"Anatomic Relationship Of Mandibular Canal Using Cone Beam Computed Tomography,"

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Abstract

Introduction – The morphometric parameters of the mandibular canal (MC) may vary depending on the population studied. Therefore, clinical data are required. The MC's specific location must know to plan and advise various dental treatments. This study aimed to measure the distance of the root of mandibular teeth to the mandibular canal & diameter of mandibular canal.

Material and Methods -CBCT scans of 200 subjects in age group of 18–60-year were evaluated. The distance of the roots of lower jaw teeth from the upper margin of the Mandibular Canal was measured in the cross-section & for diameter of mandibular canal inner maximum vertical and horizontal diameters were measured in coronal plane. Statistical analysis was performed in SPSS (VERSION 20.0)

Results – For the observations, paired t-test was applied to compare the right & the left side. Mandibular Canal was found to be in close relationship with the roots of the third molar, premolar, second molar and first molar respectively with a mean distance of 1.732, 2.743 mm, 3.254 mm, and 3.936 mm, respectively. Mandibular canal diameter the mean vertical and horizontal diameter of the MC was found to be 2.436 mm and 2.231mm,

Conclusion - it is critical to the clinician to know three-dimensionally the topographic relationships between the inferior teeth roots and the mandibular canal before proceeding to any invasive dental or surgical procedure at this region.

Keywords – Mandibular Canal, CBCT, Inferior alveolar nerve, Mandibular Foramen

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Introduction

The mandible is the largest, strongest and lowest bone in the face. It has a horizontally curved body that is convex forwards, and two broad rami that ascend posteriorly. The mandibular foramen leads into the mandibular canal, which runs downwards and forwards within the ramus, gently curving inferiorly within the body under the roots of the molar teeth, with which it communicates by small openings, and ascending in the premolar region to the mental foramen. [1]

Mandibular canal is a bilateral bony channel originating from mandibular foramen. It runs downwards and forwards longitudinally towards the mental foramen and serves as a conduit for inferior alveolar neurovascular bundle.[2-]

The main structure contained in the mandibular canal is the inferior alveolar nerve (IAN) and inferior alveolar vessels. The IAN is the largest branch of the mandibular nerve, which is the third division of the trigeminal nerve (fifth cranial nerve) Inside the mandibular canal, the IAN appears as a single large nerve bundle.[4] There is an incidence for nerve injury during dental implant placement mandibular posterior teeth extraction and inferior alveolar nerve block etc., resulting from the poor assessment of bone length or excessive length of implant bodies. Therefore to avoid damage of inferior alveolar nerve during various surgical procedure of mandible, it is important to assess the mandibular canal location in the mandible and edentulous space that represent the missing tooth.[5] Appreciation of the three-dimensional course of the mandibular canal during its passage through the mandible from the mandibular to the mental foramina is essential if damage to the inferior alveolar nerve is to be avoided in impacted third molar surgery, mandibular osteotomies, dental implant surgery and harvesting of mandibular bone grafts.[1]

Iatrogenic damage of the IAN can cause a wide range of altered sensory perception. This may result in either transient or persistent paraesthesia, anaesthesia or even disabling dysesthesia, mostly affecting the lip and chin region, including the oral mucosa and gingiva in that area.[6]

CBCT is an advanced imaging modality which is superior to panoramic radiograph (OPG) which provides high -resolution, superimposition-free, non-magnified, and undistorted three- dimensional images. CBCT can also provide multiplanar images for identifying the variations in mandibular canal, without any errors such as ghost images and pseudo canals.[7] Knowledge of anatomical variations related to mandibular canal is necessary for various clinical procedure of mandibular posterior region, especially for the inferior alveolar nerve Therefore, a detailed morphometric analysis of the mandibular canal should be carried out before any surgical procedure in the mandibular region in order to avoid complications, such as neurosensory impairment, traumatic neuroma, or bleeding, and to reduce the risk of inadequate local nerve blocking.

Thus, the aim of this study to perform measurements using CBCT images to investigate the mandibular canal diameter, location and relationship of root of mandibular teeth with mandibular canal. All of which add to a knowledge base for practitioners for successful performance of clinical procedure.

