"THE HIDDEN COMPLEXITY OF THE MYLOHYOID NERVE: ENHANCING CLINICAL PRECISION IN ORAL AND MAXILLOFACIAL SURGICAL PROCEDURES"

Gopikka Govindaraj, Dr. Jones Jayabalan, Dr. Balakrishna R N, Dr. Sribrindha, Dr. Jedidiah Fredrick Abisheg Britto , Dr. Israel Nathanael,

CRRI,Department of oral and maxillofacial surgery
Tagore dental college and hospital,Near vandalur,melakkotaiyur post, rathinamanagalam,Tamil Nadu 600127 , Tamilnadu Dr.MGR University
ORCID no: 0009-0004-9861-3151

Assistant professor,Department of oral and maxillofacial surgery
Tagore dental college and hospital,Near vandalur,melakkotaiyur post, rathinamanagalam,Tamil Nadu 600127 , Tamilnadu Dr.MGR University
ORCID no: 0000-0002-9448-9139

Associate Professor,Department of oral and maxillofacial surgery
Tagore dental college and hospital,Near vandalur,melakkotaiyur post, rathinamanagalam,Tamil Nadu 600127 , Tamilnadu Dr.MGR University
ORCID no: 0000-0001-6333-7602

Assistant professor,Department of oral and maxillofacial surgery
Tagore dental college and hospital,Near vandalur,melakkotaiyur post, rathinamanagalam,Tamil Nadu 600127 , Tamilnadu Dr.MGR Universit
ORCID no: 0009-0001-3592-2692

Assistant professor,Department of oral and maxillofacial surgery
Tagore dental college and hospital,Near vandalur,melakkotaiyur post, rathinamanagalam,Tamil Nadu 600127 Tamilnadu Dr.MGR University
ORCID no: 0000-0002-6643-0674

Associate Professor,Department of oral and maxillofacial surgery
Tagore dental college and hospital,Near vandalur,melakkotaiyur post, rathinamanagalam,Tamil Nadu 600127 Tamilnadu Dr.MGR University
ORCID no: 0000-0002-2111-2592

Corresponding Author- Dr. Jones Jayabalan
Assistant professor,Department of oral and maxillofacial surgery
Tagore dental college and hospital,Near vandalur,melakkotaiyur post, rathinamanagalam,Tamil Nadu 600127 , Tamilnadu Dr.MGR University
ORCID no: 0000-0002-9448-9139

ABSTRACT
The mylohyoid nerve is commonly labeled as the motor nerve that runs through the submandibular triangle. It innervates the mylohyoid and the anterior belly of the digastric muscle this article focuses on the anatomical variations in the mandible and the clinical implications occurring during a few surgical procedures. The variations were documented and a thorough review of literature was carried out from 1978 to 2021. Misinterpretation of the anatomy of the mylohyoid nerve is one of the major factors that lead to ineffective anesthesia, and unintentional nerve injury during oral surgery affects the success rate of the dental procedure. A thorough understanding of the variation in the anatomy of the mylohyoid nerve through this literature review will act as additional support for the success of dental anesthesia particularly during mandibular block anesthesia and implant surgery.
Keywords: Mylohyoid nerve , Anatomical variations , Dental anesthesia .

INTRODUCTION

The trigeminal nerve is the 5th cranial nerve and the largest of the cranial nerves providing facial sensory innervation and motor impulses to the mastication muscles(1,2).

It originates from the brain on the lateral surface of the pons and travels a short distance before entering the trigeminal ganglion where it branches out extensively. Among the three main branches originating from the trigeminal ganglion, the mandibular nerve (MN) is the third and largest division. In contrast to the other two branches, which mainly carry sensory (afferent) fibers, the mandibular nerve also includes motor (efferent) fibers that innervate the muscles associated with the mandible. The muscles involved in mastication include the mylohyoid, the anterior Before it enters the mandibular foramen, the mylohyoid nerve travels anteriorly belly of the digastric muscle, the tensor veli palatini, and the tensor tympani. Most of the fibers from these muscles travel directly to their target areas. The sensory axons of the mandibular nerve supply sensation to the skin on the lateral side of the oral cavity, innervate the teeth within the mandible and emerge from the mental foramen to provide sensation to the skin of the mandible(3)

