

Anatomical Variant**A NOVEL ANOMALY OF THE ANTERIOR DIGASTRIC MUSCLE****Timothy W. Hegeman*, James J. Giannone, Rahmat A. Balogun***Academic Medicine Scholars Program, New York College of Osteopathic Medicine of New York Institute of Technology, New York, USA.***RESUMEN**

Documentamos una anomalía del músculo digástrico anterior en un cadáver femenino de 85 años de edad. La anomalía consiste en cuatro vientres adicionales que salen entre los dos típicos digástricos anterior. Analizamos el significado embriológico y clínico de esta variante. El músculo digástrico es derivado de dos arcos branquiales o arcos faríngeos. El primer arco branquial forma el vientre anterior y el segundo forma el vientre posterior. Actuando juntos, los vientres ayudan a impulsar hacia abajo la mandíbula y a estabilizar el hioides. Varias anomalías en el vientre anterior del digástrico han sido previamente descritas en la literatura, pero ninguna ha replicado la formación precisa descrita aquí.

Palabras claves: *cuello, embriología, anatomía, variación anatómica.*

ABSTRACT

We document a novel anomaly of the anterior digastrics of an 85 year old female cadaver, consisting of four additional muscle bellies existing between the two typical anterior digastrics and go on to explain the embryologic and clinical significance of the variant. The digastric muscle is derived from two pharyngeal arches, the first pharyngeal arch forming the anterior belly and the second forming the posterior belly. Acting together, both bellies help to depress the mandible and stabilize the hyoid. Several abnormalities in the anterior belly of the digastric muscle have previously been described in the literature, but none have replicated the precise formation described here.

Key words: *neck, embryology, anatomy, radiology, variation.*

Variance in the anterior belly of the digastric muscle has been described for over a hundred years (Macalister, 1882), with one estimate

stating overall prevalence as approximately 5.3% (Sargon et al, 1999). The typical digastric anatomy consists of two muscle bellies connected by a fibrous central band, the intermediate tendon, which runs through a synovial pulley attached to the body of the hyoid near the lesser horn of the hyoid. The anterior digastric typically inserts on the digastric fossa on the posteroinferior surface of the inferior mandible to the greater horn of the hyoid bone. The posterior belly is longer than the anterior and runs from the hyoid bone to the medial surface of the mastoid process. These separate muscle bellies work in concert to stabilize the hyoid and to depress the mandible. To our knowledge there are no reports of muscles replicating the precise accessory muscle pattern described here, although the incidence of any anomaly, including both aberrant attachments and accessory muscle development, appears relatively high (Celik, et al, 1992; Peker, et al, 2000; Sargon et al, 1999). Bilateral variation, as that described here, appears less commonly than unilateral ones (Peker et al, 2000). Sargon and colleagues (1999) dissected and examined 99 Turkish cadavers and revealed 5 anomalies, giving perhaps the best available estimate of prevalence. Traini (1993) described a variation with four accessory digastric bellies within the submental triangle, but not in the attachment points of these bellies.

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In the gross anatomy lab at the New York College of Osteopathic Medicine the specimen, an 85-year-old female cadaver, was dissected as per the instructions given in Grant's Dissector (Tank, 2005). Upon reaching the submental triangle a muscular anomaly was obvious. The normal anterior bellies of the digastrics were

present, originating as expected on the posterior surface of the mandible, running posteroinferiorly to the hyoid where they formed the intermediate tendons, looping through fibrous slings at the hyoid, then forming the posterior digastrics, which coursed back to the mastoid process.

