

## FUNCTIONAL ANATOMY OF MANDIBULAR NERVE

Msy Rulan Adnindya, Indri Seta Septadina\*, Tri Suciati, Wardiansah

Bagian Anatomi, Fakultas Kedokteran, Universitas Sriwijaya, Palembang, Indonesia

\* email: indrisetaseptadina@fk.unsri.ac.id

*Received 11 Januari 2023; accepted 29 April 2023; published 23 Mei 2023*

---

### Abstrak

The mandibular nerve is the largest branch of the trigeminal nerve. It innervates the mandibular teeth, gums, skin of the temporal region, ear, lower lip, the lower part of the face, muscles of mastication, and mucous membrane of the anterior 2/3 of the tongue. The mandibular nerve is the main pharyngeal nerve arch. The sensory and motor fibers in the mandibular nerve originate from two roots: the sensory root, which originates from the semilunar ganglion, and the motor root, which originates from the motor nucleus. The mandibular nerve has a mixture of sensory and motor nerves and motor and sensory functions. Face, cheeks and temples, oral cavity, teeth and gums, nasal cavity and sinuses, and temporomandibular joints and muscles. Trauma to the mandible can damage or tear the inferior alveolar nerve in the mandibular canal, causing sensory loss distal to the lesion. Local anesthesia of the inferior alveolar nerve is generally reserved for dental procedures. Local anesthetic injection into the oral mucosa on the medial side of the mandible can also involve the nearby lingual nerve, thus affecting the tongue and the inside of the mouth. The close connection between the submandibular canal and the lingual nerve is important in root canal infections and surgical procedures.

**Keywords:** trigeminal nerve, mandibular nerve, clinical case of mandibular nerve

---

### 1. Introduction

The mandible or mandible is part of the facial bones. The mandible is the only movable facial bone. The mandibular bone originates from two separate bones, which fuse at about one year of age.<sup>1</sup> The part of the mandibular bone that lies horizontally is called the body or body. The vertical posterior part is called the ramus. The two parts of the mandible are called the gonion. The midpoint on the chin is called the mentum. On the inner surface of the mandible in the chin area, there is a mental foramen in the form of a small point. Because it is located anterolaterally, the mental foramen is the passage through which the nerves and blood vessels of the chin pass. The gonion or mandibular angle has a rough lateral surface for the attachment of the masticatory muscles. Then like the maxilla or commonly called the maxilla, the mandible also has an alveolar process between the teeth. The ramus on the mandible is shaped like the letter Y. The

posterior branch of the ramus is called the processus condyloid, which articulates with the mandibular fossa of the temporal bone. This articulation forms a joint or what we usually call the temporomandibular joint (TMJ). Meanwhile, the anterior branch of the ramus is the coronoid process which is in the form of a blade. The coronoid process serves as an insertion for the temporal bone, which pulls the mandible up during biting. The U-shaped indentation between the two processes is called the mandibular notch. There is a mandibular foramen just below the mandibular notch, which allows nerves and blood vessels to reach the lower teeth.<sup>2</sup>

The trigeminal nerve is a mixed cranial nerve consisting mainly of sensory neurons. It exists in the brain on the lateral surface of the pons, entering the trigeminal ganglion (TGG) after a few millimeters, followed by a series of extensive divisions. Of the three main branches that arise from the TGG, the mandibular nerve (MN) comprises the third

and largest of the three divisions. The MN division also has an additional motor component, which may operate separately from the facial compartment. Thus, unlike the other two divisions of the trigeminal nerve, which carry afferent fibers, the mandibular nerve also contains motor or efferent fibers to innervate the muscles attached to the mandible, including the muscles of mastication, the mylohyoid, the anterior belly of the digastric muscle, the tensor veli palatine, and the tensor tympani. Most fibers travel directly to their target network. Sensory axons innervate the skin on the lateral side of the oral cavity's head, tongue, and mucous wall. Several sensory axons enter the mandible to innervate the teeth and emerge from the mental foramen to innervate the skin of the mandible. Trap neuropathy is a nerve lesion caused by pressure or mechanical irritation of the anatomical structures adjacent to the nerve. This can occur where the nerve passes through a fibro-osseous canal and is relatively fixed, from impingement by an anatomical structure or from nerve entrapment between soft and hard tissue.<sup>3</sup>