The inferior alveolar nerve, a branch of the mandibular nerve's posterior division, has four branches, including the mylohyoid nerveand inferiorly along the medial surface of the mandible to reach the mylohyoid muscle. It also supplies nerve connections to the anterior

belly of the digastric muscle(4) This paper aims to serve as an educational resource, particularly for dental students, by enhancing their knowledge and understanding of the mylohyoid nerve.

ORIGIN

According to Wilson et al., the mylohyoid nerve typically branches from the inferior alveolar nerve approximately 14.7 mm before entering the mandibular foramen (5). Various anatomical studies have examined the nerve to the mylohyoid muscle. After descending into the submandibular region, the nerve travels between the mylohyoid and the anterior belly of the digastric muscles, providing innervation to both (6). Additionally, cutaneous branches supplying the submental skin have been observed (7).

INNERVATION PATTERN

The mylohyoid nerve is predominantly recognized as a motor nerve that plays a crucial role in the movement of the mylohyoid muscle, which supports the floor of the mouth. However, emerging evidence suggests that this nerve also encompasses sensory components. Beneath the mylohyoid muscle, several collateral branches of the mylohyoid nerve have been identified. These delicate nerve filaments are strategically positioned near the submandibular gland and entwined with the perivascular sympathetic plexus surrounding the facial artery(8) Notably, research by Frommer et al. indicates that the sensory aspect of the mylohyoid nerve extends beyond its primary muscular functions. It reaches out through cutaneous branches, significantly contributing to the sensory perception in the skin that encircles the mental prominence, enhancing our overall awareness of touch and sensation in that area(9)

Other studies documented the conversion of the mylohyoid groove containing the mylohyoid nerve into a mylohyoid canal by a bone bridge or plate(10,11).

MYLOHYOID NERVE ANATOMY AND VARIATIONS

The mylohyoid nerve was carefully traced from its anatomical origins in the infratemporal fossa to its ultimate destination in the mental region. (12)

In a study involving dissections of the infratemporal regions of 50 southern Indian cadavers, a nerve to the mylohyoid was identified in five cases. This nerve originated directly from the trunk of the mandibular nerve and passed posteromedial to the inferior alveolar nerve. It ran within a shallow groove on the medial surface of the mandible(12)

During a routine dissection of a 57-year-old male Caucasian cadaver, an unusual branch of the lingual nerve was discovered. The lingual nerve, measuring 2.26 mm in diameter, was located in the right pterygomandibular space. It gave rise to a lateral branch, measuring 1.79 mm in diameter, which pierced the mylohyoid muscle and exited the oral cavity. This branch innervated both the mylohyoid muscle and the anterior belly of the digastric muscle.

This variation, though extremely rare, suggests that damage to the lingual nerve during dental procedures could result in paralysis of the mylohyoid and digastric muscles (13).

NERVE COMMUNICATION

A study by Thotakura .et al. dissected 36 specimens and found variations in the posterior branches of the mandibular nerve in 11.1% of cases. Communication between the mylohyoid and lingual nerves was observed in two specimens.

1. In one specimen, a connecting branch was present on both sides. This branch was thicker than the mylohyoid nerve and originated at the lower border of the lateral pterygoid muscle. It traveled underneath the inferior alveolar nerve before joining the lingual nerve as it entered the submandibular region.
2. In another specimen, a thin branch connected the mylohyoid nerve and the lingual nerve in the right infratemporal region(14).

CLINICAL SIGNIFICANCE

Understanding the anatomy of the mylohyoid nerve is critical for dental procedures, including:

- Mandibular block anaesthesia
- Implant surgeries
- Management of orofacial pain

Misinterpreting its anatomy can result in inadequate anesthesia or inadvertent nerve damage during surgery.

