Assessing the Anatomical Variations of Lingual Foramen and its Bony Canals with CBCT taken from 120 Patients

Altaf Hussain Chalkoo[1], Deeksha Rajput[2]

ABSTRACT

Introduction: The lingual foramen is situated in the midline, level with or superior to the genial tubercles. It contains blood vessels that supply the anterior mandible. This study was conducted with aim of assessing the anatomical variations of lingual foramen & its bony canals with Cone Beam Computed Tomography imaging within the local population.Also,to evaluate the correlation between various measurements taken with Age and Sex.

Material and methods: This retrospective radiographic study was conducted in the department of oral medicine and Radiology, Govt Dental College & Hospital, Srinagar which included 120 patients (60 males and 60 females). Their CBCT were subjected to various measurements in cognizance with objectives of the study.Radiographic types and morphometric measurement were recorded. Radiographically subtypes of lingual foramen were recorded according to classifation given by Sekerci AE(2014)

Results: In our study, all 120(100%) patients showed median lingual foramen, some patients also showed paramedian position (4 males and 3 females) Double lingual foramen (55.8%) is shown in most of the cases followed by single foramen (38.3%) .There was significant difference between gender seen in single lingual foramen (p-value 0.024). Type I lingual foramen was most (33.3%) commonly found followed by type VI(30.85%)

Conclusion: There is wide range of anatomical variation of lingual vascular canals in respects of number, position and dimension.CBCT is a three-dimensional radiographic imaging modality with greatly reduced doses of radiation and high accuracy.Results will be discussed in detail in presentation.

Keywords: Lingual Foramen, Bony Canals of Lingual Foramen, CBCT, Mandibular Implant Treatment Planning.

INTRODUCTION

The lingual foramen is located in the midline, level with or superior to the genial tubercles[1](Fig.1).When noticed on intraoral radiographs of the mandibular incisor region, the foramen is observed as a circular area of radiolucency enveloped by a peripheral radio-opacity (Fig.2). The mandibular intermental foramen region is in general considered as a secure area, involving few possibilities of damage to crucial anatomic structures while doing any surgical procedure. However, these safety recommendations are not based on knowledge of the position and course of some indespensible anatomical landmarks[2].

White (2009) reported the contents of superior lingual foramen as a neurovascular bundle, which insinuates a nerve, artery and vein whereas the inferior lingual is supplied by the sublingual or submental arteries and mylohyoid nerve[3](Fig.3). Ennis (1937) suggested that a terminal branch of the inferior alveolar artery also passes through the lingual foramen to anastomose with the lingual artery.[4]

A comprehensive understanding of number, morphological description, dimension of bony canal and dimensional relation of foramen with the alveolar crest superiorly and mandibular border inferiorly of absolute importance while performing any anterior mandibular surgery for example implant placement, genioplastic, or grafting procedures in order avert various complications. Intraoperative and Postoperative complications can occur, some of these difficulties are intraoperative bleeding, nerve injury and neuropraxia of the mandibular incisive nerve[5].

These days,dental implants are regarded as a prevailing option for the prosthetic rehabilitation of edentulous patients. In some circumstances life-threatening hemorrhagic episodes can occur,because of perforation of the lingual cortex while placing dental implants in the anterior third of the mandible. Several studies indicated that if the lingual periosteum is ruptured an extensive hematoma develops within this region and progressive swelling of the floor of the mouth may cause upper airway obstruction.Thus, it is necessary to do careful preoperative planning, including radiological imaging[6].

Image quality of CBCT systems and their comparably lessened dose and cost as compared to conventional computed tomography have allowed more accessible three-dimensional assessment of craniofacial structures in dental practice.

This study was performed to explore regional frequency and anatomical variations of lingual foramen in local population through investigations performed on restricted number of cbct images obtained clinically.

Aims and Objectives

Aim:

To assess the anatomical variations of lingual foramen & its bony canals with Cone Beam Computed Tomography imaging within the local population. Also, to evaluate the

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correlation between various measurements taken with Age and Sex**.**

Objectives: To assess the following:

A) Location of lingual foramen.

