

Maxillary Nerve Variations and Its Clinical Significance

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Abstract:

The aim of this review is to collect data from the literature and gives a detailed description of the innervation of the maxilla. We carried out a search of studies published in PubMed up to 2011, including clinical and anatomical studies .several articles has has been published regarding the anatomical variations of the maxillary nerve supplies.

The purpose of this paper is to demonstrate the variation in the paths and communications of the maxillary nerve which should be considered by the clinicians as nerve supply, assumed prime importance to oral surgeons to understand better and to avoid complications associated with anaesthesia and surgical procedures.

Key words: maxillary nerve, clinical variations

THE MAXILLARY NERVE:

1. Anatomical variations of the maxillary nerve supply.
2. Anatomical variations of the infraorbital nerve.
3. Anatomical variations of the superior alveolar nerve
4. Anatomical variations of the greater palatine nerve.
5. Anatomical variations of the nasopalatine nerve.

AXILLARY NERVE:

The maxillary nerve is a sensory nerve. After its origin from the trigeminal ganglion, the maxillary nerve passes through the cavernous sinus below the ophthalmic nerve exits through the foramen rotundum and enters into the pterygopalatine Fossa. In the fossa, several sensory branches are given off the meningeal branches, the superior alveolar nerves, the zygomatic and infraorbital nerves. The other nerve originate from the Pterygopalatine ganglion and nasopalatine nerve.

ANATOMICAL VARIATION OF MAXILLARY NERVE

SUPPLY:

Knowledge of the anatomical variations of the maxillary nerve is necessary for a surgeon while performing maxillofacial surgery and regional block anaesthesia. In the literature, there is little data concerning the maxillary nerve component. Previous observation had no significant variations relating to the ophthalmic and maxillary nerves. On the contrary, anatomical variations were found in 20% of cases in relation with the mandibular nerve and its branches^[1].

ANATOMICAL VARIATION OF INFRA ORBITAL NERVE:

The infraorbital nerve is a direct extension of the maxillary division of the trigeminal nerve . It courses anteriorly through a canal within the bone of the orbital floor and provides superior alveolar nerves for the sensory innervations of the maxillary teeth. The infraorbital nerve then emerges from the infraorbital foramen and gives 4 branches, the inferior palpebral, the external nasal, the internal nasal and the superior labial branches for the sensory innervation to the skin of the eyelid, nose, cheek and upper lip. Infraorbital

foramen is usually a single foramen but several studies have proven to have two or three foramen^[2-8]. A low percentage (4.7%) was observed during a study on 1064 skulls, with a higher frequency on the left side, both in male and in female skulls^[9]. The distance from the infraorbital foramen to the inferior border of the orbital rim is from 4.6 to 10.4 mm^[10-13].

Since the infraorbital nerve block is often used to achieve regional anaesthesia of the face, the study of frequency and position of accessory infraorbital foramen are useful to reduce anaesthetic and surgical complications, especially in trunk block of the infraorbital nerve.

ANATOMICAL VARIATIONS OF THE SUPERIOR ALVEOLAR NERVE:

The superior alveolar nerve is given off from the maxillary nerve in the pterygopalatine fossa, runs in the infraorbital canal and divides into branches, which supply the maxillary teeth .The contribution of the three alveolar nerves to the maxillary teeth innervations has been reported being different. The superior molar teeth are normally innervated from the posterior superior alveolar nerve and occasionally from the middle superior alveolar nerve, whereas there is no innervation to the first molar from the anterior superior alveolar nerve^[14,15]. In superior premolar teeth, it is interesting to observe that some patients have only two maxillary alveolar nerves and that the middle superior alveolar nerve, the innervation ascribes to the premolar teeth was often missing and was provided by the posterior superior alveolar nerve.^[15,16] The innervation of the canine and incisor teeth is normally due to anterior superior alveolar nerve; Robinson and Wormald showed that there was a wide variation to the branching pattern of the anterior superior alveolar nerve and the middle superior alveolar nerve within the anterior surface of the maxilla^[17].