KEY CLINICAL INSIGHTS

- The mylohyoid nerve provides sensory innervation to the first molar and is anesthetized along with the lingual nerve during extractions of mandibular posterior teeth.
- Routine inferior alveolar nerve (IAN) blocks may fail if the mylohyoid nerve has variations, such as high branching in the infratemporal region or passage through accessory foramina on the lingual surface of the mandible.
- An anatomical study by Bennett et al. found that the branching level of the mylohyoid nerve and inferior alveolar nerve averaged 13.4 mm before the mandibular foramen, with measurements ranging from 3.9 mm to 20.7 mm (15).

Failure to achieve deep anesthesia of mandibular incisors is often due to overlapping incisive nerves or accessory innervation via the mylohyoid nerve (16).

HYPOTHESES FOR MYLOHYOID NERVE BLOCK FAILURE

1. The mylohyoid nerve may branch above its usual level in the infratemporal fossa, avoiding the anesthetic agent (17).
2. The sphenomandibular ligament may separate the inferior alveolar and mylohyoid nerves, preventing effective anesthesia (18).
3. The mylohyoid nerve may cross directly to the opposite side at the midline, bypassing the anesthesia site (19).

For cases of inadequate anesthesia with conventional IAN blocks, lingual infiltration near the wisdom tooth region may successfully block the mylohyoid nerve (20).

ACCESSORY FORAMINA AND SENSORY CONTRIBUTIONS

A detailed study on accessory foramina in the human mandibular symphysis regionwas conducted (21-25)). It was found the superior retromental (or lingual) foramen, the intermediate retromental foramen, and the paramedian or lateral apertures. These foramina provide a pathway for branches of the mylohyoid nerve to enter the mandible and supply the anterior teeth(26-32)

Additionally, sensory impulses from the mental region are carried by this well-known motor nerve(33,34)

1. The superior retromental foramen, located above the genial tubercles, is present in 87.3% to 96.2% of cases and transmits a branch of the sublingual artery (35)

2. The inferior retromental foramen, found at the inferior border of the mandible, is observed in 61.4% to 76.9% of cases.

Clinical difficulties in attaining deep pulpal analgesia of the lower incisors can be attributed to two main factors: the supplementary nerve supply via the mylohyoid nerve and the overlap of the right and left incisive nerves(36).

SURGICAL IMPLICATIONS

Recent advances in head and neck reconstructive surgery emphasize the usefulness of the submental island flap (SMIF), which may involve the anterior belly of the digastric muscle and, occasionally, the mylohyoid muscle. Preserving the mylohyoid nerve during flap preparation can help maintain the functional integrity of the mylohyoid muscle, aided by the identification of the mylohyoid triangle (37)

CONCLUSION :

The findings presented in this review article emphasize the importance of understanding the mylohyoid nerve and its anatomical variations for improving outcomes in oral and maxillofacial procedures. This nerve provides essential motor innervation to muscles involved in chewing and plays a key role in sensory perception, highlighting its dual significance.

Anatomical variations, including branching patterns and connections with nearby nerves, necessitate that clinicians remain well-informed to prevent complications such as inadequate anesthesia or nerve injury during surgeries.

In conclusion, enhancing our knowledge of the mylohyoid nerve can directly benefit clinical practices, particularly in mandibular block anesthesia and dental implant procedures. By incorporating this understanding into education and practice, dental professionals can increase the predictability and success rates of surgical outcomes, ultimately improving

patient care. Further anatomical studies and clinical research are needed to explore the implications of these variation.