- Median or paramedian (right side or left side)
- Lingual or buccal
- Below the mandibular apices or in between the apices

B) Number of foramen : single/double/triple/multiple

C) Classified according to radiographically subtypes**.**

D) Morphological measurements (lingual canal diameters, the canal length,vertical distance of the lingual foramina to the alveolar crest of the mandible.)

Inclusion criteria

- Presence of all lower erupted anterior dentition
- Male/female aged 18 years or older
- Absence of any pathological conditions or deformities in the jaws

Exclusion criteria

- Inadequate CBCT image quality (patient movement, operator errors etc.
- CBCT scans that did not include mandible
- History of trauma or orthognathic surgery
- Presence of pathologic bone disease or unerupted teeth in the concerned region and syndromic patients

Determination of sample size: Using GPOWER software (Version 3.0.10), it was estimated that the least number of patients required with 80% power, 5% significance level and an effect size of 0.25 is 120. Thus a total of 120 patients were included in our study.

MATERIAL AND METHODS

This retrospective radiographic study was conducted in the department of oral medicine and Radiology, Govt Dental College &Hospital,Srinagar, which included 120 patients,60 males and 60 females,divided into age groups less than 35 Yrs between 35-55 Yrs, greater than 55 Yrs of age . Cone Beam 3D imaging Newtom Machine with `NNTviewer software were used for digital imaging and communications in medicine DICOM imaging system with axial thickness of 0.150mm, FOV is 8×8cm, tube voltage- 90 Kvp, tube current - 9mA, time scan – 63.85 sec.

Median or paramedian location were examined on axial and coronal section of CBCT scan, number of lingual foramen were studied on coronal as well as sagittal section.

Radiographic types and morphometric measurement were recorded on saggital section. Radiographic subtypes of lingual foramen were recorded according to classification given by Sekerci AE(2014)[7]

Type I: single lingual vascular canal located above the genial tubercle.

Type II: single lingual vascular canal located below genial tubercle.

Type III: single lingual vascular canal at the inferior-most part.

Type IV: single lingual vascular canal at the superior-most part.

Type V: single lingual vascular canal exiting through the labial side of the mandible.

Type VI: two canals (one located above the genial tubercle, other located below genial tubercle), one oriented downwards and another oriented upwards.

Type VII: two canals (intersection of two separate canals; one— oriented downwards—located above the genial tubercle, other—oriented upwards—located below genial tubercle).

Type VIII: cross-section image of canal is a representation of two parallel canals.

Type IX: two canals (intersection of two separate canals; one exiting through the lingual cortical plate and one through the labial).

Type X: two canals located below genial tubercle.

Type XI: three canals (one within or superior to the genial tubercle, one—oriented downwards—located above the genial tubercle and one through the labial).

Type XII: three canals (one—oriented downwards located above the genial tubercle, others located below genial tubercle).

Statistical Methods: The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as Mean±SD and categorical variables were summarized as frequencies and percentages. Graphically the data was presented by bar line diagrams. Analysis of variance (ANOVA) and Student's independent t-test were employed for comparison of continuous variables. Chi-square test was applied for comparing categorical variables. A P-value of less than 0.05 was considered statistically significant.

RESULTS

Total 120 patients were included in our study,60 were males and 60 were females.

Anatomical Position of lingual foramen (table 1) out of 60 males ,4 patients had paramedian position of mandibular lingual foramen,2 had buccally placed lingual foramen and out of 60 females ,3 patients had paramedian position of lingual foramen ,3 patients had buccally placed lingual

Gender	N	Median	Paramedian	Buccal	Lingual	Below the apices	Between the apices
Males	60	60	4	2	60	60	0
Females	60	60	3	3	60	60	0
Total	120	120	7	5	120	120	0

Table-1: Anatomical position of lingual foramen

No. of lingual foramens	Males		Females		Total	
	No.	%age	No.	%age	No.	%age
Single	29	48.3	17	28.3	46	38.3
Double	30	50.0	37	61.7	67	55.8
Triple	1	1.7	6	10.0	7	5.8
Total	60	100	60	100	120	100.0
Chi-square=7.433; P-value=0.024 (Statistically Significant)						

