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Variations In Lingual Foramen Of Mandible Using Cone-Beam Computed Tomography

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Abstract

Background: *Cone beam computed tomography (CBCT) -a diagnostic imaging modality for implant placement and planning procedures in anterior mandibular area. This gives adequate information with optimum image quality, excellent geometric accuracy, and low radiation dose.*

Aim: *The aim of this study was to evaluate prevalence and anatomical variations of Lingual foramen in Mandible in CBCT scans of the Mandibular region.*

Methodology: *All CBCT cross-sectional images of 500 study participants were analyzed for the presence of Lingual Foramen. Lingual Foramen was compared with age groups, dentition, gender, and right and left side and their respective distances from the alveolar crest were measured using CS 3D imaging software (Kodak)*

Results: *Lingual Foramen were seen in all (100%) study samples. On statistical analysis, the difference of the mean distance from alveolar crest was significant with relation to dentate, partially dentate, and edentulous were found to be significant (P < 0.001).*

Conclusions: *Careful assessment of the lingual foramen cross sectional views is essential to avoid bleeding complications using CBCT.*

Keywords: *Lingual Foramen, CBCT, Implant, Anterior mandible, Incisors.*

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Cone beam computed tomography (CBCT), with its lower radiation dose compared to medical CT, lower cost, better accessibility and associated software programs specifically designed for use in dental diagnosis and treatment planning is due to examining the anatomical landmarks in axial, sagittal and coronal planes.[6]

Pre- operative radiological examination of anatomical landmarks are necessary to avoid complications. Cross- sectional imaging like cone beam computed tomography provides adequate information about anatomical landmarks and their variations, assessing the apical bone height, buccolingual width and angulations of the available bone, topography and location of anatomical structures.[7]

The Aim of this study was to evaluate variations in anatomical landmarks in , Lingual Foramen, on Cone Beam Computed Tomography (CBCT) scans of maxillofacial region. The objective of this study are to find out prevalence, to measure and compare the distance of Lingual Foramen from alveolar crest in males and females, various age groups, dentition and right and left side by using cone beam computed tomography (CBCT) scans of the maxillofacial region. This descriptive type of observational study was conducted in Rajasthan dental college and hospital Jaipur, Rajasthan during the study period of 24 months from February 2022 to February -2025.

500 patients belonging to age group of 20 -60 years who were advised to undergo CBCT were selected from radiology section, Rajasthan dental college and hospital,Jaipur, Rajasthan. Patients with periodontal diseases, partially dentulous and completely edentulous for implant planning, assessment of impacted teeth and orthodontic evaluation of dentulous were included and Patients with systemic diseases like bone disorders,

congenital diseases, syndromes, benign & malignant tumors, were excluded in this study.