REFERENCES :

1. Romano, N., Federici, M., &Castaldi, A. (2019). Imaging of cranial nerves: A pictorial overview. *Insights Into Imaging, 10*(1), 33. https://doi.org/10.1186/s13244-019-0717-4
2. Casselman, J., Mermuys, K., Delanote, J., Ghekiere, J., &Coenegrachts, K. (2008). MRI of the cranial nerves—More than meets the eye: Technical considerations and advanced anatomy. *Neuroimaging Clinics of North America, 18*(2), 197–231. https://doi.org/10.1016/j.nic.2008.01.005
3. Patestas, M. A., & Gartner, L. P. (2016). *A textbook of neuroanatomy* (2nd ed.). John Wiley & Sons.
4. Du Toit, D. F. (2003). Nervuslingualis: Applied anatomical relevance to dental practice and oral surgery. *South African Dental Journal, 58*(5), 207–210.
5. Wilson, S., Johns, P., & Fuller, P. M. (1984). The inferior alveolar and mylohyoid nerves: An anatomic study and relationship to local anesthesia of the anterior mandibular teeth. *Journal of the American Dental Association, 108*, 350–352. https://doi.org/10.14219/jada.archive.1984.0320
6. Haveman, C. W., &Tebo, H. G. (1976). Posterior accessory foramina of the human mandible. *The Journal of Prosthetic Dentistry, 35*(4).
7. Sutton, R. N. (1974). The practical significance of mandibular accessory foramina. *Australian Dental Journal, 19*, 167–173. https://doi.org/10.1111/j.1834-7819.1974.tb04870.x

8. Hwang, K., Han, J. Y., Chung, I. H., & Hwang, S. H. (2005). Cutaneous sensory branch of the mylohyoid nerve. *The Journal of Craniofacial Surgery, 16*(3), 343–345; discussion 346. https://doi.org/10.1097/01.scs.0000163805.68546.0e
9. Frommer, J., Mele, F. A., & Monroe, C. W. (1972). The possible role of the mylohyoid nerve in mandibular posterior tooth sensation. *Journal of the American Dental Association, 85*(1), 113–117. https://doi.org/10.14219/jada.archive.1972.0031
10. Jidoi, K., Nara, T., & Dodo, Y. (2000). Bony bridging of the mylohyoid groove of the human mandible. *Anthropological Science, 108*(4), 345–370. https://doi.org/10.1537/ase.108.345
11. Madeira, M. C., Percinoto, C., & Silva, M. G. M. (1978). Clinical significance of supplementary innervation of the lower incisor teeth: A dissection study of the mylohyoid nerve. *Oral Surgery, Oral Medicine, and Oral Pathology, 46*(5), 608–614. https://doi.org/10.1016/0030-4220(78)90216-2
12. Kumar, S., Kumar, C. J., Bhat, S., & Kumar, A. (2011). Anatomical study of the unusual origin of a nerve to the mylohyoid muscle and its clinical relevance. *The British Journal of Oral & Maxillofacial Surgery, 49*(5), e14–e15. https://doi.org/10.1016/j.bjoms.2010.08.007
13. Iwanaga, J., Kikuta, S., Oskouian, R. J., & Tubbs, R. S. (2019). Nerve to mylohyoid branched from the lingual nerve: Previously undescribed case. *Anatomical Science International, 94*(3), 266–268. https://doi.org/10.1007/s12565-019-00489-w
14. Thotakura, B., Rajendran, S. S., Gnanasundaram, V., &Subramaniam, A. (2013). Variations in the posterior division branches of the mandibular nerve in human cadavers. *Singapore Medical Journal, 54*(3), 149–151. https://doi.org/10.11622/smedj.2013051

