REVIEW

Mandibular Nerve: Variations & Clinical Relevance

Khushi Gupta, Bhumica Dang, Arvinder Pal Singh Batra

Gupta K, Dang B, Batra APS. Mandibular nerve: variations & clinical relevance. Int J Anat Var. 2021;14(1):42-44.

ABSTRACT

Many anatomy textbooks describe the mandibular nerve. However, it's branching and variations are many and inconsistent between individuals. Also the mandibular region that it supplies has its own variants.

Our review article has taken into consideration articles describing these anomalous innervations by the mandibular nerve and its branches and their clinical relevance. The many variants have been documented after gathering information from all relevant review articles and case reports.

This thorough review of branching and clinical correlation will be helpful for anesthetists, dentists and surgeons to get success of anesthesia, etiology of pathological processes and prevent surgical mishaps.

Key Words: *Mandibular nerve, Inferior alveolar nerve, Lingual nerve, Auriculotemporal nerve, Entrapment, Anesthesia*

INTRODUCTION

Mandibular nerve is the largest division of the with cranial nerve i.e. trigeminal. It is a mixed nerve and has a large sensory and a small motor root. It comes out of the foramen ovale of the skull.

It then enters the infratemporal fossa, gives two branches –meningeal or nervous spinosus (sensory) and the nerve to medial pterygoid (motor). The meningeal supplies the duramater of the middle cranial fossa and the latter supplies medial pterygoid, tensor tympani and tensor veilpalatine muscles.

It further divides into two– anterior and posterior divisions. The anterior division is mixed and gives rise to 3 motor- mesenteric, nerves to lateral pterygoid and deep temporal branch and a sensory branch- the buccal nerve, which supplies the skin, gums of the cheek and premolars.

The large posterior division later gives rise to 3 branches – auriculotemporal nerve, lingual nerve and inferior alveolar nerve. The auriculotemporal supplies external ear, temporomandibular joint, and skin of the temple and gives secretomotor fibers to parotid gland.

The inferior alveolar gives a mixed branch before it enters the mandibular canal and innervates the mandibular teeth, gums, lips and skin of the chin, after coming out of the mental foramen.

The terminal, smallest branch, lingual nerve, carries general sensation from the anterior 2/3rds of the tongue, floor of mouth and mandibular gum. It also gives parasympathetic supply to the sublingual and submandibular glands.

Embryology

The mandibular nerve supplies the first pharyngeal arch. F-spondin and T-cadherin released by caudal somite are known to cause neural development. Abnormal neural crest migration will lead to nerve variations [1,2].

Variations in Mandibular nerve and its branches

Mandibular nerve and especially its posterior division have many variations.

Inferior alveolar nerve has intra- and extra osseous branches. Intraosseous branches can be in the form of a single trunk, major and minor trunk or 3 and more branches [3]. It can be in the form of type I- single entity or type II –a plexus [4]. It can also be in the form of A= single unbranched nerve, B= series of individual branches to superior border of mandible, C= fine molar plexus and D=proximal and distal nerve plexus [5]. Multiple extra osseous branches can be in the form of the inferior alveolar nerve splitting and then re-uniting before entering the mandibular fossa [6,7]. They may be related to accessory foramen and canals [7].

Variations of the subdivisions of inferior alveolar nerve may also be present. Mental nerve may have additional branches. It may form a loop before emerging from the mental foramen as studied by Kieser et al. [8] Y- or T-shaped divergence of mental and incisive nerves may occur [8]. Nerve may re-enter the mandible after a short extraosseous course [9,10]. There may be cross innervation of the incisor teeth by the contralateral mental nerve [9-11].

Incisive nerve may have variations in the form of cross innervation of the incisor teeth by the contralateral nerve [12-14].

