

Unusual Duplication of the Inferior Belly of the Omohyoid Muscle. Anatomical Description and Clinical Implication

Silvio Antonio Garbelotti Junior,¹ Paulo Laino Cândido,¹ Osvaldo Pelozo Junior,¹ Marcelo Calil Burihan,^{1,2} Aluisio Andrade Junior,^{1,2} Marco Antonio De Angelis¹

¹Discipline of Descriptive and Topographic Anatomy, Santa Marcelina Medical College, São Paulo, Brazil

²Department of Surgery, Santa Marcelina Hospital, São Paulo, Brazil

Disclose and conflicts of interest: none to be declared by all authors

ABSTRACT

Introduction: anatomical variations of the omohyoid muscles are clinically important due to their close relationship with the internal jugular vein, as well as their significance when accessing the neck during surgery.

Case report: we present an atypical duplication of the lower belly of the omohyoid muscle in the right anterior cervical region of a 60-year-old male cadaver. This aberrant lower belly had a common origin with the normal omohyoid muscle tendon that ran medially until the thyroid cartilage and was inserted in the lateral border of the sternothyroid muscle. No other muscle anomalies, anatomical variations, or pathology were found.

Conclusion: the omohyoid muscle is used as a reference point during exploratory neck dissection surgeries. Knowledge of possible anatomical variations of the omohyoid muscle is important to avoid misinterpretations and surgical complications.

Keywords: Anatomical variation; infrahyoid muscles; Omohyoid muscle; Neck”.

Introduction

The omohyoid muscle is an infrahyoid muscle and consists of two muscle bellies united by an intermediate tendon. The inferior belly usually arises from the superior border of the scapula near the scapular notch, and occasionally from the superior transverse ligament of the scapula. It then passes behind the sternocleidomastoid muscle. The intermediate tendon crosses superficially near the internal jugular vein.

The superior belly begins at the intermediate tendon and extends upward to insert into the lower border of the hyoid bone.¹⁻⁴ In general, the infrahyoid muscles are innervated by the ansa cervicalis roots. The vascular supply is provided by branches of the superior thyroid and lingual arteries.^{3,4}

The function of the omohyoid muscles is to aid in swallowing and chewing and they actively lower and stabilize the hyoid bone during the depression, retrusion, lateral placement of the mandible.³⁻⁵ However, the omohyoid muscles role in phonation is still debatable.^{6,7} In electromyographic research, Castro *et al.*⁵ observed that the strongest activity of the superior belly of the omohyoid occurred during placement of the tip of the tongue on the soft palate. Nevertheless, the same activity was not verified during normal tongue movements during human speech.

The omohyoid muscle located in the cervical region is particularly important to anatomists. It anteriorly defines the carotid triangle and divides the

posterior cervical triangle into two parts. Because of its relationship to the large cervical vessels, it is often used by surgeons as a convenient marker in head and neck lymph node dissection procedures. The omohyoid muscle is a reference point for identifying level III and IV lymph node metastases.^{1,2,7-11} Therefore, the presence of an anatomical muscle variation in any region of the neck can be a problem due to the compact and complex neck structures found in this region.

Many studies have reported variations in the omohyoid muscle and often report a duplicated omohyoid muscle.^{7,9,10,12-15} However, an aberrant medial attachment in the thyroid cartilage is apparently uncommon. In this study, we present a variation in the inferior belly of the omohyoid muscle that was duplicated and attached to the right lamina of the thyroid cartilage. It shares a close relationship with the internal jugular vein and the sternothyroid muscle.

Case Report

During routine dissection in the neck region of a 60-year-old male cadaver, an anatomical variation of the right omohyoid muscle was found (Figure 1). After the right sternocleidomastoid muscle was resected, a normal omohyoid muscle was identified and presented a normal path and attachment points. However, while examining a common clavicle attachment to the typical inferior belly, an aberrant duplicated belly was found that was located transversely and medially. It

was fixed on the right lamina of the thyroid cartilage to the far lateral border of the sternothyroid muscle. This aberrant muscle belly presented a superficial path to the internal jugular vein, and it was attached to the deep structures by a fascia. No other muscle anomalies, anatomical variations, or pathology were found in the neck or larynx regions.