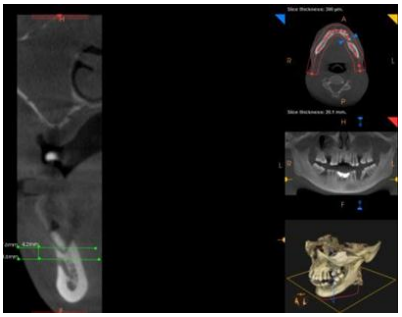


Fig-1- Measurement of lingual foramen from Alveolar crest

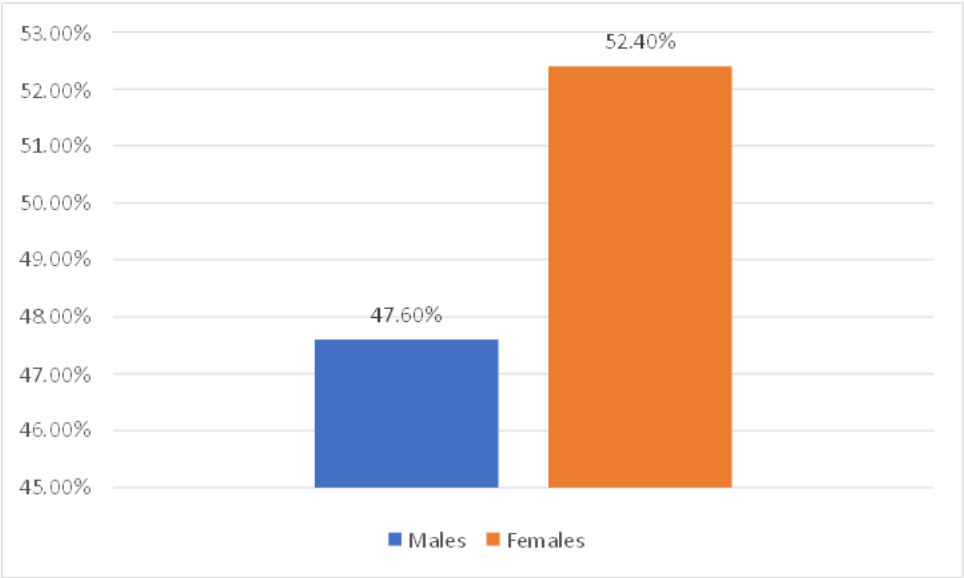
The tube voltage ranged from 75-90kvp, tube current was 4mA and an exposure time of 11.50 sec was used. All CBCT images were taken Care stream imaging system (CS 3D imaging) using FOV 17x11cm image volume reconstructed with isotropic 300x300x300 µm voxels. The Mandible of each patient was rotated with the Occlussal plane and the lingual foramen (lingual canals) were searched in and transform images on the monitor, then the distance from alveolar crest were determined. (Fig-1)

To eliminate inter observer variations, if a landmark was not seen by two observers it was considered as not seen. But if it is seen by two or more observers it is considered as to be present and average of measurement was kept as final reading.

The software used for the statistical analysis were **SPSS - version 24.0.** The **p-value** was taken significant when less than 0.05 **(p<0.05)** and Confidence interval of 95% was taken. sample size taken for this study was n=500 in which 238 were males (47.6%) and 262 were females (52.40%).

Table -1- Gender wise distribution of Lingual Foramen

Gender	N	%
Males	238	47.6%
Females	262	52.4%



Graph-1- Gender wise distribution of Lingual Foramen

This study was divided into three age groups, 20-39 years, 40-59 years and 60 ≤ years. with mean age of 50.6 years. the majority of participents (47.6%) are in 40-59 age group, followed by those aged > 60 (32.6%) and 20-39 (20.2%). Females slightly out number Males (52.4% vs. 47.6%), consistent with the original data. (SD-

14.24) as shown in Table-1 and Graph-1.

Table-1

Age	Male		Female		Total	
	No.	%	No.	%	No.	%
20-39 years	63	12.6%	38	7.6%	101	20.2
40-59 years	100	20.00%	138	27.6%	238	47.6
≥60 years	75	15.0%	88	17.6%	163	32.6
Total	238	47.6%	262	52.4%	500	100.00

