Bifurcated Mandibular Neural Canal: An Inside-Out Review

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Abstract

Some patients develops "bleeding of unknown origin or mandibular nerve neurological symptoms" after surgical procedures such as sagittal split ramus osteotomies or implants.(SSRO/BSSRO). In researching the causes of these symptoms, "a number of researchers came to the conclusion that the mandibular nerve canal is not a single structure but rather comprises variations at numerous sites." According to the results of several studies, the presence of a bifurcated mandibular nerve canal is also an unusual but not exceptionally rare characteristic. They might originate from a single mandibular foramen or at any point along their path inside the mandible.

Keywords: Bifurcated Mandibular Nerve Canal**,** Mandibular foramen**.**

INTRODUCTION

"According to the Head and Neck Book, researched by BD Chaurasia and Gray's Anatomy, the inferior alveolar and lingual nerves, both of the mandibular sensory branches, may be located in the infratemporal fossa. (Cranial Nerve V3 i.e. occulomotor nerve)". The inferior alveolar nerve emerges from a dip on the medial side of the lateral pterygoid muscle. "The mandibular nerve divides into the inferior alveolar nerve and the superior alveolar nerve just before it reaches the mandible via the mylohyoid foramen".

"Studies have shown that the inferior alveolar nerve travels parallel to the jaw's medial side before innervating the mylohyoid muscle. The inferior alveolar nerve enters the mandible via the mandibular foramen". "As it travels through the mandibular canal after entering the mandible, the inferior alveolar nerve gets sensory input from the mandibular molars, the 2nd mandibular premolar, and the adjacent labial gingivae." "The terminal branches of the inferior alveolar nerve are the incisive and mental nerves". The incisive nerve, which is located within the mandibular canal, supplies blood and nerve fibers to the mandibular first premolar, canine, and incisors, as well as the gingivae that are located nearby. "The mental nerve comes out from the mandibular canal via the mental foramen to provide blood and nerve fibers to the lower lip and chin".[1,2]

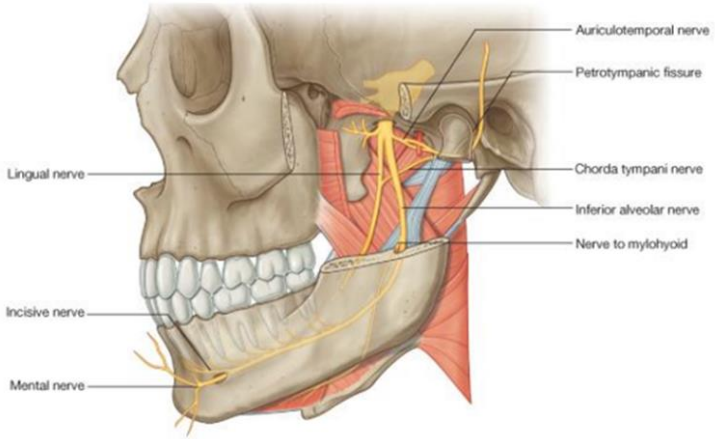

FIG 1 : MANDIBULAR NERVE LATERAL VIEW (AURICULOTEMPORAL BRANCH).[3]

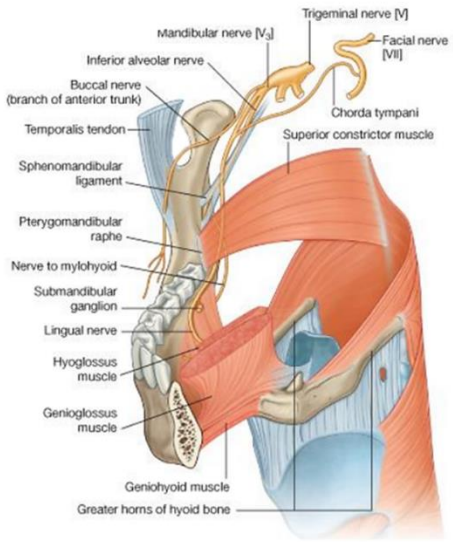

FIG 2 : MANDIBULAR NERVE (ANTERIOR VIEW).[3]

The mandibular nerve courses inferiorly and generates multiple branches within the infratemporal fossa. One of the mandibular nerve's branches, namely the inferior alveolar nerve, descends within the mandible, splits from the mandible, and enters the mandibular foramen. "Before dividing to produce the incisive and mental premolar nerves, the mandibular nerve supplies vascular and neural innervation to the mandibular molars, the second mandibular nerve, and the accompanying labial gingivae".[4]

"Studies have shown that the lingual branch of sensory nerve V3 enters the oral cavity through the infratemporal fossa between the tensor veli palatini and lateral pterygoid muscles, carrying general sensation from the anterior two-thirds of the tongue, the mucosa covering the oral cavity floor, and the anterior gingivae associated with the mandibular teeth. The chorda tympani, a branch of the facial nerve and Cranial Nerve VII, commonly known as the lingual nerve, innervates all of the salivary glands situated under the lingual fissure. The lingual nerve is situated in the anterior fossa".[1,2]