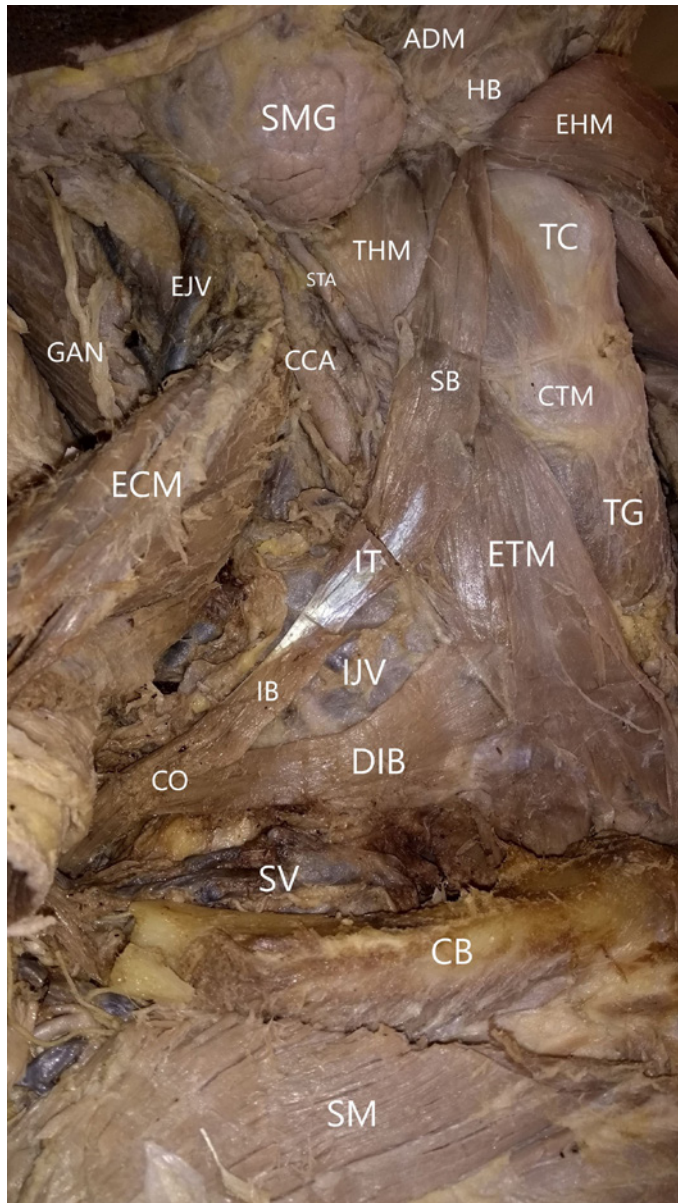


Figure 1. Right side view of the neck. SMG – Submandibular gland; ADM – Anterior belly of the digastric muscle; HB – Hyoid bone; EHM – Sternohyoid muscle (reflected); GAN – Great auricular nerve; EJV – External jugular vein; CCA – Common carotid artery; STA – Superior thyroid artery; THM – Thyrohyoid muscle; TC – Thyroid cartilage; CTM – Cricothyroid muscle; ECM – Sternocleidomastoid muscle (reflected); SB – Superior belly of the omohyoid muscle; IT – Intermediate tendon; IB – Inferior belly of the omohyoid muscle; IJV – Internal jugular vein; DIB – Duplicated inferior belly of the omohyoid muscle; CO – Common origin of the lower bellies of the omohyoid muscle; ETM – Sternothyroid muscle; TG – Thyroid gland; SV – Subclavian vein; CB – Clavicle; SM – Subclavius muscle.

Discussion

Although omohyoid anomalies are well reported in the literature and affect 15% to 20% of the population⁷ a complete duplication of the omohyoid muscle from

its attachment to the scapula and to the hyoid bone is uncommon. The most common abnormal variations include attachment of both inferior bellies, hypoplasia, hypertrophy, absence, or duplication of the superior or inferior bellies, multiple bellies, aberrant attachment in the clavicle or in the transverse process of C6, unusual posterior path to the internal jugular vein, and fusion of the superior belly to the sternohyoid muscle.^{2,7,12,15-18}

These variations were classified into four types by Sukekawa and Itoh¹³ and Rai *et al.*¹⁴ and classified into six types by Miura *et al.*¹⁷ Based on these classifications, our case is similar to type III by Rai *et al.*¹⁴, this is in accordance with data from Bergaman *et al.*¹² who reported an incidence of only 3% in cases of clavicle inferior belly duplications. Raikos *et al.*⁷, Rai *et al.*⁹, Kim *et al.*¹⁰, and Iwanaga *et al.*¹⁵ described a similar variation of an aberrant inferior belly found on a thyroid cartilage attachment close to the lateral border of the sternohyoid muscle. This type of variation appears to be more unusual than the duplication of the superior belly.⁷