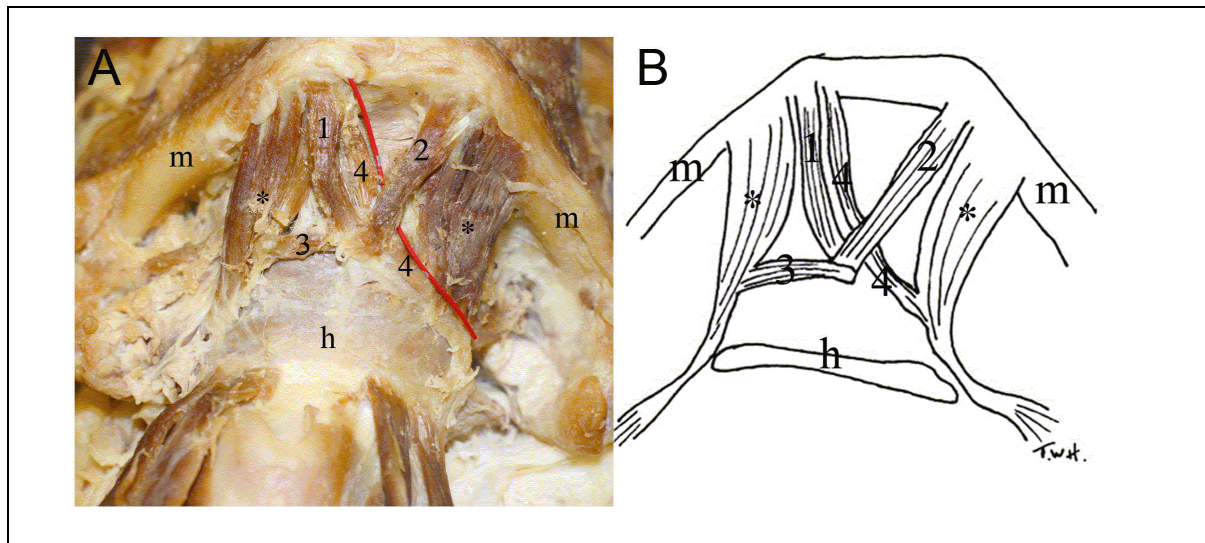


Figure 1. A: Photograph of the anomalous anterior digastric. A red wire passes along the anterior border of the muscle belly labeled with a three in order to clearly display the course of this muscle. B: Representative drawing of the anomalous anterior digastrics. 1-4, distinct and anomalous muscle bellies of anterior digastric; *, conventional anterior digastric; m, mandible; h, hyoid.

Between the conventional anterior digastrics four irregular muscle bellies formed an X-shape within the submental triangle (fig. 1A and 1B). Two of the accessory bellies originated just medial to the mandibular attachment of the normal anterior digastric and inserted on a point on the midline raphe of the mylohyoid muscle 2.5 cm superior to the hyoid bone. On the right side a third belly originated at this midline raphe attachment, ran laterally and blended into the intermediate tendon of the right digastric. The fourth belly originated from the right side of the mandible, just medial to the other accessory digastrics, and coursed across the midline raphe of the mylohyoid, deep to the other accessory structures. This fourth belly continued to blend the fibers of the left intermediate tendon.

The anterior digastrics form the lateral borders of the submental triangle, an anatomical region that contains the submental lymph nodes, which drain the lower lip and floor of the mouth. Both anterior

and posterior digastrics help define the inferior boundaries of the submandibular triangles, the contents of which include internal and external carotid artery, internal jugular vein, submandibular glands and deep cervical lymph nodes, which drain the upper lips, cheeks, and parts of the tongue. The lymph nodes of the submental and submandibular triangles are a common site of metastasis of head and neck cancers, demonstrating the need to accurately visualize and assess this area to provide pretreatment evaluation and surgical planning (Som, 1987).

The use of computer tomography (CT) and magnetic resonance imaging (MRI) provides a detailed picture of internal anatomy, an indispensable tool in the evaluation of head and neck cancers while also aiding in preparation for surgical procedures. The utility of radiologic scanning is dependent on the understanding of the spectrum of normal anatomy. In the region

examined here it has been shown that variability and asymmetry of the digastric muscle is visible on CT and MRI of asymptomatic subjects (Larsson and Lufkin, 1987; Muraki, et al, 1983). Confounding the radiographic evaluation of the submandibular space is the fact the nodes found within this space have a signal similar to skeletal muscle (Mancuso, et al, 1983). An alteration of the expected borders of the submandibular triangle may result in overlooking potentially diseased lymph nodes or judging a benign yet anomalous digastric muscle as malignant tissue (Loukas, et al, 2005). Ultrasound has been used recently as a means to assess the submandibular space and may provide a way of identifying a muscular anomaly in a manner that is inexpensive and effective (Mashkevich, et al, 2009).

The two bellies of the digastric muscle develop from two separate pharyngeal arches and are innervated via two different nerves (Moore and Persaud, 2003). The pharyngeal arches form all of the muscles of the head and neck in a process that begins with migration of neural crest cells from rhombomeres (hindbrain segments) 2 through 7. Most anomalies in this region originate during early embryonic development (Sadler, 1995). The pharyngeal arches are composed of two mesenchymal cell populations, neural crest cells and cranial mesoderm. The digastric muscle itself is derived from the mesoderm but its course of development is strongly influenced by neural crest cells and any disruption or aberration in signaling from these cells may cause disruption in muscle formation. As evidenced by Heude, et al (2010), expression of Dlx (a neural crest cell signaling molecule) by cranial neural crest cells is required for determination, differentiation and patterning of craniofacial muscles in vertebrates. Broadly, the malformation described could potentially be explained by an error in neural crest cell signaling or more specifically, the Dlx signaling pathway, either of which could have lead to erroneous mesodermal cell migration. Alternatively the signaling could have operated appropriately but some of the neural crest cells responsible for orchestrating the mesoderm development may themselves have improperly migrated, thereby signaling the formation of muscle where it typically is not seen. Aberrant migration of neural crest cells has been implicated in the etiology of major anatomical malformations such as diGeorge syndrome and certain congenital heart defects (Moore and Persaud, 2003). The development of anomalous anterior digastric muscles described here, although not itself clinically significant, could

follow a pathogenetic sequence that is very similar these clinically severe conditions.

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