Mylohyoid nerve may supply the mandibular teeth via accessory retro mental foramen or via a plexus [15-19]. There may even be an accessory mylohyoid nerve, supplying the mandibular teeth[15-20] or the mylohyoid muscle [21]. The nerve may communicate with the inferior alveolar nerve to form a plexus and then supply the mandibular teeth [16]. Madeira demonstrated this supplementary branch in 13 out of 26 cadavers.

Lingual nerve may have variants in the form of its relation with the third molar region based on race, genetic and individual constitution. Presence or absence of teeth, tone of muscles and connective tissue tension has been found to have no relation with its position [22,23]. It may have communications with the inferior alveolar nerve supplying the teeth and lower labial salivary glands as demonstrated by Racz and Khaledpour in 25% and 7% cadavers respectively [24,25]. It may also have communications with the mylohyoid nerve and thus, may supply the anterior tongue as studied by Racz et al. in 33% cases and by Kim et al. in 12.5% cases [24,26,27]. Collateral branches to lingual gingivae around lower third molar and retromolar region may be found [26,28,29].

Auriculotemporal nerve may have upto 5 roots of origin (Komarnitki et al.) [30]. and may have linking with the inferior alveolar nerve as studied by Thotakura et al. [24,25,31-36].

Buccal nerve may have additional innervation of molar teeth via retromolar foramen and may have communication with the inferior alveolar nerve [6,37-39].

Variants in relation to the maxillary artery may be as follows. Inferior alveolar nerve may originate from 2 or 3 roots and maxillary artery may pass between these roots [40-43]. This has been studied by Roy, Khan and Daimi et al. It may pass between a communicating branch of inferior alveolar and auriculotemporal and a root of inferior alveolar nerve [31]. It may pass between root of inferior alveolar and lingual nerve [24-26,44,45]. It may even pierce lingual nerve or a common trunk formed by lingual and inferior alveolar nerves [31,46,47].

Additional supply of the mandibular region by the great auricular nerve (C2,C3) may be present [6,48]. Facial nerve may communicate with auriculotemporal nerve [49]. Communication of all three nerves of posterior

Department of Anatomy, Bhagat Phool Singh Government Medical College for Women, Khanpur Kalan, Sonepat, Haryana, India

Correspondence: Dr. Khushi Gupta, Department of Anatomy, Bhagat Phool Singh Government Medical College for Women, Khanpur Kalan, Sonepat, Haryana, India. Telephone +919821773924; E-mail:khudkhushi@gmail.com

Received: Oct16, 2020, Accepted: Jan29, 2021, Published: Feb05, 2021

division of mandibular nerve ie. auriculotemporal, inferior alveolar and lingual nerve may also be present [50].

There may be anatomical variants in the anatomy of the mandibular canal in form of accessory canals- bifid and trifid which may contain nerves84 or blood vessels [37]. Langlais et al. studied 6000 radiographs and reported 0.95% incidence of bifid mandibular canals. Sanchis reported 0.35% incidence of these canals. Nortje found 0.9% incidence, while Naitoh et al observed bifid canals in 65% of patients and further divided them into retromolar, dental, forward and buccolingual canals. Divisions of the mandibular canal in high, intermediate and low forms may be seen as well in some people.

Apart from the variations in mandibular canals, mandibular foramen may also show deviation from the normal pattern in its location based on age,86 gender, race and individual l.87 Accessory mandibular foramens have also been found related to bifid inferior alveolar nerve.

Two or three accessory mental foramen related to accessory mental nerves or mental neurovascular bundle have also been seen [37].

Retromental foramen with the mylohyoid nerve exiting out of this foramen [15,17-19] and retromolar foramen with buccal and accessory branches of inferior alveolar nerve innervating the molar teeth is also present in some cadavers as studied by Carter and Keen in 40% of the human mandibles(3 out of 8) [16].

Clinical Significance

Trigeminal neuralgia is pain along distribution of the trigeminal nerve and its branches. Classical trigeminal neuralgia is due to vascular compromise, while, secondary is due to neurological diseases for example multiple sclerosis or tumours [6]. Pterygospinous foramen replacing the foramen ovale could provoke trigeminal neuralgia too [49].