The infrahyoid muscles vary considerably during development, and anomalies that occur during the unfolding of the embryonic leaflets during development may explain these anatomical variations. Although the omohyoid is an infrahyoid muscle, it differs from the other three muscles (sternohyoid, sternothyroid, and thyrohyoid) due to the formation process of this muscle group.¹³ These muscles form a primitive muscle leaflet in the anterior cervical area and divide into a superficial anterior layer forming the sternothyroid and thyrohyoid muscles, and then grow into a deep layer obliquely in lateral and inferior directions giving rise to the omohyoid.^{14,19}

In evolutionary terms, there are speculations that these anatomical variations represent a reduced vestigial muscle of the episternal-cleido-hyoid muscle present in seals and lower vertebrates, such as reptiles.¹⁷ In addition, Zimmermann *et al.*²⁰ reported that the omohyoid is present only in frogs and salamanders but may be deeply mixed with the sternohyoid in some species. In humans, tongue muscles and infrahyoid muscles are called hypobranchial muscles and are of somitic origin. In other words, are muscles originating from the trunk that migrate a long-distance anteriorly to the neck and head during development. This fact also explains why the extrinsic muscles of the tongue and the infrahyoid muscles are innervated by the cervical nerves or by the hypoglossal nerve (NC XII).^{20,21}

In this case, we cannot say that this variation caused dysfunction movements during phonation or in the normal movement of the mandible or tongue, as suggested by Castro *et al.*^{5,6} And we can only speculate that the contraction of this anomalous belly could cause excessive compression of the internal jugular vein due to the close relationship observed between the structures. The direct relationship of the intermediary tendon of a normal omohyoid muscle with the anterior

wall of the internal jugular vein and its connection with it through a thin layer of the pre-tracheal fascia of the cervical fascia generates a direct effect over the vessel lumen during muscle contractions.^{2,9,11,14}

According to Patra *et al.*, this effect is important because compression of the internal jugular vein by the omohyoid can lead to an anti-reflux function, equivalent to venous valves, which can play a role in cerebral protection during activities such as laughing or forced inspiration.² Lang reported that the contraction of the infrahyoid muscles, particularly the omohyoid muscle, causes dilation of the penetrating veins in the neck.³ Classically, the omohyoid was thought to stretch a pre-tracheal fascia during inspiration and thereby dilate the internal and external jugular veins.²² This would then presumably facilitate venous return to the heart.⁶ In addition, the omohyoid muscle has been used as a transposition option for restoring abduction of a paralyzed vocal fold, bilaterally. It has been used to create a loop around the tracheoesophageal shunt to restore voice function and decrease the aspiration rate in patients with a total laryngectomy

after cancer surgery.^{7,18} And Wang *et al.* reported that infrahyoid myocutaneous flaps are commonly used for reconstruction of the tongue after lingual carcinoma resection surgery.²⁴

In any case, the omohyoid muscle is considered the best reference point for identifying an internal jugular vein.^{1,7-11} Therefore, any variation in this muscle can increase the risk of vessel injury during surgery or restrict direct access to the internal jugular vein, which can result in a deep hematoma. An aberrant muscle can create technical difficulties if found during surgery because it could possibly prevent the effective creation of the required loop in the tracheoesophageal shunt.⁷

Conclusion

For the great importance of the omohyoid muscle in neck surgical procedures, and its close relationship to the internal jugular vein, it is important that the literature reflect descriptions of anatomical variations that can affect the outcome of neck surgical procedures, as well as the potential for functional recovery.