There are no anatomical predictors of the innervation pattern. Therefore, clinicians may have to modify their approach to avoid anaesthetic procedure failure.

ANATOMICAL VARIATIONS OF POSTERIOR SUPERIOR ALVEOLAR NERVE :

The posterior superior alveolar nerve originates from the maxillary nerve just before it enters infra orbital groove(fig1).Then it gives several branches to gingival and mucosa of teeth. Then it enters the posterior alveolar canal on the infra temporal surface of maxilla and gives off branches to the mucuous membrane of maxillary sinus and upper molar teeth. Several variations in the branching patterns of this nerves has been recorded has single or multiple nerve root .

Mc Daniel ^[24] found that posterior superior alveolar nerve had one branch in 21% two branch in 30% and three branches in 25% of specimens. Branching pattern of this nerve should be considered during anaesthetic procedure in this nerve, the different origins of the posterior superior alveolar nerve compared to the middle and the anterior branches offers the possibility to anaesthetise only the posterior branch. Indeed, the posterior superior alveolar nerve is approached near the maxillary tuberosity, whereas the anterior superior alveolar nerve in the region of infraorbital foramen. The posterior superior alveolar nerve block may not cause complete maxillary molar anaesthesia due to the presence of branches from the palatine nerve that could innervate the molar and premolar teeth^[25]

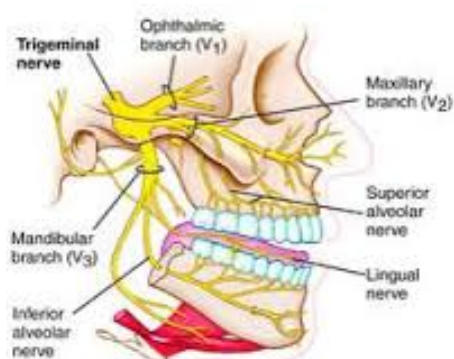
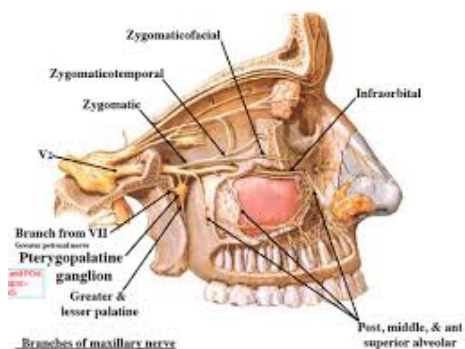


fig:1

THE MIDDLE SUPERIOR ALVEOLAR NERVE:

Middle superior alveolar nerve arises from infra orbital neve when it is the infraorbital canal.McDaniel^[24] reported that the middle superior alveolar nerve followed the classical description in only 30% of examined cases whilst the majority of middle branch entered the formation of a nerve plexus that supplied the teeth. When the middle branch was absent, the innervation of the premolar teeth may be provided by secondary branches of the anterior superior alveolar nerve, by the posterior superior alveolar nerve or by a nervous plexus between these two nerves. Even if this situation is not easily detectable, this variation should be considered during anaesthetic procedures.



THE ANTERIOR SUPERIOR ALVEOLAR NERVE:

The anterior superior alveolar nerve comes from the infraorbital nerve at variable distances from the infraorbital foramen. The nerve arises from the middle and anterior thirds of the infraorbital nerve and courses in the infraorbital canal. After entering the anterior surface of the maxilla, it courses across the maxilla towards the canine fossa before branching and forming the superior dental plexus located in the maxillary alveolar process.

The anterior superior alveolar nerve was present as a single trunk in 75%, of cases as reported by McDaniel^[24]; in 35% there was a diffuse fine plexus of the anterior superior alveolar nerve branches overlying the canine fossa. The presence of a superior dental plexus appears to be favoured by multiple posterior branches and by the presence of a middle branch or an anterior branch with multiple main branches.