Temporomandibular joint dysfunction (TMD) is a group of conditions that cause pain and joint dysfunction6 characterised by masticatory muscle pain, capsulitis and internal derangement of the joint. A medially placed disc of this joint can interfere with the lingual and inferior alveolar nerves that pass close to the medial part of the condyle. TMJ surgery can lead to paraesthesia along auriculo temporal nerve [6]. A successful block can relieve this pain. Condylar and subcondylar fractures can lead to lingual and inferior alveolar nerve anaesthesia, an indication for open reduction of the fracture.

Radiation of pain can occur to the ear in case of diseases that involve the auriculotemporal nerve [6]. Ear pain, fluttering sensation and fullness can occur due to tonic tensor tympani syndrome. Increased activity of tensor tympani is noticed in people with hyperacusis [6].

Tumors can occur in the Meckel's cave where the trigeminal ganglion exists and can erode the bone. Brainstem lesions like glioma and infarction can result in Vth nerve symptoms. Less common lesions include metastasis, cavernous hemangiomas, hemorrhage and arteriovenous malformations [49]. Rarely, retrograde extension of the herpes simplex virus can also occur in the trigeminal nerve.

Entrapment of trigeminal nerve in the infratemporal fossa can lead to TMJ dysfunction, persistent idiopathic facial pain (PIFP) and myofascial pain syndrome (MFPS). Mandibular nerve entrapment can occur while passing between medial and lateral pterygoid resulting in pain during chewing and speech, and trigeminal neuralgia. Buccal nerve compression has been reported by hyperactive temporalis muscle leading to neuralgia. Compression of the masseteric nerve anterior to TMJ is found in excessive condylar translation. Compression of auriculotemporal may lead to neuralgia, paresthesia of TMJ and external acoustic meatus. Entrapment of the lingual nerve may lead to weak taste sensations from anterior 2/3rd of the tongue unilaterally and can affect speech articulation. Chronic compression of the nerves results in muscular paresis and swallowing difficulties. Interruption of the post-ganglionic sympathetic efferent fibers can lead to vaso- and sudomotor paralysis, and the skin becomes red and dry. Pain in facial muscles can also occur during entrapment if communicating fibers are found [49].

Anaesthesia of mandibular nerve and its branches is problematic due to its many anatomical and physiological variants [6] and should be taken into consideration in third molar extraction, mandibular surgery, implant placement and osteotomies. Haematomas can form if any vessel is affected during anaesthesia eg. Maxillary artery, inferior alveolar vessel and external carotid and the veinsn [6]. Pain and trismus can occur if mucosa is torn during anaesthesia. Other reported complications are ptosis, extraocular muscle paralysis, aphonia, necrosis of skin of chin, diplopia, abducent nerve palsy, atrophy of optic nerve and third molar agenesis.

CONCLUSION

For surgeons, dentists and anaesthetists a thorough understanding of the branching pattern and anomalies of the mandibular nerve and its region is necessary and should be carefully considered to treat the patient right.

