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Case report

DEEP BELLY OF TEMPORALIS OR SPHENO-MANDIBULAR MUSCLE? ANATOMICAL ASSESSMENT BY IMAGING

F. Cecchetti[1], M. Di Girolamo[2], L. Baggi[1] and D. Mazza[1]

[1]Department of Social Dentistry and Gnathological Rehabilitation, National Institute for Health, Migration and Poverty (NIHMP), Rome, Italy
[2]Department of Clinical Sciences and Translational Medicine, Tor Vergata University, Rome, Italy;

**Correspondence to:*
Dario Mazza, DDS
Department of Social Dentistry and Gnathological Rehabilitation,
National Institute for Health, Migration and Poverty (NIHMP), Rome, Italy
e-mail: mzzdra@hotmail.com

ABSTRACT

The presence and the anatomical relationships of the deep belly of the temporalis muscle with adjacent structures were assessed by means of computer tomography (CT) and magnetic resonance imaging (MRI). The study group included 40 subjects (26 men and 14 women) ranging from 36 to 74 years (mean age of 56). A multislice Somatom Volume Zoom Spiral CT and 1.5-Tesla-MRI equipment were used for imaging, with a dedicated coil for facial structures; T1-weighted TSE sequences performed exams. The study volume was the same for both investigations. The deep belly of the temporalis muscle was depicted and studied on axial, sagittal, and coronal planes in all exams. The deep belly of the temporalis muscle corresponds to the spheno-mandibular muscle.

KEYWORDS: *temporalis, muscle, pain, diagnosis, CT, MRI.*

INTRODUCTION

In the last nineteen years, many authors have studied the temporalis muscle (TM) and its accessory fasciae (1-5). Some authors described the origins of the TM, such as the infratemporal crest, the frontal surface of the frontal process of the zygomatic bone, the lower surface of the zygomatic arch and the temporalis fascia insertions including the "pre-anterior belly of the TM", which inserts on the medial surface of the ramus of the mandible.

In 1995, Dunn et al. conducted an anatomic study of 25 cadavers (6). They observed that what was described as "the deep belly of the TM" was another muscle whose vascularization and innervation was different from those of the TM. This structure was therefore renamed the "sphenomandibular muscle" (SM) (7).

On its medial fascia, next to its origin, the SM muscle is innervated by branches of the buccinator nerve (fifth pair of

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cranial nerves), whereas vascularization is supplied by branches of the pterygoid artery (8) (coming from the maxillary artery) entering the SM on its medial surface, below the nerves.

In the present study, we attempt to show, by multislice CT and MRI, the position and structure of the SM correlations with adjacent structures and provide hypotheses concerning its function.

MATERIAL AND METHODS

The initial sample included 45 subjects without TMJ disease and with a stable dental occlusion subject. Patients underwent CT and MRI examinations for ENT reasons. Five subjects were excluded from the study since MR and CT imaging of TMJs showed structural changes in the joints. The remaining study group included 40 subjects (26 men and 14 women) with ages ranging from 36 to 74 years (mean, 56 years).

All patients underwent routine clinical examinations. As a result, diagnostic, treatment, and consensus for the scientific use of data were obtained from all patients. The study was performed in conformity with the Declaration of Helsinki of 2013.

A multislice Somatom Volume Zoom Spiral CT equipment (Siemens, Erlangen - Germany) was used for CT imaging. Axial scans, 3 mm in thickness, were performed parallel to the hard palate, extending from the skull base's anterior portion to the mandible's lower margin. The total scan duration was approximately 20 seconds. Coronal and sagittal images were reconstructed using Vitrea® 2.0 3-D reconstruction software (Vital Images, Fairfield, Iowa, USA). Reconstruction following planes perpendicular to the latero-lateral axis of the SM (viewed on an axial scan) was used for sagittal images. Reconstruction following planes parallel to the major axis of the SM (viewed on sagittal images) was used for coronal images. 1.5-Tesla MRI (Magnetom Vision, Siemens Germany) was used with a dedicated coil for facial structures.

