature from the submental flap: a contingency plan for facial nerve palsy. *Plast Reconstr Surg Glob Open* 2:e266 [PubMed: 25587500]
37. Zdilla MJ (2014) Variant anterior digastric muscle transfer for marginal mandibular branch of facial nerve palsy. *Plast Reconstr Surg Glob Open* 2:e110 [PubMed: 25289304]
38. Zdilla MJ (2015) Screening for variations of anterior digastric musculature prior to correction of post-traumatic anterior open bite by injection of botulinum toxin type A: a technical note. *J Korean Assoc Oral Maxillofac Surg* 41:165–167 [PubMed: 26131435]
39. Zdilla MJ (2016) Atrophy of the anterior digastric muscle: response to a prospective clinical study. *Br J Oral Maxillofac Surg* 54:1055 [PubMed: 26969291]
40. Zdilla MJ, Lambert HW (2015) Mylohyoid insertion at the mid-belly of a combined geniohyoid via a fibrous pseudo-hyoid: an observation with implications for submental flap surgery. *JPRAS Open* 5:1–3
41. Zdilla MJ, Pancake AR, Lambert HW (2016) Morphometrics of the anterior belly and intermediate tendon of the digastric muscle: sexual dimorphism and implications for surgery. *J Craniofac Surg* 27:1321–1326 [PubMed: 27258716]

42. Zdilla MJ, Soloninka HJ, Lambert HW (2014) A fractal anterior digastric: a case report with surgical implications. *Int J Anat Var* 7:106–108
43. Zdilla MJ, Soloninka HJ, Lambert HW (2014) Unilateral duplication of the anterior digastric muscle belly: a case report with implications for surgeries of the submental region. *J Surg Case Rep* 12:1–2
44. Zdilla MJ, Swearingen JV, Miller KD, Bender-Heine A, Lambert HW (2017) The retaining ligament of the anterior digastric muscle. *J Craniofac Surg* 28:534–538 [PubMed: 28045823]
45. Zlabek K (1933) Contribution a la connaissance des anomalies du ventre anterieur du digastrique de l'Homme. *Arch Anat Histol Embryol* 16:357–406

Fig. 1.

Inferior view of the submental triangle demonstrating the arrowhead muscular variation connecting the anterior bellies of the digastric muscles with underlying mylohyoid. The mylohyoid is obscured from view by the arrowhead musculature, which occupies nearly all of the visible inter-digastric area. *ABDM* anterior belly of the digastric muscle, *IT* intermediate tendon of the digastric muscle, arrowhead: arrowhead muscular variant, asterisk: accessory muscular belly traveling between the mandible and the arrowhead variant

Fig. 2.

Inferolateral view from the right of the submental region with anterior digastric muscle bellies reflected away from their mandibular attachments and the accessory muscle (shown in Fig. 1) between the mandible and the arrowhead variant resected. The arrowhead muscular variation is seen attaching at the posterior anterior digastric muscle belly, the intermediate tendon of the digastric muscle, and the mylohyoid raphe. The posterior margin of the arrowhead variant is free from the underlying tissue and the thin, sheet-like, nature of the musculature can be appreciated. Each side of the arrowhead variation has muscle fibers that travel parallel with each contralateral mylohyoid, respectively. *MH* mylohyoid muscle, *ABDM* anterior belly of the digastric muscle, *IT* intermediate tendon of the digastric muscle, arrowhead: arrowhead muscular variant

Fig. 3.

Illustration of the muscular anatomy of the submental and submandibular triangles as viewed from the inferior corresponding to the musculature seen in Figs. 1 and 2. Muscle fiber direction is emphasized to appreciate the parallel nature of the arrowhead bellies with the mylohyoid musculature on the contralateral side

Fig. 4.

Inferior view of the submental triangle demonstrating the arrowhead muscular variation. Overlying the arrowhead musculature are two small accessory muscles that diverge toward the mandible from two thin tendinous slips. *ABDM* anterior belly of the digastric muscle, *IT* intermediate tendon of the digastric muscle, arrowheads: underlying arrowhead muscular variant, *TS* tendinous slips, asterisk: accessory muscular bellies traveling between the mandible and the tendinous slips

Fig. 5. Inferior view of the submental triangle seen in Fig. 4 with the small accessory muscle bellies removed to expose the underlying arrowhead variation. *ABDM* anterior belly of the digastric muscle, *IT* intermediate tendon of the digastric muscle, arrowhead: arrowhead muscular variant, *MH* mylohyoid, asterisk: deep accessory muscular belly traveling from the apex of the arrowhead variant to the mandible

Fig. 6.

Illustration of the muscular anatomy of the submental and submandibular triangles as viewed from the inferior corresponding to the musculature seen in Figs. 4 and 5. Muscle fiber direction is emphasized in order to appreciate the parallel nature of the arrowhead bellies with the mylohyoid musculature on the contralateral side

Table 1

References to photographs and line drawings of “arrowhead” variants of anterior digastric and mylohyoid musculature

Citation	Page(s)	Plate	Figure(s)
Buck and Stedman [4]	578	NA	4921 ^b
Yamada [33]	312	NA	12 ^b , 13 ^b , 17 ^b
Sargon et al. [27]	311	III	3a ^a , 3b ^b
Reyes et al. [26]	E342	NA	1 ^a , 2 ^b , 3 ^a , 4 ^b
Yamazaki et al. [34]	524	NA	1a ^a , 1b ^b , 2a ^a , 2b ^b
Karunakaran et al. [16]	180	NA	1a ^a , 1b ^b
Buffoli et al. [5]	113,114	NA	1 ^a , 2 ^a , 3 ^b

^aPhotograph

^bLine drawing/illustration

Table 2

Size of noteworthy structures that correspond to Case 1

Muscular structure	Length (mm)	Width (mm)	Area (mm ²)
Right anterior digastric muscle belly	44	11	504
Left anterior digastric muscle belly	45	12	541
Right arrowhead component	n/a	n/a	230
Left arrowhead component	n/a	n/a	306
Midline muscle	31	6	185

Table 3

Size of noteworthy structures that correspond to Case 2

Muscular structure	Length (mm)	Width (mm)	Area (mm ²)
Right anterior digastric muscle belly	45	12	379
Left anterior digastric muscle belly	42	13	400
Right arrowhead component	n/a	n/a	230
Left arrowhead component	n/a	n/a	306
Right superficial paramedian muscle	30	7	160
Left superficial paramedian muscle	30	7	155
Left deep paramedian muscle	15	2.1	29
Right tendinous slip	13	1.7	22
Left tendinous slip	15	1.7	25