REFERENCES

1. Drebby-Brafman A, Burstyn-Cohen T, Klar A, et al. F-spondin expressed in somite regions avoided by neural crest cells, mediates the inhibition of distinct somite domains to neural crest migration. Neuron. 1999;22:475-88.
2. Ranscht B, Bronner-Fraser M. T-cadherin expression alternates with migrating neural crest cells in the trunk of the avian embryo. Development. 1991;111:15-22.
3. Rodella L, Labanca M, Rezzani R, et al. Anatomiachirurgica per l'odontoiatria. 1st ed. Masson:Elsevier;2008.
4. Olivier E. The inferior dental canal and its nerve in the adult. Br Dent J. 1928;49:356-8.
5. Kieser J, Kieser D, Hauman T. The course and distribution of the inferior alveolar nerve in the edentulous mandible. J Craniofac Surg. 2005;16:6-9.
6. Ghatak RN, Helwany M, Ginglen JG. Anatomy, Head and Neck, Mandibular Nerve.
7. LF Rodella, B Buffoli, M Labanca, et al. A review of the mandibular and maxillary nerve supplies and their clinical relevance. Arch Oral Biol. 2012;57:323-34.
8. Kieser J, Kuzmanovic D, Payne A, et al. Patterns of emergence of the human mental nerve. Arch Oral Biol. 2002;47:743-7.
9. Serman NJ. Differentiation of double mental foramina from extra-bony coursing of the incisive branch of the mandibular nerve. J Dent Med. 1987;5:20.2.
10. Serman NJ. The mandibular incisive foramen. J Anat. 1989;167:195-8.
11. Pogrel MA, Smith R, Ahani R. Innervation of the mandibular incisors by the mental nerve. J Oral Maxillofac Surg. 1997;55:961-3.
12. Evers H, Haegerstam G. Handbook of dental local anaesthesia. Denmark: Schultz Medical Information; 1981.
13. Starkie C, Stewart D. The intra-mandibular course of the inferior dental nerve. J Anat. 1931;65:319-23.
14. Stewart D, Wilson D. Regional anesthesia and innervation of the teeth. Lancet. 1928;2:809-11.
15. Stein P, Brueckner J, Milliner M. Sensory innervation of mandibular teeth by the nerve to the mylohyoid: implications in local anesthesia. Clin Anat. 2007;20:591-5.
16. Carter RB, Keen EN. The intramandibular course of the inferior alveolar nerve. J Anat. 1971;108:433-40.
17. Wilson S, Johns P, Fuller PM. The inferior alveolar and mylohyoid nerves: an anatomic study and relationship to local anesthesia of the anterior mandibular teeth. J Am Dent Assoc. 1984;108:350-2.
18. Madeira MC, Percinoto C, das Graças M, et al. Clinical significance of supplementary innervation of the lower incisor teeth: a dissection study of the mylohyoid nerve. Oral Surg Oral Med Oral Pathol. 1978;46:608-14.
19. DuBrul EL. Sicher's oral anatomy. 7th ed. St. Louis: Mosby; 1980.
20. Chapnick L. Nerve supply to the mandibular dentition A review. J Can Dent Assoc. 1980;46:446-8.
21. Anjali S. Sabnis. A case report on additional branch of mandibular nerve. IJAV. 2013;6:197-8.
22. Pogrel MA, Renaut A, Schmidt B, et al. The relationship of the lingual nerve to the mandibular third molar region: an anatomic study. J Oral Maxillofac Surg. 1995;53:1178-81.
23. Ho ¨lzle FW, Wolff KD. Anatomic position of the lingual nerve in the mandibular third molar region with special consideration of an

atrophied mandibular crest: an anatomical study. Int J Oral Maxillofac Surg. 2001;30:333-8.