Material and method

This was an observational cross-sectional study conducted in the Department of Anatomy and oral medicine & Radiology at NIMS University, Jaipur, Rajasthan, Clearance certificate obtained from the Ethical Committee of the University. Informed consent was obtained from the patients regarding the study. A total number of 200 patients have been advised and undergone CBCT for diagnostic purpose within the span of 1 year. Measurement of mandible like diameter, location of MC from buccal cortical and lingual cortical plate and distance from root of mandibular teeth to mandibular canal were taken. Images were made using a CS 9300 unit (care stream) with field of view of 10cm×10cm,vocal size-90um, X-ray pulse time of 30ms,kvp-60-90 kv(max) ,mA-2-15 , exposure time of 10.8s. Selection criteria

involved Dentulous patients with age group of 18-60 year. No retained deciduous or supernumerary tooth should be present. Patients with existing pathological disorder of mandible such as cyst, tumor were excluded from study. Any images which was showing missing or malpositioned mandibular 1st or 2nd molars were excluded from the study. Images were analysed by DIACOM software in cross sectional, sagittal & coronal sections. The statistical evaluation was done using Statistical Package for the Social Sciences (SPSS) version 20.0 (SPSS: an IBM Company)

Results

In our study, the mean vertical and horizontal diameter of the MC was found to be 2.325 mm and 2.136 mm, respectively. The difference in the dimensions of inner maximum vertical and inner maximum horizontal between the two sides was not statistically significant. The inner vertical diameter of the mandibular canal was found to be maximum in third molar region which gradually decreased till first premolar region.

(mm)	Second Molar	First Molar	Second Premolar	First Premolar
Vertical	2.4676	2.3362	2.2178	1.941
Horizontal	2.3622	2.2961	2.077	1.688

Table 1 Mean Inner vertical and horizontal diameter of the mandibular canal mm

In this study, the location of the mandibular canal from buccal and lingual cortical plate in the horizontal plane was found to be close to lingual cortical plate in third molar, second molar and first molar region respectively, while it was close to the buccal cortical plate in second premolar and first premolar region. Also, the canal was found to be at a mean distance of 4.331 mm from the lateral aspect of the buccal cortical plate and 1.819 mm from medial aspect of the lingual cortical plate in the third molar region. These findings are important in order to avoid inadvertent injury to the neurovascular bundle located in mandibular canal in case of anatomical variation of the location of the mandibular canal from the buccal and lingual cortical plate also from the crestal bone level to the lower border of the mandible in horizontal as well as in vertical plane.

(mm)	Third molar	Second molar	First molar	Second premolar	First premolar
Horizontal Distance from Buccal Cortical Plate	4.3415	5.0271	4.3312	2.0645	1.7754
Horizontal Distance from Lingual Cortical Plate	1.9127	1.9384	2.1248	4.5149	4.6679
vertical distance from crestal bone level	13.689	14.2675	14.4837	14.4211	14.807
vertical distance from inferior border of mandible	6.573	6.3769	6.0532	7.0433	8.0068

Table-2 Mean of Location of the mandibular canal (horizontal and vertical plane) from buccal and lingual cortical plate and from crestal bone level to lower border of mandible (in mm)

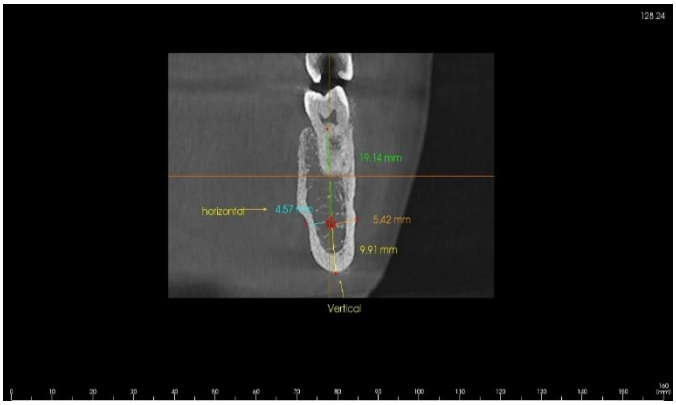

Fig-1 Location of mandibular canal in the vertical and horizontal direction

In this study distance from the Mandibular molar root apex to MC was measured on CBCT for 200 subjects, which gave values of 11.99 mm for the mean distance and 1.27 for SD respectively. The average diameter of the MC from second molar to second premolar was measured below each tooth root. Mandibular Canal was found to be in close relationship with the roots of second molar, first molar & second premolar with a mean distance of 2.7 mm, 3.2 mm, and 3.9 mm, respectively.