Graph -1

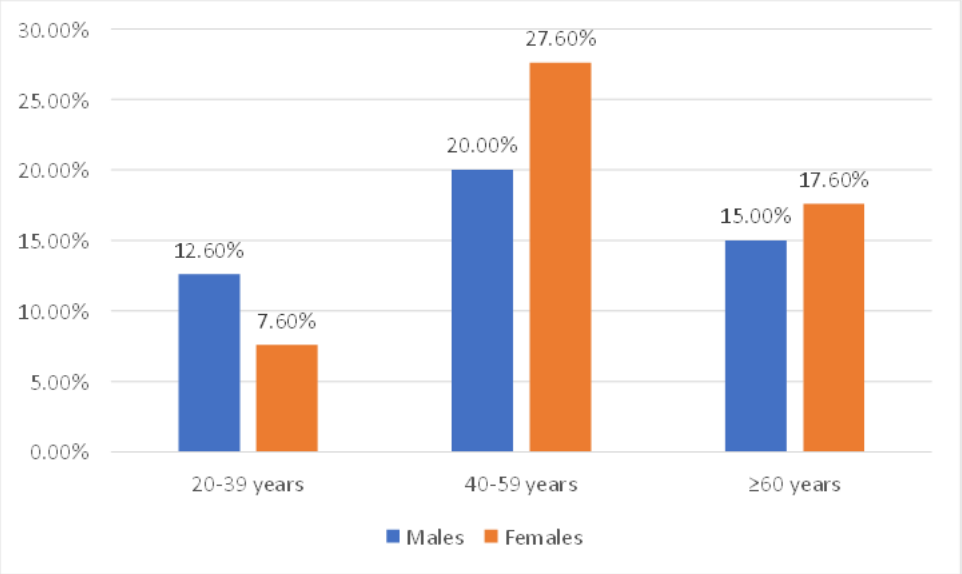


Table-2- Dentition wise distribution

Dentition	Male		Female		Total	
	No.	%	No.	%	No.	%
Dentate	125	25.00	88	17.50	213	42.50
P.D	113	22.50	87	17.50	200	40.00
Edentulous	0	0.00	87	17.50	87	17.50
Total	238	47.50	262	52.50	500	100.00

The mean distance of lingual foramen from alveolar crest in age group **20-39** years, **40-59** years and **60** or above year were not statistically significant in right and left side Mean distance of **lingual foramen** from alveolar crest in **Dentate** was 17.4mm, partially **dentate** was 15.21mm, **Edentate** was 13.01mm.P value was found to be **0.132** The mean distance of lingual foramen from alveolar crest in dentate, partially dentate and edentulous were not statistically significant P>0.05 in both right and left side. Mean distance of **Lingual foramen** from alveolar crest in **Males it** was **17.8** mm and in **Females** it was 13.9mm.P value was found to be **0.417** on right side and **0.366** on left side. no significant difference in observed between any pair of mean values on right and left side.

I. Discussion

The lingual foramen is present in midline, leveled with or superior to genial tubercle. The mandibular lingual foramina from the midline are penetrated by branches from Sublingual artery (branch of Lingual artery) or Sub mental artery (branch of Facial Artery) or branches resulting from the anatomises between these vessels. The lingual artery has sufficient size to present difficulty in control of haemorrhage intraosseously or in soft tissue,so its position is important to be considered for implant placement in the midline[6].

In the present study, lingual foramen was present in 100% of cases as was seen in study conducted by **Mehnazetal**[94], **Tepper *et. al.*, Gablieter *et. al.*, A. Tagaya**[92] **andMc Denell.**[6] Yet the present result provides no evidence for those of **Jacob*et. al.*** in which lingual foramen was seen only in 81% of spiral CT images . New

CBCT allows comparatively less radiation and high resolution (spatial resolution of 0.3 mm homogenous voxel) than spiral CT. therefore the CBCT measurements for the mandibular lingual foramen are reliable[94].

In the present study the mean distance of lingual foramen from alveolar crest was 17.8±5.6 mm in males and 13.9±3.82 mm in females. **DaeHyn *et. al.*.** observed 58.8 % appearance of lingual foramen in mandibular cortical bone in Koreans using Multi slice CT[101] but it was seen in the present study all 100 % appearance of lingual foramenin Indian population using CBCT. The reason is CBCT allows comparatively higher resolution (spatial resolution 0.1mm homogenous voxel) than CT.[94]

Anna C Oette*et. al.* observed that there is no statistical difference according to Gender, age and dentition pattern for inferior distances. The superior distance exhibits a significant difference amongst the sexes (P-.004) and dentitions pattern (P-0.0006) in their study[102] and similar result was seen in present study.[92]

II. Conclusion

The lingual foramen are consistent anatomical landmarks within the anterior regions of mandible. These are areas of clinical significance as they comprise vital structures such as blood vessels and neurovascular bundles. These may incur irrevocable damage if perforated during implant placement and bone grafting procedures consequently leading to haemorrhage and neurosensory disturbances. Preoperative planning utilizing cross sectional images thus becomes mandatory for gaining supplementary information regarding variations in anatomical landmarks.

Limitation of study- Other variations including diameter and length of foramina, distances from buccal and lingual cortices of mandible etc should also be considered while electing to undertake any invasive procedures in the vicinity of these vital structures.

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