24. Racz L, Maros T, Seres-Sturm L. Anatomical variations of the nervusalveolaris inferior and their importance for the practice (author's transl). AnatAnz. 1981;149:329-32.
25. Khaledpour C. An anatomic variant of the inferior alveolar nerve in man. Anat Anz. 1984;156:403-6.
26. Kim SY, Hu KS, Chung IH, et al. Topographic anatomy of the lingual nerve and variations in communication pattern of the mandibular nerve branches. Surg Radiol Anat. 2004;26:128-35.
27. SassoliFazan VP, Rodrigues Filho OA, Matamala F. Communication between the mylohyoid and lingual nerves: clinical implications. Int J Morphol. 2007;25: 561-4.
28. Merrill RG. Prevention, treatment snd prognosis for nerve injury related to the difficult impaction. Dent Clin N Am. 1979;23:471-88.
29. Rosse C, Gaddum-Rosse P. Hollinshead's textbook of anatomy. 5th ed. Lippincott-Raven; 1997.
30. Komarnitki I, Andrzejezak-Sobocinska A, Tomezyk J, et al. Clinical anatomy of the auriculotemporal nerve in the area of the infratemporal fossa. FoliMorhol. 2012;71:187-93.
31. Anil T, Peker T, Turgut HB, et al. Variations in the anatomy of inferior alveolar nerve. Br J Oral Maxillofac Surg. 2003;41:236-9.
32. Bharadwaj N, Sahni P, Singhvi A, et al. Anomalous bilateral communication between inferior alveolar nerve and auriculotemporal nerve. Malaysian J Med Sci. 2014;21:71-4.
33. Gulekon N, Anil A, Poyraz A, et al. Variations in the anatomy of auriculotemporal nerve. Clin Anat. 2005;18:15-22.
34. Muraleedharan A, Veeramani R, Chand P. Abnormal communications among the branches of mandibular nerve especially the posterior division are significant due to various procedures undertaken in this region. Indian Med J. 2014;54:149-51.
35. Peker T, Turgut HB, Gulekon IN, et al. Variations in the anatomy of inferior alveolar nerve. Br J Oral Maxillofac Surg. 2003;41:23.
36. Thotakura B, Rajendran SS, Gnanasundaram V, et al. Variations in the posterior division branches of mandibular nerve in human cadavers. Singapore Med J. 2013;54:149-51.
37. Lew K, Townsen G. Failure to obtain adequate anaesthesia associated with a bifid mandibular canal: a case report. Aust Dent J. 2006;51:86-90.
38. Blanton PL, Jeske AH. The key to profound local anesthesia: neuroanatomy. J Am Dent Assoc. 2003;134:753-60.
39. Loizeaux AD, Devos BJ. Inferior alveolar nerve anomaly. J Hawaii Dent Assoc. 1981;12:10-1.
40. Roy TS, Sarkar AK, Panicker HK. Variation in the origin of the inferior alveolar nerve. Clin Anat. 2002;15:143-7.
41. Khan MM, Darwish HH, Zaher WA. Perforation of the inferior alveolar nerve by the maxillary artery: an anatomical study. Br J Oral Maxillofac Surg. 2010;48: 645-7.
42. Pai MM, Swamy RS, Prabhu LV. A variation in the morphology of the inferior alveolar nerve with potential clinical significance. Biomed Int. 2010;1:93-5.
43. Daimi SR, Siddiqui AU, Vyas VR, et al. Unique presentation of maxillary artery, lingual nerve, and inferior alveolar nerve complex. Int J Appl Basic Med Res. 2011;1:125-6.
44. Bergman RA, Thompson SA, Afifi AK. Catalog of Human Variation. Baltimore, Md: Urban and Schwarzenberg; 1983.
45. Sakamoto Y, Akita K. Spatial relationships between masticatory muscles and their innervating nerves in man with special reference to the medial pterygoid muscle and its accessory muscle bundle. Surg Radiol Anat. 2004;26:122-7.
46. Sandoval MC, Lopez FB, Suazo GI. An unusual relationship between the inferior alveolar nerve, lingual nerve and maxillary artery. Int J Odontostomat. 2009;3:51-3.
47. Pretterklieber ML, Skopakoff C, Mayr R. The human maxillary artery reinvestigated: I. Topographical relations in the infratemporal fossa. Acta Anat (Basel). 1991;142:281-7.
48. Tong DC. The great auricular nerve: a case report and review of anatomy. N Z Dent J. 2000;96:57.
49. M Piagkou, T Demesticha, G Piagkos, et al. The Mandibular Nerve: The Anatomy of Nerve Injury and Entrapment, Maxillofacial Surgery, Leon Assael, IntechOpen, 2012.
50. Bhadoria P, Wadhwa S, Nagar M. A typical Communicating Pattern between Branches of Mandibular Nerve: Clinical Significance & Review. AIMDR. 2016;2:4-6.