Exams were performed using T1-weighted TSE sequences (500-600 TR, 12-20 TE, 160-200 FoV, two acquisitions, 256x256 matrix, slice thickness of 3 mm, and duration of each sequence of 2 min. and 30 sec.). Axial, sagittal, and coronal scans were obtained; CT and MRI study volumes were the same. All morphological features of the SM and adjacent structures were evaluated.

RESULTS

The SM was studied on axial, sagittal, and coronal planes. It proved to be a paired and symmetrical muscle originating from behind the orbit, anterio-laterally to the pyramidal process and from the anterior portion of the infratemporal surface of the greater wing of the sphenoid. It inserts on the medial surface of the coronoid process and, partially, on the mandible's ramus, at the maxillary sinus level. The upper fibres of the upper belly of the lateral pterygoid muscle (LPM) originate from the posterior surface of the pyramidal process. In contrast, inferior fibres of the upper belly of the LPM originate from aponeurosis placed between the posterior surface of the SM and the upper belly of the LPM.

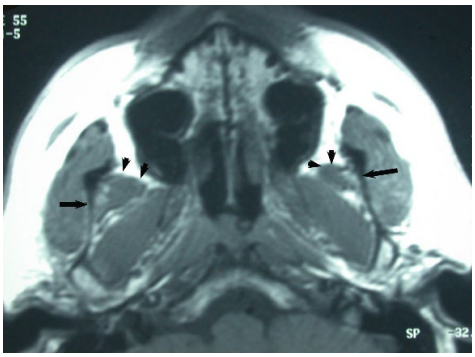


Fig. 1. *MRI axial plane. Black arrows point: deep belly of temporal muscle. Thin black arrows: mandibular insertion.*

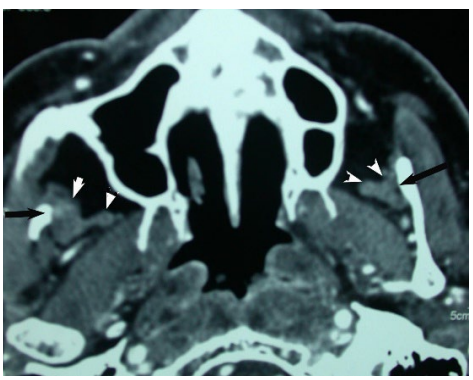


Fig. 2. *CT axial plane. White arrows point: deep belly of temporal muscle. Thin black arrows: mandibular insertion.*

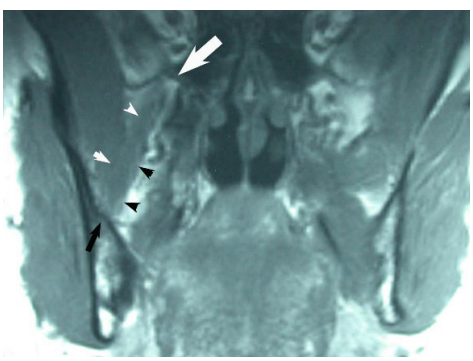


Fig. 3. *MRI coronal plane. Black and white arrows point: deep belly of temporal muscle. Thin black arrow: mandibular insertion. White arrow: insertion in the pyramidal apophysis of the sphenoid bone.*

In the axial plane (Fig. 1, 2), the SM is triangular with a lateral base and a medial apex. This triangular area is very important from an anatomical and surgical point of view; it binds the space of the infratemporal fossa where the internal infratemporal artery runs. This triangle has a very limited lateral base, formed by the ramus of the mandible at the level of the sigmoid sinus, and a medial apex, the pyramidal apophysis of the sphenoid; the anterior side is formed by the posterior border of the SM, whereas the posterior side is composed by the anterior border of the LPM.

In the coronal plane, the SM is triangular or rhomboidal (according to the width of the insertion on the pyramidal process) and inserts on the medial surface of the coronoid process of the mandible at the level of the maxillary sinus (Fig. 3, 4).