Various anatomical structures, including bone, muscle, or fibrous bands, can trap and potentially compress the mandibular nerve branches.<sup>4</sup> The infratemporal fossa is a common site for mandibular nerve compression and one of the most challenging areas of the skull to access surgically. Other potential sites for entrapment of the mandibular nerve and its branches include the fully or partially ossified, pterygospinous or pterygial ligaments, the large lamina of the lateral plate of the pterygoid process, the medial fibers of the lower abdomen of the lateral pterygoid muscle and the inner pterygoid muscle. medial pterygoid muscle fibers. The clinical consequences of mandibular nerve entrapment depend on which branch is compressed.<sup>4</sup> Compression of the motor branch of the mandibular nerve can cause paresis or weakness in the muscles it innervates. In contrast, compression of the sensory branch can trigger neuralgia or

paresthesias. Compression of one of the major branches of the mandibular nerve, the lingual nerve, is associated with numbness, hypoesthesia, or even tongue anesthesia, loss of taste in the anterior two-thirds of the tongue, lingual gum anesthesia, pain, and impaired speech articulation. This paper discusses the anatomy of the mandibular nerve and the essential clinical conditions to study. This paper was made with the benefit of using it as knowledge material to add and deepen insights about the mandibular nerve, especially for students studying dentistry.<sup>5</sup>

## 2. Discussion

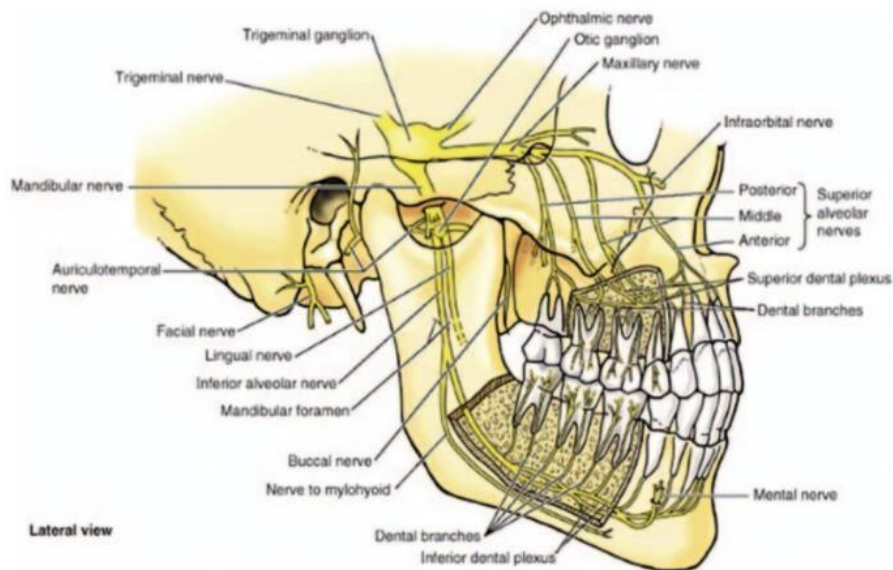
### 2.1 Mandibular nerve division

The mandibular nerve is the largest branch of the trigeminal nerve. It innervates the mandibular teeth, gums, skin of the temporal region, ear, lower lip, the lower part of the face, muscles of mastication, and mucous membrane of the anterior 2/3 of the tongue. The mandibular nerve is the main pharyngeal nerve arch. Contains motor and sensory fibers. Motor roots originating from the motor nucleus pass through the foramen ovale and join the sensory roots below the foramen to form the main trunk. Sensory roots originating from the semilunar ganglion are in the cranial cavity through the foramen ovale.<sup>3</sup>

The sensory roots are larger than the motor roots, which unite at the foramen ovale. The figure shows that the nerve descends from the skull, giving off two branches from the undivided trunk. The meningeal nerves enter the cranial cavity through the foramen spinosum, with the middle meningeal artery supplying the dura mater. Nerves to the medial pterygoid: One branch from the main trunk supplies the medial pterygoid muscle. The main branch trunk is located in the infratemporal fossa, in the tensor veli palatine, deep pterygoid laterally, and is divided into 2; anterior division and posterior division. This anterior branch is smaller than the posterior branch and supplies the muscles of

mastication, the skin, and the mucous membrane of the cheeks. It gives four sub-branches (3 motor and one sensory). The motor root consists of the masseteric nerve: a branch released opposite the temporomandibular joint. The nerve supplies the masseteric muscle by running across the mandibular notch with the masseteric artery. Deep temporal nerve in

the anterior and posterior: to supply the temporalis muscle. Lateral pterygoid muscle and nerve: supplies and innervates the lateral pterygoid muscle. Buccal nerve and buccinator muscle: sensory function, passing between the two lateral pterygoid heads to innervate the buccinator muscle.<sup>6</sup>



