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Research Article

CBCT EVALUATION OF MANDIBULAR CANAL ASSESSMENT OF ITS CONFIGURATION RELATIONSHIP TO THE ROOTS OF MANDIBULAR 3RD MOLARS AND THE LOCATION OF MENTAL FORAMEN

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ABSTRACT

This study investigated the diagnostic accuracy of cone beam computed tomography (CBCT) in determining the anatomical position of the impacted third molars in relation with the mandibular canal and the location of mental foramen. Materials and Methods: The prospective study included 50 patients (100 hemi mandibles) who presented with un erupted mandibular third molars, CBCT images obtained for all the patients using planmeca promax 3D mid proface unit. All types of impacted third molars (mesioangular, vertical, distoangular and horizontal) were included in this study. Results: Out of 100 hemi mandibles evaluated, 23% of cases mandibular nerve was seen buccal to the third molars, 25% was seen lingual to the third molars, 52% was seen inferior to the third molars. Mental foramen location identified in 14% at the 1st premolar region, in 40% of the mental foramen was identified at the 2nd premolar region and 46% of the mental foramen was identified in between the first and second premolars. Conclusion: CBCT imaging is an effective volumetric diagnostic imaging technology that produces accurate submillimeter resolution images of diagnostic quality. Hence CBCT evaluation is essential in the relationship of mandibular impacted 3rd molars to the mandibular canal and location of mental foramen during minor surgical procedures.

Abbreviations: Cranial Nerves (CNs), Computed Tomography (CT), Cone Beam Computed Tomography (CBCT), Mental Foramen (MF), Inferior Alveor Nerve (IAN).

Key words:- Impacted 3rd molars, Cone Beam Computed Tomography, Inferior alveolar nerve, Mental Foramen, Mental nerve.

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INTRODUCTION

The trigeminal nerve is the largest and most complex of the 12 cranial nerves (CNs). It suppliessensations to the face, mucous membranes, and other structures of the head. It is the motor nervefor the muscles of mastication and contains proprioceptive fibers. It exits the brain by a largesensory root and a smaller motor root coming out of the pons at its junction with the middle cerebral peduncle. It passes laterally to join the gasserian (semilunar) ganglion in the Meckel cave. [1]

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The trigeminal nerve originates from three sensory nuclei and one motor nucleus extending from the midbrain to the medulla. At the level of the pons, the sensory nuclei merge to form a sensory root. The motor nucleus continues to form a motor root.

The peripheral aspect of the trigeminal ganglion gives rise to divisions of the ophthalmic (V1), maxillary (V2) and mandibular (V3).

The mandibular nerve exits via the foramen ovale entering the infra-temporal fossa. [1]

Mandibular nerve gives rise to four terminal branches in the infra-temporal fossa:

1. Buccal nerve,
2. Inferior alveolar nerve(IAN),
3. Auricotemporal nerve and
4. Lingual nerve.

These branches innervate the skin, mucous membrane and striated muscle derivatives of the mandibular prominence of the 1st pharyngeal arch. [1]

The incidence of damage to the IAN increases to 30% when a close relationship between the third molars and the mandibular canal is observed radiographically. Therefore, it is important to evaluate the position of the third molars and determine its relationship with the mandibular canal preoperatively to minimize the risk of nerve damage. [2]

Although panoramic radiography is one of the most effective and widely used dental radiographic tools for evaluating the risk of IAN nerve damage, the absence of the cortical bone of the mandibular canal may not be clearly evident with this method, and it is impossible to determine whether its course is buccal or lingual to the roots or between the roots. [2]

The risk factors for the close relationship between the teeth and the mandibular canal or IAN injury based on the findings from panoramic images. Such as the darkening of the roots, the interruption of the white lines of the canal, the diversion of the canal, and the narrowing of the canal.

Computed tomography (CT) may be recommended to verify the close relationship between the third molars and the mandibular canal in a three-dimensional (3D) view. The higher radiation dose, increased financial cost and less accessibility, however, are the negative aspects of CT compared with conventional imaging.

Cone beam computed tomography (CBCT) is an imaging modality that has recently become popularized for dentomaxillofacial imaging. When compared with conventional CT scanners, CBCT units cost less and requires less space, have a rapid scan time, limit the beam to the head and neck, reduce radiation dose and have interactive display modes that offer maxillofacial imaging and multiplanar reformation making them more suitable for use in dental practices. [3]

The mental foramen (MF) is a funnel-like opening located on the lateral aspect of the mandible.
It is an important anatomical landmark through which the inferior alveolar nerve and vessel bundles pass. Once the nerve leaves the MF, it branches to innervate the anterior teeth and neighboring structures. The blood vessels supply the soft tissues of the lower jaw. Surgeons must establish the position of the MF accurately because any invasive procedure performed in this region may damage the neurovascular bundles and cause serious sequelae, such as paresthesia or anesthesia. [4]

Although root canal therapy is the primary method to treat endodontic diseases and some patients require periapical surgery. Because the MF is located near the root apices of the mandibular premolars, periapical surgery performed in this region may damage the neurovascular bundles.