In the sagittal plane (Fig. 5, 6), the SM is ribbon-shaped vertically, with its antero-posterior thickness reducing medially. The lateral border of the SM is parallel to the medial surface of the TM, whereas the medial border is parallel to the inferior belly of the LPM. In this plane, the SM, together with the superior and inferior belly of the LPM, forms a triangle through which the buccinator nerve passes. The anterior side of this triangle is the SM, the triangle's base is the inferior belly of the LPM, and the upper belly of the LPM creates the posterosuperior side.

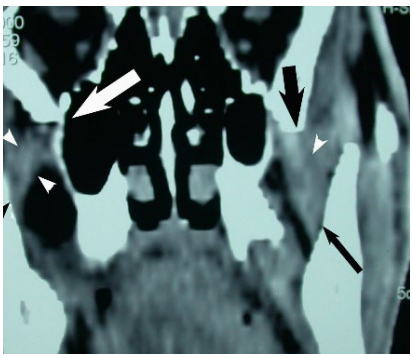


Fig. 4. *CT coronal plane. White arrows point: deep belly of temporal muscle. Thin black arrows: mandibular insertion. Black and white large arrows: insertion in the pyramidal apophysis of the sphenoid bone.*

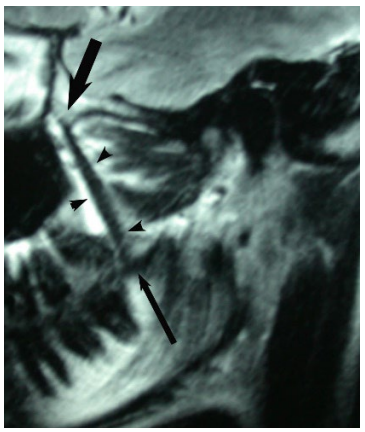


Fig. 5. *MRI parasagittal plane. Arrows point: deep belly of temporal muscle. Thin arrow: mandibular insertion. Large arrow: insertion in the pyramidal apophysis of the sphenoid bone.*

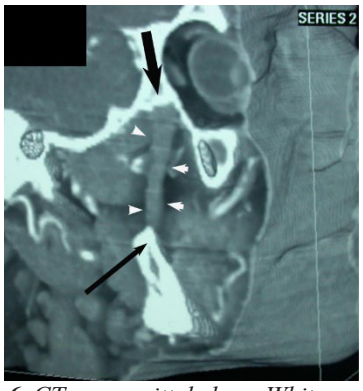


Fig. 6. *CT parasagittal plane. White arrows point: deep belly of temporal muscle. Thin black arrow: mandibular insertion. Black large arrow: insertion in the pyramidal apophysis of the sphenoid bone.*

DISCUSSION

In 1996, in their study performed on autoptic specimens, Dunn et al. (6) assumed that the SM had a vital role in the origin of pain localized behind the orbital region because of its vicinity with some nervous branches which could be compressed against the posterior maxillary wall during its contraction.

Our study shows how the origin of this muscle runs next to the posterior surface of the maxillary sinus and, in some cases, it almost touches the posterior maxillary wall, as reported by Geers et al. in 2005 (9).

The SM originates from a small apophysis of spongy bone, the pyramidal process of the sphenoid. Since this muscle is very thin, it is probably not aimed at raising the mandible during mastication; this part is played by other muscles with large bone insertions and is highly developed, unlike the SM, because of the great strength required. However, the vertical trend and the larger insertion on the medial surface of the coronoid process and the mandible's ramus suggest that SM should also have a role during mastication.

Based on morphological and structural findings, the following hypotheses can be made: 1): the structure of the SM seems ideally designed to "control" the vertical dimension of the mandible and the free interocclusal space (SM has a function on the postural control of the mandible); 2): this muscle probably acts in synergy with the homolateral lower belly of the LPM and with the posterior belly of the contralateral TM in lateral mandibular movements.

More recently, clinical evaluations have indirectly provided further evidence of the role played by this muscle (10-13).