References

- Mizen KD, Mitchell DA. Anatomical variability of omohyoid and its relevance in oropharyngeal cancer. *Br J Oral Maxillofac Surg* 2005;43:285-288.
- Kasapoglu F, Dokuzlar EU. An unknown anatomical variation of omohyoid muscle. *Clin Anat* 2007;20:964-965.
- Standring S. *Gray's anatomy: the anatomical basis of clinical practice*. 41st ed. London: Elsevier; 2015: 443-473.
- Moore KL, Dalley AF, Agur AMR. *Clinically oriented anatomy*. 18th ed. London: Elsevier; 2018: 2239-2278.
- Castro HA, Resende LA, Berzin F, Konig B. Electromyographic analysis of the superior belly of the omohyoid muscle and anterior belly of the digastric muscle in tongue and head movements. *J Electromyogr Kinesiol* 1999;9:229-232.
- Castro HA, Resende LA, Berzin F, Konig B. Electromyographic analysis of superior belly of the omohyoid muscle and anterior belly of the digastric muscle in mandibular movements. *Electromyogr Clin Neurophysiol* 1998;38:443-447.
- Raikos A, Agnihotri A, Yousif S, Kordali P, Saberi M, Brand-Saberi B. Internal jugular vein cannulation complications and elimination of the muscular triangle of the neck due to aberrant infrahyoid muscles. *Rom J Morphol Embryol* 2014;55:997-1000.
- Hatipoglu ES, Kervancioglu P, Tuncer MC. An unusual variation of the omohyoid muscle and review of literature. *Ann Anat* 2006;188:469-472.
- Rai R, Nayak SR, Ranade AN, Prabhu LV, Vadgaonkar R. Duplicated omohyoid muscle and its clinical significance. *Rom J Morphol Embryol* 2007;48:295-297.
- Kim D-I, Kim H-J, Park J-Y, Lee K-S. Variation of the infrahyoid muscle: duplicated omohyoid and appearance of the levator glandulae thyroideae muscles. *Yonsei Med J* 2010;51:984-986.
- Singh N, Kathole M, Kaur J, *et al.* Bilateral clavicular attachment of omohyoid muscle. *Morphologie* 2018;102:87-90.
- Bergman RA, Afifi AK, Miyauchi R. *Illustrated encyclopedia of human anatomic variation: muscular system: omohyoideus, sternohyoideus, thyrohyoideus, sternothyroideus*; 1996. Available at: <https://www.anatomyatlases.org/AnatomicVariants/MuscularSystem/Text/O/14Omohyoideus.shtml>. Accessed July 17, 2021.
- Sukekawa R, Itoh I. Anatomical study of the human omohyoid muscle: regarding intermediate morphologies between normal and anomalous morphologies of the superior belly. *Anat Sci Int* 2006;81:107-114.
- Rai R, Ranade A, Nayak S, Vadgaonkar R, Mangala P, Krishnamurthy A. A study of anatomical variability of the omohyoid muscle and its clinical relevance. *Clinics* 2008;64:521-524.
- Iwanaga J, Tabira Y, Fisahn C, *et al.* Unusual muscle of the anterior neck: cadaveric findings with surgical applications. *Anat Cell Biol* 2017;50:239-41.
- Tubbs RS, Salter EG, Oakes WJ. Unusual origin of the omohyoid muscle. *Clin Anat* 2004;17:578-582.
- Miura M, Kato S, Itonaga I, Usui T. The double omohyoid muscle in humans: report of one case and review of the literature. *Okajimas Folia Anat Jpn* 1995;72:81-97.
- Thangarajan R, Shetty P, Sirasanagnadla SR, D'souza MR. Unusual morphology of the superior belly of omohyoid muscle. *Anat Cell Biol* 2014;47:271-273.
- Moore KL, Persaud TVN, Torchia MG. *The developing human: clinically oriented embryology*, 10th ed. London: Elsevier; 2016: 357.
- Ziermann JM, Diaz Jr RE, Diogo R. Heads, jaws, and muscles: anatomical, functional, and developmental diversity in chordate evolution, 1st ed. Cham: Springer; 2019:280-282.
- Diogo R, Noden DM, Smith CM, *et al.* *Understanding human anatomy and pathology: an evolutionary and developmental guide for medical students*. 1st ed. Boca Raton: CRC Press, Taylor & Francis; 2016: 55,79-81.
- Patra P, Gunness TK, Robert R, *et al.* Physiologic variations of the internal jugular vein surface, role of the omohyoid muscle, a preliminary echographic study. *Surg Radiol Anat* 1988;10:107-112.
- Lang J. *Clinical anatomy of the cervical spine*. 1st ed. New York: Thieme; 1993: 29.
- Wang HS, Shen JW, Ma DB, *et al.* The infrahyoid musculocutaneous flap for reconstruction after resection of head and neck cancer. *Cancer* 1986;57:663-668.

Mini Curriculum and Author's Contribution

1. Silvio Antonio Garbelotti Junior – PhD: Case report conception and design; Acquisition of case (dissection); Analysis and interpretation of case; Drafting of manuscript; Critical revision of manuscript. ORCID: 0000-0001-8178-8183
2. Paulo Laino Cândido – MSc: Case report conception and design; Acquisition of case (dissection); Analysis and interpretation of case. ORCID: 0000-0003-2424-7908
3. Osvaldo Pelozo Junior – MSc: Analysis and interpretation of case; Critical revision of manuscript. ORCID: 0000-0001-5729-4298
4. Marcelo Calil Burihan – MSc: Analysis and interpretation of case; Clinical interpretation. ORCID: 0000-0002-9973-5239
5. Aluisio Andrade Junior – MD: Analysis and interpretation of case; Clinical interpretation. ORCID: 0000-003-1986-3626
6. Marco Antonio De Angelis – PhD: Analysis and interpretation of case; Critical revision of manuscript. ORCID: 0000-0001-5729-4298

Received: September 30, 2021
Accepted: October 4, 2021

Corresponding author
Silvio Antonio Garbelotti Junior
E-mail: silviogarbelotti@gmail.com