Table-2: Number of lingual foramens according to gender

Type of lingual foramen	Males		Females		Total	
	No.	%age	No.	%age	No.	%age
Type I	24	40.0	16	26.7	40	33.3
Type II	2	3.3	0	0.0	2	1.7
Type III	1	1.7	1	1.7	2	1.7
Type IV	0	0.0	3	5.0	3	2.5
Type V	0	0.0	0	0.0	0	0.0
Type VI	12	20.0	25	41.7	37	30.8
Type VII	12	20.0	2	3.3	14	11.7
Type VIII	6	10.0	5	8.3	11	9.2
Type IX	2	3.3	0	0.0	2	1.7
Type X	0	0.0	0	0.0	0	0.0
Type XI	0	0.0	3	5.0	3	2.5
Type XXI	1	1.7	5	8.3	6	5.0
Total	60	100	60	100	120	100
Chi-square=26.07; P-value=0.002 (Statistically Significant)						

Table-3: Classification of lingual formamen according to gender

Lingual canal length	< 35 Yrs		35-55 Yrs		> 55 Yrs		P-value
	Mean	SD	Mean	SD	Mean	SD	
Superior	6.39	2.31	6.12	1.92	5.85	1.24	0.721
Inferior	6.75	2.29	5.98	1.39	6.21	2.21	0.753

Table-4: Comparison of lingual canal length (mm) as per age

Lingual canal length	< 35 Yrs		35-55 Yrs		> 55 Yrs		P-value
	Mean	SD	Mean	SD	Mean	SD	
Superior	0.951	0.336	0.993	0.201	0.933	0.297	0.852
Inferior	0.751	0.278	0.602	0.224	0.901	0.537	0.329

Table-5: Comparison of lingual canal diameter (mm) as per age

Lingual canal length	Male		Female		P-value
	Mean	SD	Mean	SD	
Superior	6.47	1.98	5.81	1.78	0.223
Inferior	7.28	1.92	5.81	1.85	0.087

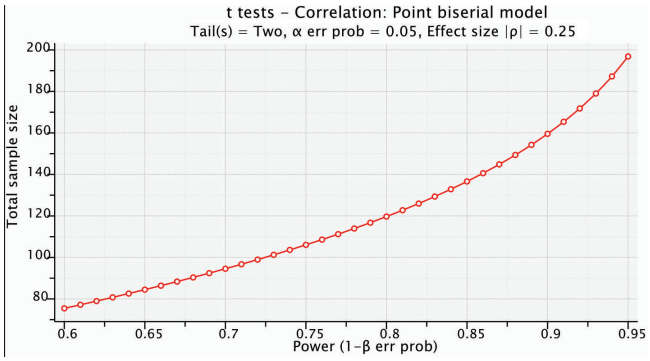
Table-6: Comparison of lingual canal length (mm) as per gender

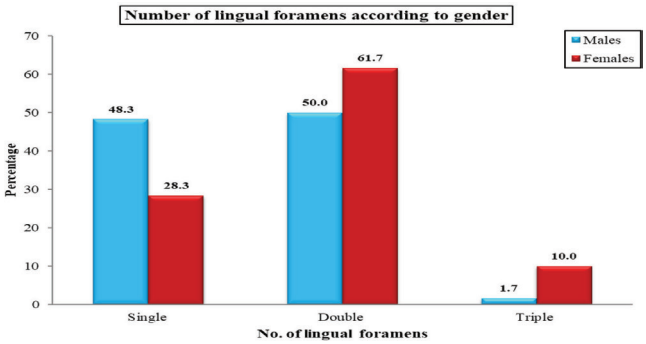
Lingual canal length	Male		Female		P-value
	Mean	SD	Mean	SD	
Superior	0.984	0.249	0.929	0.324	0.509
Inferior	0.725	0.431	0.773	0.367	0.779