It would be useful to remember that the intraoral palpation of the posterosuperior vestibular fornix aimed at assessing the painfulness of the LPM is almost impossible due to the presence of the SM, which is placed just

in front of the LPM. Therefore, the palpation of this region detects the presence and possible tonic-trophic alterations of the SM and not LPM.

CONCLUSIONS

In this descriptive study, the presence and the anatomical relationships of the SM with adjacent structures are assessed by CT and MR imaging. Due to its position, this muscle makes intraoral palpation of the LPM impossible.

MRI well depicts SM's anatomy. However, further studies on the microscopic anatomy of SM are required to confirm results and highlight neuromuscular spindles and neurotendinous structures. In addition, it is necessary to investigate ontogenesis and phylogenesis to better define its function in the stomatognathic system.

Authors' contribution

DM collected imaging and interpreted data; FC drafted the manuscript; MDG revised the manuscript; LB approved the final version.

REFERENCES

1. Koritzer R, St. Hoyme L. A biophysical model for craniomandibular management. In: *New Concepts in Cranimandibular and Chronic Pain*. Mosby-Wolf: New York, NY; 187-213; 1994.
2. Shankland WE. Craniofacial pain syndromes that mimic temporomandibular joint disorders. *Annals of the Academy of Medicine, Singapore*. 1995;24(1):83-112.
3. Lillie J, Bauer B. *Sectional Anatomy of the Head and Neck – a Detailed Atlas*. Oxford University Press, New York, NY; 1994
4. Miller J. *Craniomandibular Muscles: Their Role in Function and Form.* CRC Press: Boca Raton, FL; 1991.
5. Ernest EA, Martinez ME, Rydzewski DB, Salter EG. Photomicrographic evidence of insertion tendonosis: the etiologic factor in pain for temporal tendonitis. *The Journal of Prosthetic Dentistry*. 1991;65(1):127-131. doi:10.1016/0022-3913(91)90064-4
6. Dunn GF, Hack GD, Robinson WL, Koritzer RT. Anatomical observation of a craniomandibular muscle originating from the skull base: the sphenomandibularis. *Cranio: The Journal of Craniomandibular Practice*. 1996;14(2):97-103; discussion 104-105. doi :10.1080/08869634.1996.11745955
7. Mazza D. Functional and morphological evaluation of the sphenomandibular muscle with MRI. 37th Annual Meeting of CED of IADR. Rome: 2001; 307.
8. Kwak HH, Hu KS, Hur MS, et al. Clinical implications of the topography of the arteries supplying the medial pterygoid muscle. *The Journal of Craniofacial Surgery*. 2008;19(3):795-799. doi:10.1097/SCS.0b013e31816aab4b
9. Geers C, Nyssen-Behets C, Cosnard G, Lengelé B. The deep belly of the temporalis muscle: an anatomical, histological and MRI study. *Surgical and Radiologic Anatomy*. 2005;27(3):184-191. doi:10.1007/s00276-004-0306-3
10. Busato A, Vismara V, Bertele' L, Zollino I, Carinci F. Relation between disk/condyle incoordination and joint morphological changes: a retrospective study on 268 TMJs. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*. 2010;110(3):e34-e40. doi:10.1016/j.tripleo.2010.04.014
11. Guo Y, Guo C. Maxillary-fronto-temporal approach for removal of recurrent malignant infratemporal fossa tumors: Anatomical and clinical study. *Journal of Cranio-Maxillofacial Surgery*. 2014;42(3):206-212. doi:10.1016/j.jcms.2013.05.001
12. Iriarte-Diaz J, Terhune CE, Taylor AB, Ross CF. Functional correlates of the position of the axis of rotation of the mandible during chewing in non-human primates. *Zoology*. 2017;124:106-118. doi:10.1016/j.zool.2017.08.006
13. Leitner C, Hager PA, Penasso H, et al. Ultrasound as a Tool to Study Muscle–Tendon Functions during Locomotion: A Systematic Review of Applications. *Sensors*. 2019;19(19):4316. doi:10.3390/s19194316