MORPHOMETRY OF MANDIBULAR CANAL USING CONE BEAM COMPUTED TOMOGRAPHY & ITS CORRELATION WITH AGE & GENDER

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Abstract

Background- Mandibular canal (MC) is a bony structure that begins in the mandibular foramen on the medial face of ramus of the mandible. Increased neurological clinical complications after the procedure of mandible necessitate the demand for precise detection of mandibular canal prior to surgical procedure of the mandible. The morphometric parameters of the mandibular canal (MC) may vary depending on the population studied. This study aimed to measure the distance of the root of mandibular teeth to the mandibular canal & Identification of the Bifid/trifid mandibular canal.

Material and method-CBCT scans of 100 subjects in age group of 18–60-year were evaluated. The distance of the roots from the upper margin of the Mandibular Canal was measured in the cross-section & axial, coronal, sagittal, cross-sections, and volume rendering were viewed to assess bifid Mandibular Canal. Statistical analysis was performed in SPSS (VERSION 20.0) & Microsoft excel software. All images were recorded at 90 kVp and 10 mA using a 14x10 cm field of view, and axial slice thickness of 0.38 mm and isotropic voxels. Results-For our study a sample size of 200 patients with an age group varying from a minimum of 18 years to a maximum of 60 years were recorded. The mean age of 31-40year and the Mean±SD (Median) of 35.19±9.40 (34.00).The observations of the study were 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. the canal divided in the first molar region bilaterally and rejoined in the first premolar region, terminating at the mental foramen. The incidence was found 2%.

Conclusion-it is critical to 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. CBCT imaging allows clinicians to see a cross-sectional view of the mandible to locate key anatomic features. When planning a surgical procedure apical to the tooth in the posterior mandible, a clinician should strongly consider a CBCT to avoid nerve damage to the IAN.

Keywords- Inferior alveolar nerve (IAN), Mandibular canal, Morphometry, CBCT.

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Introduction-

The anatomy of the head and neck is perhaps the most complex structure in the human body. So likewise, when pertaining to mandible, a preoperative evaluation is very important.[1] Mandibular canal (MC) is a bony structure that begins in the mandibular foramen on the medial surface of ramus of the mandible. Its pathway follows the lower and lateral direction passing to the body of the mandible, where it is closely related to the roots of the lower teeth.[2] The mandibular canal carries, from its origin until the incisive region, the inferior alveolar vessel and inferior alveolar nerve. The components of the inferior alveolar neurovascular bundle, which is the major supplier of both sensation and blood to the mandible, are arranged consecutively from the superior to inferior positions as follows: vein, artery, and nerve.[3] Mandibular canal was generally known to be a single structure, but branched variations such as bifid mandibular/trifid canal (BMC) have been reported.[4]

Maxillofacial surgical procedures of the mandible, such as extraction of impacted third molar, osteotomies, bone-harvesting procedures or placement of dental implants, are all associated with a significant risk of unintentional injury of the inferior alveolar nerve (IAN). 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.[5]

Performed incorrectly, implant surgery and endodontic procedures can lead to neurological deficits such as pain, paresthesia, or anesthesia. The inferior alveolar nerve is one area particularly at risk of damage. it is imperative for the surgeon to be familiar with the anatomic landmarks and structures adjacent to the area. Use of cone-beam computed tomography (CBCT) can provide accurate measurements.[6]

Before performing an invasive apical surgical procedure in the posterior mandible, it is imperative to know the relative position of the IAN. Studies have shown CBCT to be reliable and accurate for clinical measurements.[7]

A preoperative evaluation of the true relationship between the roots of the mandibular molar and the inferior alveolar nerve. Imaging is one of the most important tool today for dentists worldwide to not only diagnose difficult cases but also to design an effective treatment plan. With the arrival of 3-dimensional imaging, the credibility of oral diagnosis and accuracy in designing an effective treatment plan has leapfrogged to another level.[8]

Cone-Beam Computed Tomography (CBCT) is a relatively new radiographic imaging method which may provide the ability to predict more accurately the relationship of the root(s) to the inferior alveolar canal, and therefore a more predictable and favourable outcome.[9]

The purpose of the present study was to perform measurements using existing CBCT scans to investigate the MC location below mandibular posterior root apicies and presence of bifid /trifid canal to add a knowledge base for dental practitioners.

Material and method –

It was a observational cross-sectional study. A total sample of 200 patients was devised involving the patients visited the department of oral medicine and radiology department and who had undergone CBCT imaging for better evaluation of mandible within a span of 1 year. An informed consent was be obtained from the patients regarding the study. 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. relationshiop with root of mandibular teeth and bifid or trifid canal. Entire set of study values obtained were tabulated and categorized. Data collected and managed using Microsoft excel and analysed (Student's Paired T- test, p value < 0.05) using Statistical Package for Social Sciences (SPSS) version 20.0. Images was 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. Images was reconstructed using a high spatial frequency reconstruction algorithm. Images was analysed by DIACOM software in cross sectional, sagittal & coronal sections. Cross sectional images was oriented parallel to the long axis of the tooth, then the shortest distance from the deepest point of root apices and superior border of the inferior alveolar canal was obtained to be examined

Results-

For our study, a sample size of 200 patients with an age group varying from a minimum of 18 years to a maximum of 60 years was recorded. The mean age of these patients was between 31-40year and the Mean±SD (Median) of 35.19±9.40 (34.00).