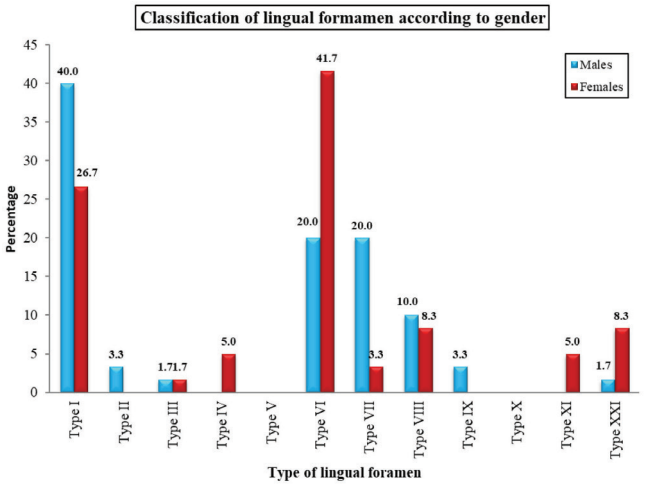
Table-7: Comparison of lingual canal diameter (mm) as per gender

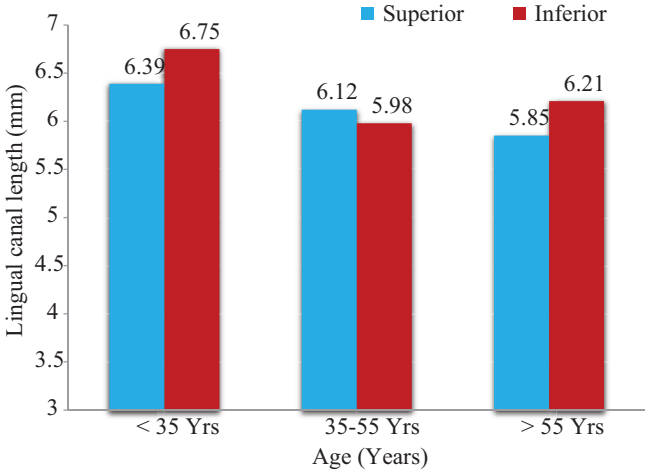
foramen,however all 60 males and 60 females had atleast one lingual foramen which was present lingually and in the median position.

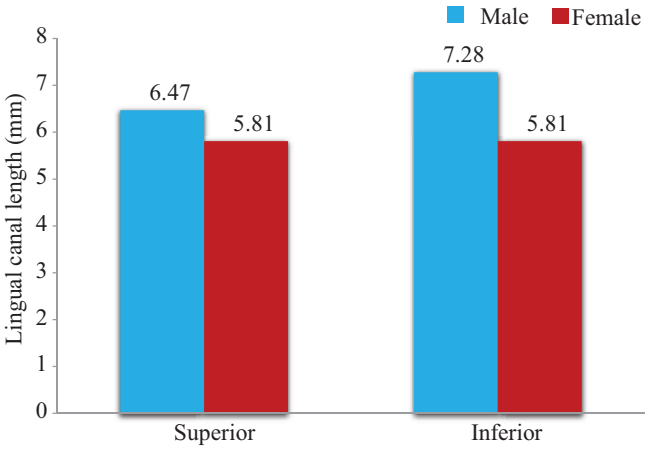
Number of Lingual foramen according to gender (Table 2), 48.3% males had single lingual foramen(29),28.3% females showed single(17),statistically significant difference was found between males and females with respect to single mandibular lingual foramen(males showed more no. of