Thus, it is important to explore the precise position of the MF and its relationship with peripheral structures. [4]

Hence knowledge of anatomy and their variations are essential to ensure precise surgical procedures to safeguard patients vital structures by using advanced technology like CBCT.

The purpose of this study is to assess the inferior alveolar nerve proximity to the mandibular 3rd molar roots and location of the mental foramen with the help of CBCT.

MATERIALS AND METHODS:

The present study was an attempt to evaluate the relationship between the mandibular third molar roots with mandibular canal using CBCT.

STUDY POPULATION:

CBCT images of 50 patients referred for impacted third molars surgery.

CBCT images of patients with presence of impacted third molars, male and female patients above age 20 years, all types of impacted third molars (mesio angular, vertical, distoangular and horizontal) were included in this study and presence of pathologies in the jaws associated with unerupted or impacted teeth, history of previous surgeries in body and ramus region, Patients with developmental defects of face, patients not willing for CBCT are excluded from the study.

METHODOLOGY:

50 CBCT images of patients (100 side/hemi-mandibles) were taken. These scans were performed by planmeca promax 3D midproface in standing position. The age group selected was above 20 years of age since the third molars are erupted normally at this age. The volumes were analysed by Romexis viewer software. Relationship of mandibular third molars to the inferior alveolar canal were recorded on right and left sides for all

the patients.

- The location of mental foramen were also determined.
- All the parameters were reviewed by two maxillofacial radiologists.

RESULTS:

Out of 100 sides evaluated, mandibular nerve was seen buccal to the third molars in 23% of cases, lingual to the third molars in 25% of the cases and inferior to the third molars in 52% of the cases. (Table 1 & Graph 1)

Out of 100 images evaluated, mental foramen was present at the 1st premolar region in 14%, the mental foramen was present at the 2nd premolar region in 40% and the mental foramen was present in between the first and second premolars in 46% of the cases (Table 2 & Graph 2).

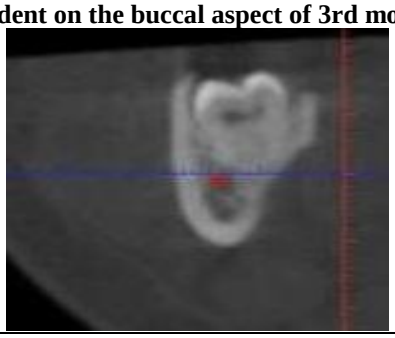
Table 1. Relation of mandibular third molar roots to the mandibular nerve:

	Frequency	Percent
Buccal	23	23.0
Lingual	25	25.0
Inferior	52	52.0
Total	100	100.0

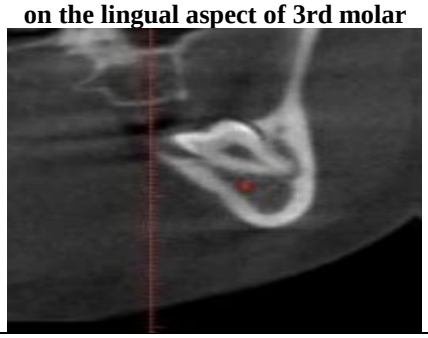
Table 2. Location of mental foramen

	Frequency	Percent
1st Premolar	14	14.0
2nd Premolar	40	40.0
Between 1st & 2nd	46	46.0
Total	100	100

Picture 1. The position of mandibular canal was evident on the buccal aspect of 3rd molar



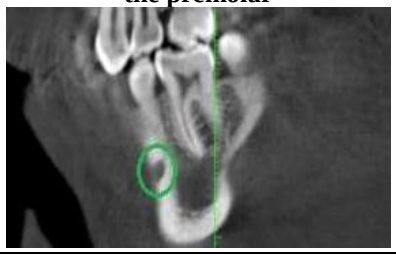
Picture 2. The position of mandibular canal was evident on the lingual aspect of 3rd molar



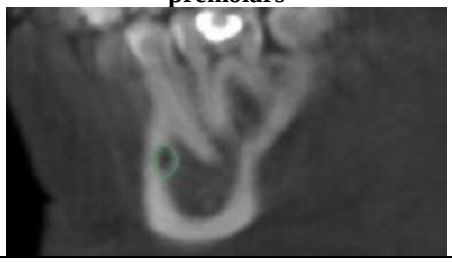
Picture 3. The position of mandibular canal was evident on the inferior aspect of 3rd molar