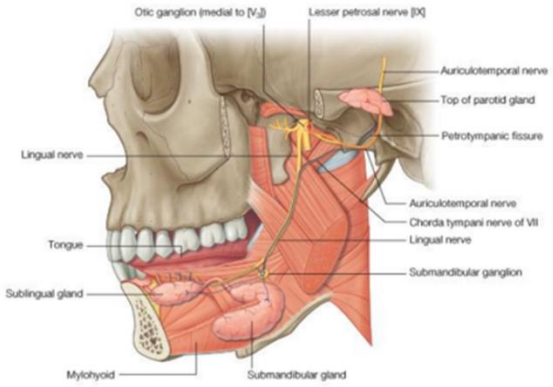

FIG 3 : LINGUAL NERVE DIVISION[3]

The lingual nerve , which transmits lingual sensation from soft tissues, enters the oral cavity.[4]

In certain patients who visit the dental clinic, alveolus operations, implantation, and sagittal split ramus osteotomies (SSRO and BSSRO) are connected with neurological symptoms and bleeding of the mandibular nerve. A substantial amount of research has revealed that the mandibular nerve canal is not a uniform structure but rather displays variations at a few discrete sites in an attempt to discover the cause of these symptoms.[5]

"According to the results of a number of studies, the presence of bifurcated mandibular nerve canals is an unusual but not very rare characteristic".[6] "They might originate from a single mandibular foramen or at any point along their path inside the mandible".[7] According to the literature search, there is no comprehensive review paper detailing the inside-out bifurcated mandibular neuronal canal. As a consequence, in our review, we will talk about variations in the mandibular canal that may cause problems for patients.

HISTORY

The literature suggests that both prior to and during its traversal inside the mandibular canal, the inferior alveolar nerve may undergo structural alterations. "There have been several reports in the medical literature of accessory mandibular foramina with bifid inferior alveolar nerves situated either inside the major mandibular canal or within accessory mandibular nerves".[4]

LITERATURE REVIEW

1. **Schejtman et al (1967)[8]** conducted a study on human cadavers to establish the origin and distribution of the parts that make up the mandibular retromolar canal. They concluded the presence of accessory mandibular canals (retromolar canals) in 13 of 18 mandibular specimens in the majority of dissected human cadavers.

2. **Carter and Keen (1971)**[9] did a study on the inferior alveolar nerve's intramandibular route.They concluded that multiple accessory foramina was present that supply neurovascular bundles to the muscles of mastication.

3. **Haveman and Tebo (1976)[10]** analyzed on 150 dry specimens and reported an average of 36 accessory foramina per mandible.The data obtained reveal that these foramina occur often and in about the same places. This suggests that these foramina are functionally relevant in supplying neural and/or vascular components to the mandible.

4. **Serman NJ (1987)[11]** study was carried out on a total of 79 mandibular specimens were studied. The researchers arrived at the conclusion that there was a dual occurrence of mandibular incidence.

5. **Jeyaseelan and Sharma (1984)[12]** examined the many medial foramina present in the mandible, paying close attention to the medial foramina on the mandibular face, close to the final molars. Macerated mandibles showed the presence of foramen in 4% of cases. The prospective contribution of these to neurovascular transmission was investigated. Once the local anesthetic at the mandibular foramen blocks the inferior dental nerve, pain fibers might travel to the lower final molars and incisors through the unnamed medial foramen and the incisive foramen. Dissected mandibles and associated muscles showed blood vessel transmission via the present mandibular foramina at the muscle insertion.

6. **Ossenberg (1987)[13]** conducted a study that analyzed 2,500 specimens and reported a notable prevalence of retromolar accessory mandibular foramina in the arid region.

"Moreover, previous studies conducted by Shiller (1954)[14], Wiswell and Sutton (1974)[15], and Chapnick (1980)[16] have documented the existence of accessory foramina in the mandibular symphyseal region of desiccated cranium specimens, alongside accounts of desiccated mandibular foramina and canals".

LANDMARK STUDIES

Bifid mandibular canals bwas first time ever reported by Patterson and Funke (1973)[17] as well as Kiersch and Jordan (1973)[18] observed by radiographic evaluations and it was called as Roentgeno-oddities.

Later on, Nortje et al.(1977)[19] In a retrospective review of 3612 panoramic radiographs from normal dental patients. They found that the mandibular canals are often, but not always, single and bilaterally symmetrical. The placement of the canal varies with respect to the inferior border of the mandible and the apexes of the teeth; therefore, it cannot be utilized as a universal standard for prosthetic or orthodontic assessment. They came to the conclusion that there are three varieties of supplemental mental mandibular canals.