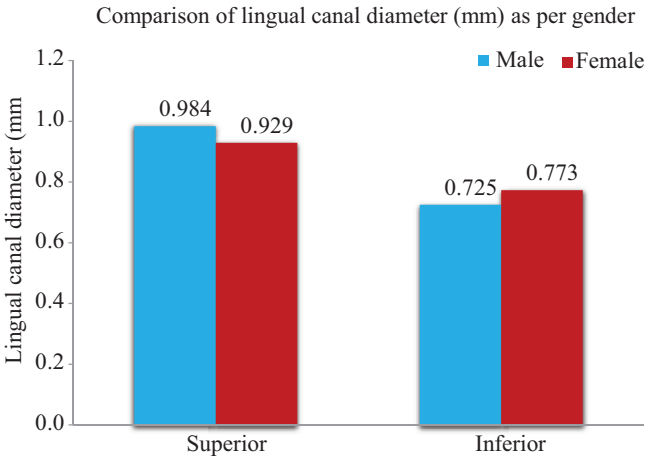












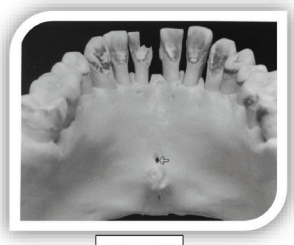


Figure 1

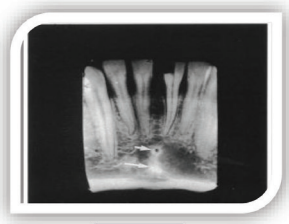


Figure 2

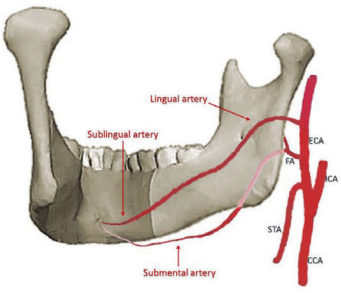
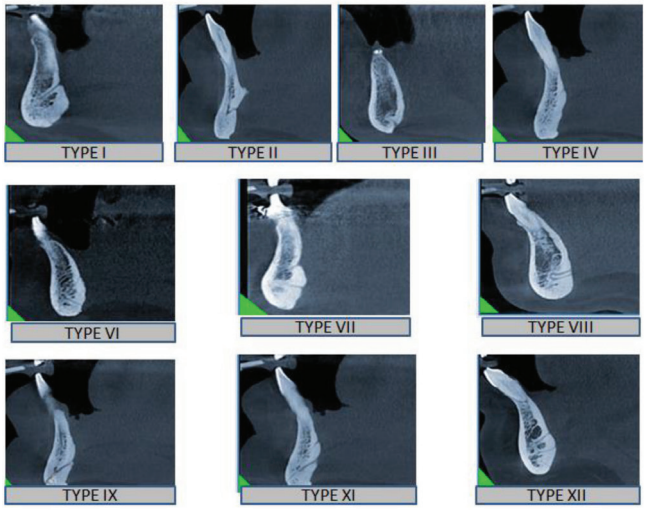
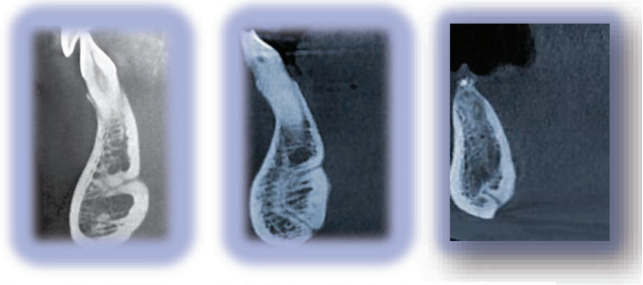
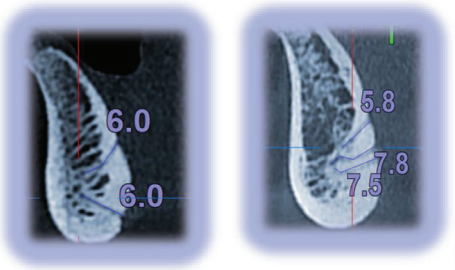


Figure 3

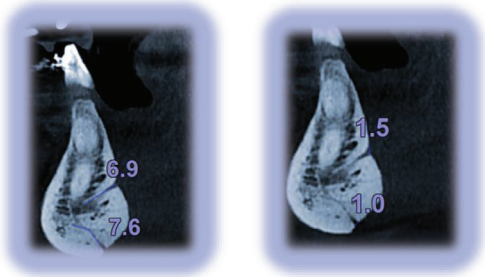


CLASSIFICATION GIVEN BE SEKERCI ET AL (2014)


Cross-sectional CBCT image of anterior mandible showing lingual foramen



Lingual canal length (superior and inferior foramen)



Lingual Foramen diameter

single foramen) with p value of 0.024.

50%(30) of males showed double lingual foramen where as 61.7%(37)of females showed double lingual foramen ,only 1.7% males showed triple lingual foramen and 10% females showed triple lingual foramen.

Classification of lingual foramen(Table 3),out of all radiographic types (12)given by Sekerci AE(2014)[7] ,10 types were observed in our study. Type I lingual foramen was most commonly found which was 33.3% of total patients, followed by type VI which was present in 30.8% of study population. Type VII and type VIII were found in 11.7% and 9.2% of study population respectively. Type V and type X were not observed in any of the patient.