**Figure 1. Mandibular nerve division**

Branches posterior division: larger than the anterior division and gives 3 branches. Mostly sensory consists of the auriculotemporal nerve: it arises with 2 roots, originating from 2 heads which encircle the middle meningeal artery. It moves posteriorly to reach the mandibular neck on the medial side. It also carries secretomotor fibers to the parotid gland and innervates the upper part of the ear, the sublingual gland, and the mucous membrane of the anterior 2/3 of the tongue. Auricular portion – supplies skin of tragus, top of pinna, external acoustic meatus & tympanic membrane. Temporal portion – supplies the temples, TMJ, carries secretomotor & sensory fibers to the parotid gland. Inferior alveolar nerve: This is the largest branch of the mandibular nerve. It accompanies the inferior alveolar artery and enters the mandibular foramen and runs under the anterior teeth in the

mandibular canal and exits the mental foramen. Runs vertically downward lateral to the medial pterygoid & sphenomandibular ligaments.<sup>7</sup>

The inferior alveolar nerve gives off four branches, namely the mylohyoid nerve. Before entering the mandibular foramen, it runs anteriorly and inferiorly on the medial surface of the mandible to reach the mylohyoid muscle. Also, it supplies the anterior belly of the digastric muscle. Alveolar branch: this branch supplies all the teeth, passes through the mandibular foramen, and enters the pulp through the apical foramen; Incisive branch: terminal branch of the inferior alveolar nerve, running anteriorly to supply the canines and incisors; Mental nerve: belongs to the terminal branch of the inferior alveolar nerve which branches from the mental foramen where the nerve arises and

whose branches supply the skin over the chin and the skin and mucous membrane of the lower lip (located between the roots of the premolars).<sup>8</sup>

The next branch is the lingual nerve which is a nerve that branches out from the mandibular nerve and descends between the tensor veli palatine and the lateral pterygoid, which is positioned medial to the inferior alveolar nerve. It is located between the medial pterygoid muscle and the medial surface of the mandible. It is very close to the root of the mandibular molar and runs medially to reach the floor of the mouth. It is located between the hypoglossus and mylohyoid muscles. This nerve carries sensation from the mucous membranes of the anterior 2/3 of the tongue and the mucosa on the lingual side of the mandible. It is one of the two terminal branches of the posterior division, begins 1 cm below the skull, arises at the lower border of the lateral pterygoid, runs downward and forwards on the ramus mandible & medial pterygoid, in direct contact with the mandible behind three molars, running above hyoglossus & genioglossus, deep into mylohyoid.<sup>8</sup>

The mandibular nerve is a mixture of sensory and motor nerves. The mandibular nerve transmits sensory fibers from the skin to the mandible, the sides of the cheeks and temples, the oral cavity and its contents, the external ear, the tympanic membrane, and the temporomandibular joint (TMJ). This nerve also supplies the meninges in the membranous neurocranium (cranium vault). The mandibular nerve is the motor for eight muscles originating from the first branchial arch, namely: The muscles of mastication (m. temporalis, m. masseter, m. pterygoideus medialis, and m. pterygoideus lateralis); M. mylohyoid, forming the floor of the mouth; Anterior belly of m. digastricus, the small muscle at the bottom of the jaw; M. tensor tympani, inside the ear, muffles loud noises; M. tensor veli palatine, elevates the soft palate at the back of the mouth. Some of its distal branches also have parasympathetic

secretomotor fibers to the salivary glands and taste fibers from the anterior part of the tongue.<sup>6,8</sup>

While the sensory function of the mandibular nerve includes N. spinous or meningeal branch, supplying the dura mater (the thick membrane surrounding the brain and spinal cord); n. buccal transmits sensory information from the cheek and two rear molars; N. auriculotemporal provides sensory innervation to the sides of the head; N. lingual provides sensation to the anterior 2/3 of the tongue and floor of the mouth; plays a role in; tasting.<sup>8</sup>; N. alveolar inferior supplies the mylohyoid and anterior belly of m. digastricus, located along the mandibular teeth, has several motor functions, namely, raising the hyoid and complex jaw movements (speaking, swallowing, chewing, and breathing). Mandibular nerve is the largest branch of the trigeminal nerve. It innervates the teeth and gums of the mandible, skin of the temporal region, ears, lower lip and lower part of the face, mastication muscles, and the mucous membrane of the anterior two-thirds of the tongue.<sup>9</sup> The mandibular nerve consists of sensory and motor fibers which originate from two roots<sup>2</sup>, namely the sensory root, which originates from the semilunar ganglion, and the motor root, which originates from the motor nucleus.