CLASSIFICATION

Multiple researchers have classified bifid mandibular canals using panoramic radiographs and computerized tomography based on their anatomical location and configuration.[20]

"According to Carter and Keen (1971)[9] inferior alveolar nerve can be classified as-

"Type I: single large bony canal

Type II: canal is lower down in the mandible

Type III: canal separates posteriorly into two large branches".

"According to Nortje, et al.(1977)[19] gave patterns of duplication as-

"Type I: duplicate canals from a single mandibular foramen which can be of same size/lower canal smaller/upper canal smaller.

Type II: short upper canal up to the second molar areas.

Type III: two canals from separate foramina, joining at molar area

Type IV: supplemental canals joining the main canals in the retromolar areas."

"According to new classification of BMC (2019)[21]

Since there is currently no approach that is widely approved for categorizing BMC, researchers employ a variety of classification criteria. This might result in substantial heterogeneity in the results of the research. They established a reclassification of the BMC based on the precisely defined limits of the mandibular body and ramus, and this enhanced method will drive the evolution of surgery in the future.The classification was as follows:-

Type IA: Bifurcations at the mandibular ramus, and retromolar foramen has been formed.

Type IB: Bifurcations at the mandibular ramus, and retromolar foramen has not been formed. Type II: Bifurcations at the mandibular body.

Type III: Bifurcations exist both at the man-dibular body and the mandibular ramus on one side.

Type IV: Other circumstances"

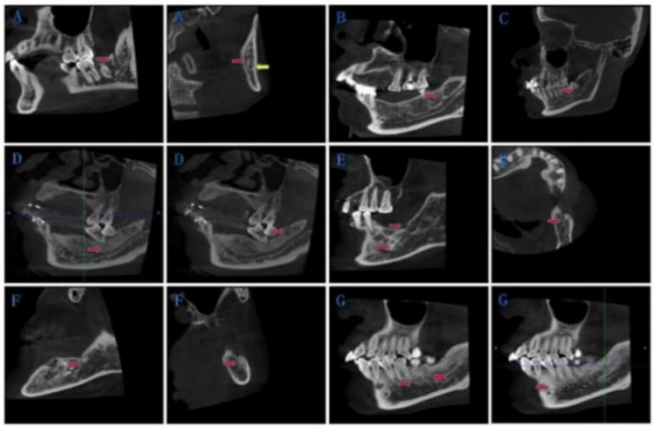

FIG 4: NEW BMC CLASSIFICATION: THE RED ARROW POINTS TO THE BIFURCATIONS, WHEREAS THE YELLOW ARROW POINTS TO THE MANDIBULAR CANAL.[21]

DIFFERENT STUDIES CLASSIFICATION ANALYSIS

Methods	Basis of classification	Tool	Dimensions of image (2D/3D)	Category	Comprehensive coverage	Measured data	Incidence rate
Nortje et al.	The height of the mandibular canal in the mandible.	Orthopantomography	2D	4	Position	None	46.7% (1685/3612) Male: 48.9% Female: 45.7%
Langlais et al.	Unilateral bifurcation or bilateral and the relationship of convergence between bifurcation and the canal.	Orthopantomography	2D	4	Unilateral or bilateral	none	Male: 39%; Female: 61%
Naitoh et al.	Directions of the canal.	CBCT	3D	4	Direction	The length of BMC: I: 14.8; II: 8.9; III: 8.6; IV: 1.6	65% (125)

TABLE 1 : DIFFERENCE BETWEEN DIFFRENT THEORIES ABOUT BIFURCATED MANDIBULAR NEURAL CANAL.[21]

ADVANTAGE OF CLASSIFICATION 2019 [21]

1. It can record multiple canal on one single side i.e. good to look for more comprehensive complications.
2. It can measure distance available between anatomical structures i.e. apical most part of root and inferior alveolar nerve canal.
3. It allow a clear picture for the sutures that are placed in mandible which can precisely guide during any surgical procedure.

DISADVANTAGE OF CLASSIFICATION 2019[21]

1. General trends of BMC was not considered in the classification.
2. The proper anatomical distance between root apical tip and inferior alveolar nerve canal cannot be assessed in numbers.

CLINICAL APPLICATION[21]

1. Delivering anaesthesia
2. “Dental extraction of impacted mandibular impacted molar”.
3. Placement of Dental Impalnt in mandible molar region.
4. Surgical procedure like sagittal split ramus osteotomy (SSRO), rigid internal fixation .
5. Identification of anatomical landmarks.

CONCLUSION

Since there is currently no approach that is widely approved for categorizing BMC, researchers employ a variety of classification criteria. This might result in substantial heterogeneity in the results of the research. They established a reclassification of the BMC based on the precisely defined limits of the mandibular body and ramus, and this enhanced method will drive the evolution of surgery in the future.

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