ANATOMICAL VARIATIONS OF THE PALATINE NERVE:

The greater palatine nerve is the anterior branch of the palatine nerve it runs in the inferior area of the hard palate and innervates the palatal gingiva and the hard palate. The palatine nerve is distributed to the roof of the mouth, soft palate, tonsil, and lining membrane of the nasal cavity. Most of its fibres derive from the sphenopalatine branch of the maxillary nerve. In older textbooks, it is usually categorized as anterior, middle, and posterior palatine nerve. More recent textbooks simplify the distribution into the greater palatine nerve and the lesser palatine nerve Variations of the location of greater palatine foramen have been reported^[18,19]. The first description of the location of the greater palatine foramen was reported by Matsuda^[20]. In particular, it was opposite the maxillary second or third molar^[21] anywhere between the maxillary second and third molar ^[22]. 5 A recent study^[19] confirmed the presence of the foramen opposite the maxillary third molar (54.87%) distal to the maxillary third molar (38.94%) and between the maxillary second and third molar (6.19%). The greater palatine nerve can sometimes gives additional branches for the molar and premolar maxillary teeth. Variation has to be considered for a complete and adequate superior alveolar nerve block.

ANATOMICAL VARIATIONS OF THE NASOPALATINE NERVE:

The nasopalatine nerve is a branch of the sphenopalatine nerve. The nasopalatine nerve is a branch of the maxillary division of the trigeminal nerve. It passes through the pterygopalatine ganglion, enters the sphenopalatine foramen and passes medially across the roof of the nose to the upper part of the posterior border of the nasal septum. It then passes forward in the mucous membrane of the nasal septum, sloping down to the incisive canal which it passes through reach the hard palate. Last (1984) states that it supplies the incisive gum of the hard palate^[23]. Gray (1980) reports that the nerve innervates the mucous membrane in the anterior part of the hard palate and that it communicates with the anterior palatine nerves. Cunningham (1981) suggests that the anterior palatine nerves supply the gingivae and supporting structures of the upper teeth only as far forward as the canines and that the nasopalatine nerve innervates the mucosa in the incisor region^[26]. Dixon (1986) is more specific, stating that the nasopalatine nerve may supply an area of mucous membrane in the region of the incisive papilla and may also help to supply the supporting structures of the central and often lateral incisor teeth^[27].

CONCLUSION:

This review summarises data concerning anatomical variations of maxillary nerve and its branches in order to provide an update of the main anatomical variations concerning these nerves and consequently, to give detailed anatomical basis for a better understanding of clinical and surgical practice related to oral and maxillofacial area. The knowledge of the branching patterns of the trigeminal nerve, the additional innervation and the presence of accessory canals and foramina should be carefully considered for choosing the best plan and consequently for optimizing anaesthetic and surgery procedure during oral and maxilla facial procedures.

REFERENCE:

1. Sie'ssere S, Hallak Regalo SC, Semprini M, Honorato De Oliveira R, Vitti M, Mizusaki Iyomasa M, et al. Anatomical variations of the mandibular nerve and its branches correlated to clinical situations. *Minerva Stomatol* 2009;58(5):209-15.
2. Hindy AM, Abdel-Raouf F. A study of infraorbital foramen, canal and nerve in adult Egyptians. *Egypt Dent J* 1993;39(4):573-80.
3. Leo JT, Cassell MD, Bergman RA. Variation in human infraorbital nerve, canal and foramen. *Ann Anat* 1995;177(1):93-5.
4. Aziz SR, Marchena JM, Puran A. Anatomic characteristics of the infraorbital foramen: a cadaver study. *J Oral Maxillofac Surg* 2000;58(9):992-6.
5. Rath EM. Surgical treatment of maxillary nerve injuries, The infraorbital nerve. *Atlas Oral Maxillofac Surg Clin North Am* 2001;9(2):31-41.
6. Bressan C, Geuna S, Malerba G, Giacobini G, Giordano M, Robecchi MG, Vercellino V. Descriptive and topographic anatomy of the accessory infraorbital foramen. Clinical implications in maxillary surgery. *Minerva Stomatol* 2004;53(9):495-505.
7. Gupta T. Localization of important facial foramina encountered in maxillo-facial surgery. *Clin Anat* 2008;21(7):633-40.
8. Tubbs RS, Loukas M, May WR, Cohen-Gadol AA. A variation of the infraorbital nerve: its potential clinical consequence especially in the treatment of trigeminal neuralgia: case report. *Neurosurgery* 2010;67(3 Suppl. operative):onsE315.[discussion onsE315].
9. Bressan C, Geuna S, Malerba G, Giacobini G, Giordano M, Robecchi MG, Vercellino V. Descriptive and topographic anatomy of the accessory infraorbital foramen. Clinical implications in maxillary surgery. *Minerva Stomatol* 2004;53(9):495-505.
10. Aziz SR, Marchena JM, Puran A. Anatomic characteristics of the infraorbital foramen: a cadaver study. *J Oral Maxillofac Surg* 2000;58(9):992-6.
11. Rath EM. Surgical treatment of maxillary nerve injuries, The infraorbital nerve. *Atlas Oral Maxillofac Surg Clin North Am* 2001;9(2):31-41.
12. Zide BM, Swift R. How to block and tackle the face. *Plast Reconstr Surg* 1998;101(3):840-51.
13. Kazkayasi M, Ergin A, Ersoy M, Tekdemir I, Elhan A. Microscopic anatomy of the infraorbital canal, nerve, and foramen. *Otolaryngol Head Neck Surg* 2003;129(6):692-7.
14. Loetscher CA, Melton DC, Walton RE. Injection regimen for anesthesia of the maxillary first molar. *J Am Dent Assoc* 1988;117(2):337-40.
15. Loetscher CA, Walton RE. Patterns of innervation of the maxillary first molar: a dissection study. *Oral Surg Oral Med Oral Pathol* 1988;65(1):86-90.
16. Heasman PA. Clinical anatomy of the superior alveolar nerves. *Br J Oral Maxillofac Surg* 1984;22(6):439-47.
17. Robinson S, Wormald PJ. Patterns of innervation of the anterior maxilla: a cadaver study with relevance to canine fossa puncture of the maxillary sinus. *Laryngoscope* 2005;115(10):1785-8.
18. Sujatha N, Manjunath KY, Balasubramanyam V. Variations of the location of the greater palatine foramina in dry human skulls. *Indian J Dent Res* 2005;16(3):99-102.
19. Chrcanovic BR, Custódio AL. Anatomical variation in the position of the greater palatine foramen. *J Oral Sci* 2010;52(1):109-13.
20. Matsuda Y. Location of the dental foramina in human skulls from statistical observations. *Int J Orthod Oral Surg Radiog* 1927;13(4):299-305.
21. Selden HM. Practical anesthesia for dental and oral surgery. 3rd ed. Philadelphia: Lea Febiger; 1947.
22. Shane SME. Principles of sedations, local and general anesthesia in dentistry. Illinois: Charles C Thomas; 1975.
23. Last, R. J. (1984). *Anatomy, Regional and Applied*, 7th ed., pp. 40&403. Edinburgh: Churchill Livingstone.
24. McDaniel WM. Variations in nerve distributions of the maxillary teeth. *J Dent Res* 1956;35:916-21
25. Blanton PL, Jeske AH. The key to profound local anesthesia: neuroanatomy. *J Am Dent Assoc* 2003;134(6):753-60.
26. Cunningham, D. J. (1981). *Cunningham Textbook of Anatomy*, 12th ed., p. 442. Oxford: Oxford University Press.
27. Dixon, A. D. (1986). *Anatomy for Students of Dentistry*, 5th ed., p. 261, Edinburgh: Churchill Livingstone.