### 2.3 Clinical Notes

Careless extraction of third lower molars (wisdom teeth), root abscesses, or mandibular angle fractures can damage the lingual nerve. This can result in loss of somatic sensation from the anterior portion of the tongue and in loss of taste sensation and parasympathetic function.<sup>9</sup> Trauma to the mandible can damage or tear the inferior alveolar nerve in the mandibular canal, causing sensory loss distal to the lesion. Local anesthesia of the inferior alveolar nerve is generally reserved for dental procedures. Local anesthetic injection into the oral mucosa on the medial side of the mandible can also involve the nearby lingual nerve, thus

affecting the tongue and the inside of the mouth. In a wisdom tooth extraction, the buccal Nerve may also be anesthetized, causing numbness in the cheek.<sup>10</sup> The proximity of the connection between the submandibular canal and the lingual nerve is important in tract infection and surgery. Submandibular stones are not uncommon due to mucus secretion. If the lingual nerve is damaged, there will be a sensory loss, both somatic and taste, on the anterior part of the tongue.<sup>11</sup>

TMJ disease or swelling of the parotid glands can cause ear pain due to referred pain. Also, pain from the lower teeth, oral cavity, and tongue can be referred to as the ear. Beware of patients with cotton swabs in the external auditory meatus.<sup>11</sup> The auriculotemporal nerve accompanies the superficial temporal artery at the temple. In the case of temporal arteritis, the nerve is anesthetized so that the overlying skin can be incised to obtain a biopsy of the artery.<sup>12</sup>

### 3. Conclusion

The mandibular nerve is the largest branch of the trigeminal nerve which contains motor (efferent) and sensory fibers to innervate the muscles attached to the mandible, including the muscles of mastication, mylohyoid, anterior belly of the digastric muscle, tensor veli palatine, and tensor tympani muscle. The sensory and motor fibers in the mandibular nerve originate from two roots: the sensory root, which originates from the semilunar ganglion, and the motor root, which originates from the motor nucleus. The mandibular nerve has a mixture of sensory and motor nerves and motor and sensory functions. Face, cheeks and temples, oral cavity, teeth and gums, nasal cavity and sinuses, and temporomandibular joints and muscles. The trigeminal nerve is the main somatosensory cranial nerve; the trigeminal sensory nucleus has three parts, each for a different modality, namely the main nucleus, spinal tracts and nuclei, and the mesencephalic nucleus. The mandibular nerve

and first branchial arch include the inferior alveolar, mental, lingual, auriculotemporal, buccal, muscle, meningeal, and first branchial arch. The parasympathetic pathway consists of the superior salivatory nucleus (VII), chorda tympani, lingual nerve, submandibular ganglion, submandibular gland, sublingual gland, then inferior salivatory nucleus (IX), minor petrosal nerve, glion otic gan, auriculotemporal nerve, parotid gland. Some clinical notes related to the mandibular nerve are careless extraction of teeth which causes damage to the lingual nerve, inferior alveolar nerve block and inferior alveolar nerve block, mumps, submandibular canal referring to ear pain, and superficial temporal artery biopsy. Clinical testing can be in the form of sensory testing or sensory testing in the form of asking the patient and using sharp or blunt tools, motor testing or motor testing such as asking the patient to bite hard on an object and asking the partner to open and close the jaw, and reflex testing or reflex testing such as checking for shock patient's jaw.

### References

1. Lampignano J, Kendrick LE. Bontrager's Textbook of Radiographic Positioning and Related Anatomy - E-Book. Elsevier Health Sciences; 2020.
2. Pramestiyani M, Wardhani Y, Sulung N, Adriani, Wahyuni TP, Oktavia S, et al. Anatomi Fisiologi. Sari M, editor. PT. GLOBAL EKSEKUTIF TEKNOLOGI; 2022.
3. Patestas MA, Gartner LP. A textbook of neuroanatomy. John Wiley & Sons; 2016.
4. Snell RS. Clinical anatomy by regions. Lippincott Williams & Wilkins; 2011.
5. Snell RS. Clinical anatomy for medical students. Lippincott Williams & Wilkins; 2000.
6. Snell RS. Clinical neuroanatomy. Lippincott Williams & Wilkins; 2010.
7. Gaudy J-F, Zouaoui A, Bravetti P, Charrier J-L, Guettaf A. Functional

- organization of the human masseter muscle. *Surg Radiol Anat.* 2000;22:181–90.
8. Du Toit DF. Nervus lingualis: applied anatomical relevance to dental practice and oral surgery. *SADJ J South African Dent Assoc Tydskr van die Suid-afrikaanse Tandheelkd Ver.* 2003;58(5):207–10.
  9. Shankland WE. The trigeminal nerve. Part IV: the mandibular division. *CRANIO®.* 2001;19(3):153–61.
  10. Khoury JN, Mihailidis S, Ghabriel M, Townsend G. Applied anatomy of the pterygomandibular space: improving the success of inferior alveolar nerve blocks. *Aust Dent J.* 2011;56(2):112–21.
  11. Kesse W, Violaris N, Howlett DC. An unusual cause of facial pain: malignant change in a calcified pleomorphic adenoma in the deep lobe of the parotid gland. *Ear, nose throat J.* 2003;82(8):623–5.
  12. Sharma NS, Ooi J, McGarity BH, Vollmer-Conna U, McCluskey P. The length of superficial temporal artery biopsies. *ANZ J Surg.* 2007;77(6):437–9.