Comparison of lingual canal length(mm) was done as per age and gender(Table 4&5) the mean values of length of superior and inferior lingual canal were found to 6.39mm ± 2.31&6.75mm ±2.29 of in patients who were less than 35 years ,in patients who were between 35-55years mean length of superior canal was 6.12 ± 1.92 and that of inferior canal was found to be 5.98± 1.39.in patients who were more than 55 years superior and inferior canal lengths were 5.85mm ±1.24 &6.21mm±2.21,but the results were statistically were insignicant.The mean values of lingual canal length in males were ,for superior canal it was 6.47mm±1.98 and for inferior canal it was 7.28mm±1.92.The mean values of lingual canal length in females,for superior canal was 5.81mm±1.78 and for inferior canal it was 5.81mm±1.85.The results were statistically insignificant.

Comparison of lingual canal diameter as per age and gender (Table 6&7) the mean values of diameter of lingual canal for superior and inferior canals were 0.951 mm±0.336 and 0.751 mm±0.278 respectively in patients who were less than 35 years.In patients whose age was between 35 to 55 years the mean values fo superior and inferior diameters were 0.993mm±0.201 & 0.602±0.224.In patients who were greater than 55 years,the mean values for superior and inferior lingual canal diameter were 0.933 The difference with respect to age was statistically insignificant.The mean values of lingual canal diameter in males were 0.984mm±0.249(superior lingual canal) & 0.725±0.431(inferior lingual canal). The mean values of lingual canal diameter in females were 0.929mm±0.324 for superior canal and 0.773mm±0.367 for inferior canal.

DISCUSSION

In our study, all 120(100%) patients showed median and lingual position of lingual foramen. Some patients also showed paramedian position (4 males and 3 females) and 5 (2 males and 3 females) patients showed buccal position of lingual foramen.Double lingual foramen was shown in 55.8% of the cases followed by single foramen which was seen in 38.3% of all the cases.Thus, double lingual foramen was shown in most of the cases. Study done by Abesi F(2015)[8] showed Lingual foramen in the median region of the mandible in100% of the cases and 39.5% had a single foramen ,53% had two foramina and 7.5% showed three foramen The results of our study were also supported by the studies done by Gahleitner at al [10], and Mc Donnell[2] studies The results of our study were in contrast to the study done by SekerciAE et al (2014)[7]where single foramen was present in 48 % of the subjects, double foramina in 36.6 %, and triple in 10.6 %. Studies done by Jacobs R et al (2007)[11] and Kawai T et al (2007)[12] also recorded single foramen most frequently.

Assari A et al (2017)[13]conducted a study in which 23.1%

,38.8% and 26.9% showed single, double and triple lingual foramen respectively but there was no significant difference in the pattern of distribution of foramina between males and females. In our study significant difference between gender was seen with respect to single lingual foramen.

In our study type I lingual foramen was most commonly recorded i.e. 33.3% of population followed by type VI which was present in 30.8% of study population. The results were in consistency with the study done by SekerciAE et al (2014)[7] in which Type I (32.98 %) was the most common variation followed by type VI (26.05 %). The mean distance between alveolar crest to lingual foramen were 20.47±4.43cm. SekerciAE et al (2014)[7] recorded mean distance from alveolar crest to superior lingual foramen was 12.04 ± 3.05 and from alveolar crest to inferior lingual foramen was 24.46 ± 6.36.[7] The average distance to the alveolar crest was of 14.2 mm (SD 4.34), with a minimum of 6.2 mm and a maximum of 26.2 mm was recodes by Babiuc I et al (2011).[14]

CONCLUSION

There is extensive range of anatomical variation of lingual vascular canals with respects to number, position, and dimension. It is foremost to consider these features planning for preoperative surgery particularly during implant placement in the anterior mandible as it may lead to uncontrolled hemorrhage intraosseously or in soft tissue. CBCT is a three-dimensional radiographic imaging modality with greatly reduced doses of radiation and high accuracy and is recently becoming a routine diagnostic tool in implant planning.

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