



INCIDENCE OF THE ANTERIOR LOOP IN THE MANDIBULAR CANAL IN PUNJAB'S POPULATION- A RADIOLOGICAL STUDY

Oral Medicine & Radiology

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ABSTRACT

The anterior loop of the mandibular canal is a critical anatomical structure located near the mental foramen. It represents the extension of the inferior alveolar nerve before it exits as the mental nerve. Proper identification and understanding of this structure is essential for procedures involving the anterior mandible, such as dental implant placement, osteotomies, nerve repositioning surgeries and also for minimizing complications such as nerve injury and altered sensation. The variations, influenced by factors such as ethnicity, gender and individual anatomy emphasize the importance of patient-specific assessments with cone-beam computed tomography being considered superior to other conventional radiographic techniques for the detailed assessment. Its ability to provide detailed three-dimensional views and precise measurements enhance the accuracy of preoperative planning.

KEYWORDS

Anterior loop, Mandibular nerve, Cone Beam Computed Tomography

INTRODUCTION:

Inferior alveolar nerve (IAN) is the branch of mandibular nerve which in further is the branch of fifth cranial nerve i.e. trigeminal nerve. It supplies sensory as well as motor innervation to the mandibular teeth and mandibular jaw bone. The anterior loop refers to "an extension of the inferior alveolar nerve, anterior to the mental foramen, prior to exiting the canal through this foramen (1).

The part of the IAN that is located anterior to the mental foramen is called the Incisive nerve, which is comprised of neurovascular bundles that innervate central and lateral incisors, canine and first premolar. (6, 7) Formerly, the inter-foraminal area was considered safe for surgical procedures. However, now it is clear that due to the presence of vital anatomical structures such as incisive nerves and vessels, surgical procedures should be performed cautiously in this area. Currently, paresthesia, hyperesthesia and bleeding are common complaints after performing surgical procedures in this region 8.5% to 24% (2).

Therefore, the location and alignment of the above mentioned neurovascular structures should be carefully assessed before undertaking any surgical procedure. (6)

In past, conventional radiographic techniques such as orthopantomography were used to assess the anterior loop. But because of its two dimensional representation and inherent magnification and distortion, it was not reliable so with advancement, three dimensional radiographic technique cone beam computed tomography (CBCT) is now a days in practice. (7)

Currently, few studies are available in literature regarding the incidence of anterior loop of inferior alveolar canal, length as well as shape of the anterior loop in different populations world-widely by Apostolakis et al.(8) De oliveira-santos et al., (9), Zahra Dalili Kajan & Ashkan Salari, (10) Uchida et al. (11) and Moghddam MR et al. (12)

However no such study has been undertaken to evaluate the anterior loop pattern on CBCT in Punjabi population of North India. So, the present study was aimed to evaluate the incidence of IAN's anterior loop in both the sexes in Punjab's population.

MATERIALS AND METHODS:

A retrospective study was conducted using CBCT images from the archives of a CBCT center in the department of Oral Medicine and Radiology, Genesis Institute of dental Sciences and Research, Ferozepur, Punjab. The CBCT scans done in the duration of 18 months i.e. from April 2023–October 2024, were included in the study. The images of 880 scans (who had undergone CBCT examination showing the mandibular premolar/molar region) were retrieved and reviewed for the presence of the anterior nerve loop.

For the calculation of sample size, a pilot study was done, and based upon the findings of the pilot study, statistician suggested the sample size of total 880 scans which would suffice our study objectives. The scans of 880 individuals were bilaterally divided into right and left sides. Hence, a total of 1660 sides (right and left) were obtained from 880 scans. Nearly 20-25 CBCT scans were examined per day by 2 oral radiology experts.

CBCT images were obtained using Vatech A9 CBCT machine with a tube voltage of 94 kV, tube current of 6.7 mA, exposure time of 18s, and a cylindrical shaped field of view (FOV) measuring 8 cm × 8 cm with a voxel size of 0.2mm. FOV used was the same for all the scans to standardize the image selection criteria. All images were assessed under optimal viewing conditions with appropriate image viewing software (EzDent -i 3D imaging software). This software of the CBCT machine was used for further data analysis and evaluation.

All statistical analyses were performed using SPSS software v 20. Descriptive and analytical tests were performed. Frequency distribution analysis and chi-square tests were performed. P value < 0.05 was considered statistically significant.

RESULT:

A total of 880 CBCT scans of age between 20-60 years were included in the study. As regards of sex distribution, 45% (400) of scans were of males and 54% (480) were of females. (Table 1)

Table1. Demographic Characteristics Status Of The Study Population

Factors	Categories	Number	Percentage
Age groups	20 – 60 years	880	99.99%

Gender	Male	400	45.45%
	Female	480	54.54%

Overall prevalence of anterior loop in the evaluated scans was found to be 43.1% which was found to be statistically significant (p value= 0.002). The prevalence of anterior loop on the right side was found to be 23.5% whereas on the left side it was 19.6%. The difference between two sides was found to be statistically non-significant as p value was $P > 0.1$. (Table 2)

Anterior loop pattern is shown in axial and sagittal view of CBCT image in Figure 1 and 2.