15. Bennett, S., & Townsend, G. (2001). Distribution of the mylohyoid nerve: Anatomical variability and clinical implications. *Australian Endodontic Journal, 27*(3), 109–111. https://doi.org/10.1111/j.1747-4477.2001.tb00223.x
16. Sicher, H. (1946). The anatomy of mandibular anesthesia. *Journal of the American Dental Association, 33*(23), 1541–1557. https://doi.org/10.14219/jada.archive.1946.0305
17. Coleman, R. D., & Kaiser, W. F. (1966). Anatomy. In M. Shapiro (Ed.), *The scientific bases of dentistry*. W. B. Saunders Company.
18. Clark, S., Reader, A., Beck, M., & Meyers, W. J. (1999). Anesthetic efficacy of the mylohyoid nerve block and combination inferior alveolar nerve block/mylohyoid nerve block. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontics, 87*(5), 557–563. https://doi.org/10.1016/S1079-2104(99)70134-1
19. Shira, R. B. (1978). Clinical significance of supplementary innervation of the lower incisor teeth: A dissection study of the mylohyoid nerve. *Oral Surgery, Oral Medicine, and Oral Pathology, 46*, 608–614. https://doi.org/10.1016/0030-4220(78)90216-2
20. Sillanpää, M., Vuori, V., &Lehtinen, R. (1988). The mylohyoid nerve and mandibular anesthesia. *International Journal of Oral and Maxillofacial Surgery, 17*(3), 206–207. https://doi.org/10.1016/S0901-5027(88)80064-7
21. Shiller, W. R., &Wiswell, O. B. (1954). Lingual foramina of the mandible. *Anatomical Record, 119*, 387–390. https://doi.org/10.1002/ar.1091190311
22. Suzuki, M., & Sakai, T. (1957). The foramina on the lingual surface of the mandible in the Japanese. *Medical Journal of Shinshu University, 2*, 1–10.
23. Inke, G. (1962). Quantitative Anatomie der Innenthache des Unterkiefers. *MorphologischesJahrbuch, 102*, 479–507.

24. Costa, P. F. da. (1969). *Contribuiçãoaoestudo dos foramina retromentaliasuperius, intermedium e inferius, com relação a spinamentalis, emmandíbulas de brasileirosadultos, brancos e negros, de ambos ossexos* (Doctoral thesis). Faculdade de Odontologia de Bauru, São Paulo, Brazil.
25. Dukart, R. C. (1973). *Foramina in the mandibular symphysis region* (Master's thesis). University of Texas, Houston.
26. Novitsky, J. (1938). Sensory nerves and anesthesia of the teeth and jaws. *Modern Dentistry, 5*, 5–10.
27. Sicher, H. (1950). Aspects in the applied anatomy of local anesthesia. *International Dental Journal, 1*, 70–82.
28. Shirai, M. (1960). BeitragzurKenntnis der Bedeutung der Löcheran der Lingualfläche des Unterkieferkörpers. *Yokohama Medical Bulletin, 11*, 541–549.
29. Coleman, R. D., & Kaiser, W. F. (1966). Anatomy. In M. Shapiro (Ed.), *The scientific bases of dentistry*. W. B. Saunders Company.
30. Sicher, H., & Du Brul, E. L. (1975). *Oral anatomy* (6th ed.). The C. V. Mosby Company.
31. Rood, J. P. (1976). The analgesia and innervation of mandibular teeth. *British Dental Journal, 140*, 237–239. https://doi.org/10.1038/sj.bdj.4803803
32. Rood, J. P. (1977). The nerve supply of the mandibular incisor region. *British Dental Journal, 143*, 227–230. https://doi.org/10.1038/sj.bdj.4803932
33. Paturet, G., &Paturet, J. (1954). Le nerf du mylo-hyoidienet du ventreantérieur du digastrique. *ComptesRendus de l'Association des Anatomistes, 40*, 535–541.
34. Bennett, C. R. (1974). *Monheim's local anesthesia and pain control in dental practice* (5th ed.). The C. V. Mosby Company.

35. Percinoto, C., Silva, M. G. M., & Madeira, M. C. (n.d.). Origem e distribuição de artériasqueatravessamforames da região da sínfise mandibular. *Arquivos do Centro de Estudos de CurativosOdontológicos, Universidade Federal de Minas Gerais (Brasil).*
36. Howe, G. L., & Whitehead, F. I. H. (1972). *Local anaesthesia in dentistry.* John Wright & Sons, Ltd.
37. Hu, S., Fan, C., Pecchia, B., & Rosenberg, J. D. (2020). Submental island flap vs free tissue transfer in oral cavity reconstruction: Systematic review and meta-analysis. *Head & Neck, 42*(8), 2155–2164. https://doi.org/10.1002/hed.26200