(mm)	Second molar	First molar	second prrmolar	First premolar
Relationship of roots to canal	3.2568	3.9354	2.8593	2.511

Table 3 Relationship of roots to the mandibular canal in mm

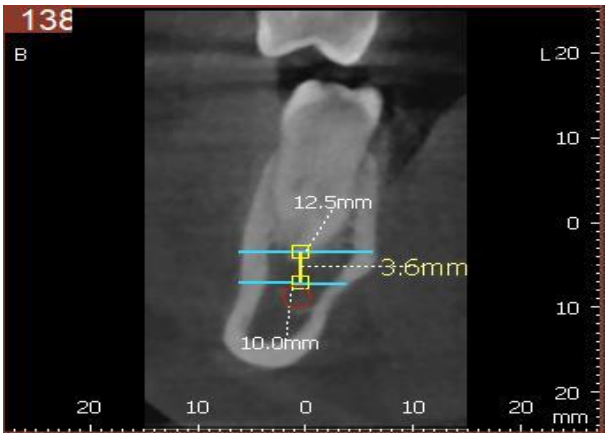

Fig2-Measurement of the distance between the root tip and upper border of the mandibular canal

Discussion

Neurosensory impairment may occur during all phases of dental implant surgery, including anaesthetic administration, incisions, soft tissue reflection, osteotomy preparation, bone augmentation, implant placement, suturing and/or soft tissue swelling after surgery and various other treatment of posterior region of mandible. The reported incidence of such nerve injuries following dental implant procedures is highly variable (0%-44%).[8] Various measurements of this study mandible like diameter of the mandibular canal, location of mandibular canal etc. will help to minimize the inadvertent injury of the inferior alveolar nerve.

The anatomic relationships between the mandibular canal, buccal and lingual cortical plates, and root apices of mandibular molars teeth should be known, in order to prevent injury to the IAN because it might result in short- or long-term altered sensation of the lower lip, gingiva and chin. With the emergence of three-dimensional imaging, CBCT is being increasingly used for the diagnosis and treatment planning of both surgical and nonsurgical procedures.[9] Various studies have been conducted regarding the proximity of IAN to the root apices of the Molar teeth. A study conducted by Simonton et al. concluded that females had significantly more vertical distance from the IAN to the mesial and distal apices; regardless of age and shorter horizontal distances from total width of mandibular bone at mesial and distal apices. The overall width of the mandibular bone decreased in both genders from the third to sixth decade of life. These three major findings in their study suggested that there could be a direct impact on treatment planning for surgical endodontic procedures involving the mandibular molar. In this present study distance from the Mandibular molar root apex to MC was measured on CBCT for 200 subjects, which gave values of 11.99 mm for the mean distance and 1.27 for SD respectively.[10] The locations observed in our study for the emergence of the MC are very similar to those reported by other authors.[11] In our study, the mean vertical and horizontal diameter of the MC was found to be 2.325 mm and 2.136 mm, respectively. The difference in the dimensions of inner maximum vertical and

inner maximum horizontal between the two sides was not statistically significant. This stood partly in accordance with the study conducted by Aung et al.[12]. for they had measured the MC bilaterally and obtained a statistically significant result on only one side. Meanwhile, it stands favourable as per the study conducted by Pertl et al., as they obtained results which were statistically significant.[13]

In this study, the location of the mandibular canal from buccal and lingual cortical plate in the horizontal plane was found to be close to lingual cortical plate in third molar, second molar and first molar region respectively. buccolingual relationship of the MC showed the greatest distance from the buccal bone at the mandibular second molar, followed by the mandibular first molar and mandibular second premolar. These findings agreed with previous reports in which the MC course showed a gradual lingo-buccal deviation in the posterior-anterior direction in Chinese, Iranians, and Malaysians.[14]

The present study confirmed that age was significantly correlated with the MC-to-root apex distance in the mandibular Canal was found to be in close relationship with the roots of second molar, first molar & second premolar with a mean distance of 2.7 mm, 3.2 mm, and 3.9 mm, respectively. Study done by Littner et al shows similar characteristics to those observed in the present study regarding distance from MC to posterior tooth apices. In general, an increase in this distance exists in the evaluation of distal apices from the second molar to root of the first molar, with subsequent reduction of this distance in relation to the second premolars.[15]

In recent years in the field of oral and maxillofacial radiology, CBCT imaging discovery formed a significant technical advancement that revolutionized pertinent clinical practice. Conventional CT scans use a flat beam from a high-output X-ray source while CBCT scans utilize a cone radiation beam from an X-ray source. CBCT proved to be better than conventional CT due to its relatively lower cost, fewer space requirements, faster image acquisition with a larger volume, superior spatial resolution, and lower radiation.[16]

Conclusion

Therefore, in an era of steadfast increased use of dental implants and frequent need for planning disimpaction, this study gives an insight beyond the two-dimensional eyesight to the maxillofacial surgeon so that such surgical procedures could be carried out more efficiently and with no or minimal complications. In order to plan a proper dental implant insertion method and select the implants of a relevant type, it is important to be aware of the diameter of mandibular canal in horizontal and vertical direction, position of the MC in connection with the cortical plates and crest of alveolar ridge. Relationship with root of mandibular molar and mandibular canal This criterion should be considered in surgeries involving posterior mandible especially in impacted third molar region.

Conflict of Interest-

No Conflict of Interest.

References

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