Table 2: Prevalence of anterior loop in the study population on right and left halves of mandible

Prevalence	No (%)
Prevalence of anterior nerve loop on the left side	345 (19.6%)
Prevalence of anterior nerve loop on the right side	415 (23.5%)
Overall Prevalence of anterior nerve loop	760(43.1%)*

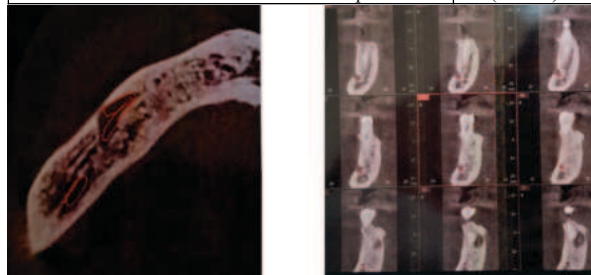


Figure 1 and 2 showing anterior loop pattern in axial and sagittal view.

Overall distribution of anterior loop on right and left sides in evaluated scans was found to be 28.9 % on right side and 35.6% on left side for type 1 respectively. The prevalence of anterior loop on the right side was found to be 27.7% and 43.37% which was found to be statistically significant (p value= 0.002). whereas on the left side it was 23.1% and 41.15% which was found to be statistically significant (p value= 0.002). for type 2 and 3 respectively. (Table 3)

Table 3: Frequency Distribution Of Anterior Loop On Right And Left Side Based Upon Their Types

Categories	Right side (415 CBCT)	Left side (345 CBCT)
Type 1	120 (28.9 %)	123(35.6%)
Type 2	115(27.7%)	80 (23.1%)
Type 3*	180(43.37%)	142(41.15%)

DISCUSSION:

The anterior loop refers to "an extension of the inferior alveolar nerve, anterior to the mental foramen, prior to exiting the canal (1). Injury to the anterior loop of the inferior alveolar nerve, the mental nerve, or adjacent vascular bundles, which innervate and vascularize the teeth, the lip, the skin, and mucous membranes in the region, could result in numbness, dysesthesia or pain and sensory changes in lower lips which range from 8.5% to 24% (2)

Previous studies done by using 2 D imaging modalities by Iyengar et al., in 2013 [13], Prados-Frutos et al. in 2017 [14], had shown that factors like ethnicity, gender, and individual anatomy can influence these variations in the pattern of inferior alveolar canal. To minimize potential complications precise understanding of the individual's anterior loop must be understood. CBCT is currently considered as the best imaging technique for this purpose as it provides detailed 3D images, allowing for precise measurements and a more accurate assessment of the anterior loop.

The anterior loop continues beyond the anterior margin of the mental foramen (MF), can be identified by the presence of the two separate canals and develops during the double back process when the mental canal exits to the mental foramen from the mandibular canal. [5] MF is the most important landmark for determining inter-foraminal region to estimate the surgical safe zone during preoperative planning.[6] Exposure of the MF during implant surgery in the symphysis area provides a direct view of the mental nerve. Radiography provides the clinician with information not readily available by any other diagnostic method. A safe distance of 2 mm should be kept between endo-osseous implants and the MFR, some studies have reported

altered sensation in the area supplied by the mental nerve following implant placement Wismeijer et al. 1997, Bartling et al. 1999, Walton 2000).[7]

The present study was conducted to evaluate the incidence of anterior nerve loop in the mandible using CBCT scans. A total of 880 CBCT scans were analyzed, as compared to study conducted by Apostolakis, D. and Brown, J.E. in 2012. They evaluated only 93 CBCT scans only to detect the incidence and length of the anterior loop of the inferior alveolar nerve. [8] In their study, equal distribution of male and female scans were done while in our study gender distribution was of 45.45% male and 54.54% was of female.

The results of our study indicate that anterior loop of the IAN is a relatively common anatomical variation in Punjabi population. The overall prevalence of anterior loop was found to be 43.1% (760 out of 1760 mandibular halves). When analyzed bilaterally, the prevalence on the right side (23.5%) was slightly higher than on the left side (19.6%). This asymmetry could be attributed to anatomical variations in nerve trajectories or developmental differences between the right and left halves of the mandible. Such variations are clinically relevant, particularly for implant placement, nerve block administration, and surgical interventions in the anterior mandible.

Rath R, Taschieri S et al studies on CBCT had shown that in case of the presence of an anterior loop, there are higher chances that the mental foramen is at a higher level in the alveolar bone which is again a clinically important finding in placing the implant in the premolar region of the mandible [15,16].

CONCLUSION

The anterior loop of the mandibular canal is an important anatomical structure that demands careful consideration during surgical procedures in the anterior mandible. Accurate identification of the anterior loop is essential for minimizing complications particularly during procedures like dental implant placement. CBCT has emerged as the gold standard for imaging in this context thereby assisting the clinician for treatment planning.

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