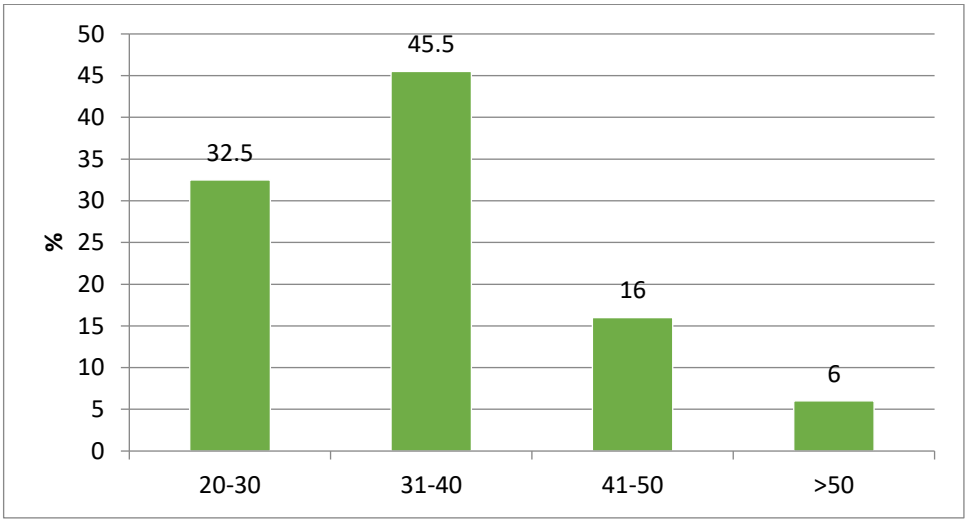

Fig. 1: Distribution of studied subjects according to age

parameter measured was the distance from the Mandibular molar root apex to MC was measured on CBCT for our given sample, 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.

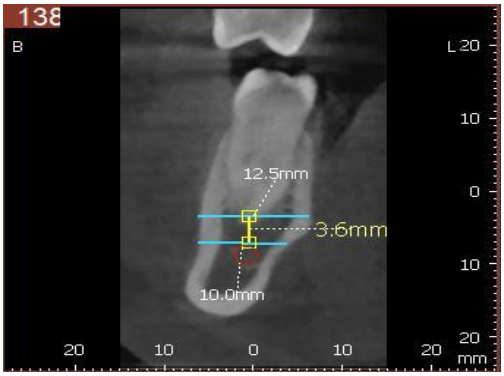

Fig2-Measurement of the distance between the root tip and upper border of the mandibular canal

The canal divided in the first molar region bilaterally and rejoined in the first premolar region, terminating at the mental foramen. The incidence was found 8%.[10\]

Overall, BMCs were observed in 16 (8%) for clear visualization of the mandibular canal, the center of rotation of the reference line for multiplanar reconstruction was initially set at the mandibular canal. Then, the various sections were rotated horizontally and the center was moved buccolingually and anteroposteriorly by varying degrees to detect the bifid mandibular canal. The actual presence of bifid mandibular canal was established only if it was found on all reformatted images such as panoramic, coronal, and sagittal section.

Age in years	**No. of subjects**	**Bifid / trifid mandibular canal**				**p-value[1]**
		Present		**Absent**		
		No.	**%**	**No.**	**%**	
20-30	65	4	6.2	61	93.8	0.18
31-40	91	5	5.5	86	94.5	
41-50	32	5	15.6	27	84.4	
>50	12	2	16.7	10	83.3	

[1]Chi-square test

Table: Association of Bifid / trifid mandibular canal with age

Discussion-

In 1995, Worthington wrote: "The number of practitioners performing implant surgery has increased dramatically over the last 15 years. As confidence is gained they tend to accept increasingly challenging cases and it is to be expected that the incidence of problems and complications will increase". It was a discerning remark; IAN injuries remain a serious complication with incidence ranged from 0% to 40%.[11]

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.[12 13]

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.[14]

Previous studies have reported wide variations in the prevalence rates of BMCs: 15.6% to 65% in Japan,8,11 26.7% to 46.5% in Turkey,14,15 30.6% in Taiwan,3 26.67% in Brazil,16 10.2% to 22.6% in Korea,6,17 and 31.1% in the Shanghai area of China.10 After meta-analysis of 15 studies, identified by using CT or CBCT assessments, Haas1 reported that the overall prevalence of BMC was 16.25%. In our study, BMCs were found in 8% of 200 patients.[15]

The previous studies have reported that the prevalence of bifid mandibular canal identified using CBCT was considerably higher than that obtained using panoramic radiography. Tantanapornkul et al. compared panoramic radiograph and CBCT in the detection of mandibular canal and reported that CBCT has 93% of sensitivity and 77% of specificity. Hence, he concluded that CBCT can be used for more accurate visualization of mandibular nerve.[16] Studies have found a higher prevalence of bifid mandibular canals in females as observed in our study. However, the gender difference was not statistically significant. A study conducted in Taiwanese population found a higher prevalence of bifurcation in males. This study was carried out using medical CT. However, the gender differences could be more related to the population observed rather than to the type of exam.[17]

Conclusion-

The mandibular canal is the safe-guarding structure of the mandible that provides path and protection for the innervation of the mandibular structures. Thus, it is of utmost importance to protect it during invasive surgical procedures. Hence, pre-surgical imaging before any invasive procedure along the region is of invaluable relevance.

The location of the MC with respect to root apices varies among patients. CBCT imaging allows clinicians to see a cross-sectional view of the mandible to locate key anatomic features. When planning a surgical procedure apical to the tooth in the posterior mandible, a clinician should strongly consider a CBCT to avoid nerve damage to the IAN.

The bifid mandibular canal was the most common anatomical variation of the mandibular canal found in this study. To avoid iatrogenic injuries, a presurgical detailed evaluation of the mandibular canal using CBCT is suggested.

Conflict of interest-

No Conflict of Interest.

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