Picture 4. Position of mental foramen at 1st premolar

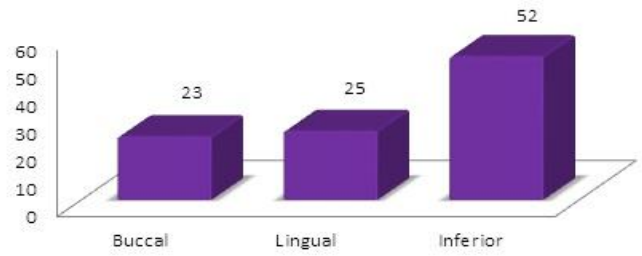
Picture 5. Position of mental foramen at 2nd premolar the premolar



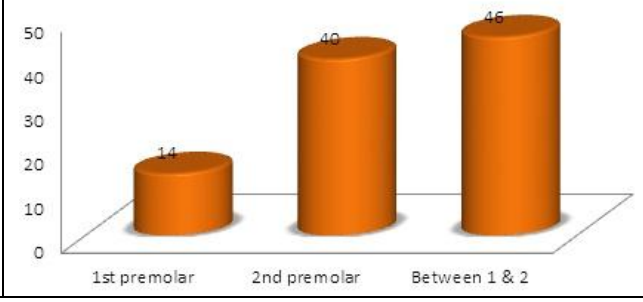
Picture 6. Position of mental foramen between the premolars



Graph 1. Percentage relation of mandibular third molar roots to the mandibular nerve



Graph 2.



DISCUSSION

Before planning extraction of mandibular third molars, the proximity between the mandibular canal and the impacted molars should be assessed to minimize the risk of inferior alveolar nerve damage. Compared with 2-D radiography, 3-D radiography provides more information about the position of the nerve; this knowledge can be used to determine a treatment plan. This study used CBCT scanning, a 3-D radiographic method to determine the anatomical proximity and the relationship of the mandibular third molar roots to the mandibular nerve.

- We found that the mandibular canal was most frequently positioned lingual rather than buccal aspect to the impacted mandibular third molars. This finding is in accordance with that of study done by De Melo Albert et al., 2006; Ohman et al., 2006; Tantanapornkul et al., 2007 [5-7].
- Furthermore, only 23% of the impaction cases showed buccal positioning of the mandibular canal, which is in agreement with other reports that the mandibular canal has a low prevalence of buccal positioning in relation to the impacted mandibular third molars.
- No superior positioning of the mandibular nerve canal in relation to the impaction was not observed in our sample population and also in previous studies.
- With regards to the side of the 23% placed buccal to the third molars, 12(24%) were seen on the right side and 11(22%) were seen on the left side. 25% were seen lingual to the third molars out of which 12(24%) were seen on right side and 13(26%) were seen on the left side, 52% were seen inferior to the third molars out of which 26(52%) were seen in on right side and 26(52%) were seen on the left side. These aspects of the study is first of its kind.
- The buccal relationship of the mandibular canal and the mandibular molars was seen in 11(19%) males and 12(28.6%) females; and the lingual relationship of the mandibular canal to the mandibular molars were seen in 11(19%) males and 14(33.3%) females respectively; Out off 52% seen inferior to the third molars, 36(62.1%) were seen in males and 16(38.1%) were seen in females. These aspects of the study are also first of its kind.
- Mental foramen (MF) is an important landmark in dentistry. Knowledge of its position is critical important to perform block anesthesia of the mental nerve or to avoid nerve damage during implant placement and surgical procedures in the premolar region of the mandible.
- The majority of MF (46%) were located apically between the two premolars in our study which was slightly less when compared to the study done by Von Arx et al 2013 (56%) and more when compared to the study done by Voljevica et al 2015(20.3%) [8].
- Mental foramen was located below the second premolar in 40% of cases which was positively correlating with the study done by Von Arx et al 2013 (37%)[9] but negatively correlating to the study results of Voljevica et al 2015.(60.3%) [8].
- In 14% of cases mental foramen was observed below first premolar which was less in accordance with Von Arx et al [9].
- On comparing between both sexes 7(12.1%) males and 7(16.76%) females of the study group had mental foramen present at the 1st premolar region. Out of 40% of the mental foramen present at the 2nd premolar region, 28(50%) were males and 12(28.6%) were females. Mental foramen was present in between the first and second premolars in 46% of the cases of which males 23(37.9%) and females 23(54.8%). On comparing between right and left sides, no significant difference was noted in this study results. These aspects of the study is first of its kind.

CONCLUSION:

The potential of anatomical variations of the mandibular canal in relation to mandibular third molars and mental foramen is worthy of further investigation to modify the risk of iatrogenic complications in humans during surgical procedures, implant placement and ridge augmentation. Due to complex and variable anatomy of

mandible more elaborate epidemiological and radiological that determine the extent and course of mandibular canal are warranted.

Mandible being more susceptible for anatomical variations according to ethnicity and gender fall under a category with increased risk to inherit iatrogenic complications which can be prevented by analyzing the anatomy more accurately using 3-dimensional imaging modality like CBCT. Thus the study stands as a pioneer for further research on the same.

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