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Assessment Of Prevalence & Length Of The Anterior Loop Of Inferior Alveolar Nerve & Mandibular Incisive Canal Using Cone Beam Computed Tomography Images Among Indian Population: A Retrospective Cross-Sectional Radiographic Study

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ABSTRACT

- **Objective:** To assess the prevalence & measure the length of anterior loop & mandibular incisive canal of the inferior alveolar nerve using Cone- Beam Computed Tomography (CBCT).
- **Materials and Methods:** A total of 250 CBCT scans of patients between the age 15 to 60 years with equal distribution among males and females were randomly selected and evaluated retrospectively.
- **Results:** The prevalence of anterior loop was 10.4 % & the prevalence of mandibular incisive (MIC) canal was 75.2 %. The mean length of MIC on right side was 4.743 ± 2.1226 mm & on left side was 4.431 ± 2.0613 mm. The mean length of anterior loop on the right side was 3.1206 ± 0.99440 mm & on the left side was 3.2264 ± 1.00606 mm.
- **Conclusion:** Plotting the incisive nerve canal & anterior loop will help oral radiologists, to plan safely and negotiate the interforaminal region. This will additionally enable surgeons to avoid postoperative neurosensory complications.

- **Key-Words: Cone-Beam Computed Tomography, Mandibular Incisive Canal, Anterior loop.**

INTRODUCTION

The anterior region of the mandible is generally a secure zone but is definitely susceptible to different risks that can cause anatomical and functional damage. It is well known that the anterior mandible contains several anatomical landmarks like Mandibular Incisive Canal (MIC) & Anterior loop (AL). The Mandibular Incisive Canal is traced as a lengthening of the mandibular canal anterior to the mental foramen that contains a neurovascular bundle[1].

The mental foramen is one of the most difficult regions for grafting because of the many differences that can occur considering to the size, shape, location, and direction of the opening of the canal. The beginning of the mental foramen is reported to traverse in different directions, i.e., superiorly, poster superiorly, labially, anteriorly, and posteriorly. The

anterior loop (AL) of the Inferior Alveolar Nerve (IAN) is an important anatomical variation that begins from the IAN. Failure to note this loop may cause complications like sensory disorders in the lower lip. Therefore, exact evaluation of its position before surgery is also essential.[2]

Cone Beam Computed Tomography (CBCT) is a highly effective imaging modality providing acceptable three-dimensional (3D) views and approachability to the craniofacial structures in comparison with conventional radiographic techniques. Therefore, this research was carried out to assess the prevalence & measure the length of anterior loop & mandibular incisive canal using CBCT.

MATERIALS & METHODOLOGY

- It is a **retrospective cross-sectional radiographic study** to assess the **prevalence and length of the anterior loop of inferior alveolar nerve and mandibular incisive canal using cone beam computed tomography images among Indian population.** Ethical committee clearance was acquired from Institutional Ethical Committee.
- A total of 250 CBCT scans of patients between the age 15 to 60 years with equal distribution among males and females were randomly selected and evaluated retrospectively. The cases were grouped by side, gender and age. Patient's age was classified into three age groups (15–30, 31–45, 46–60).
- Patients with congenital & syndromic disorders or those having adventures of trauma to the anterior mandible or any operative interventions were excluded from the study.

METHODOLOGY:

- After revision of axial, sagittal, cross-sectional and panoramic images, the CBCT images were first viewed for the existence or absence of the anterior loop and the mandibular incisive canal on both sides. If present, it was noted if present unilaterally or bilaterally. The **anterior loop** is the region of the inferior alveolar nerve that ascends and often curves for a few millimetres front to the mental foramen returning end to the mental foramen and the **mandibular incisive canal** is the medial extension of the mental nerve, which runs in the anterior region of the mandible and may open lingually close to the genial tubercle. To estimate the length of anterior loop in tangential plane, two parallel lines from the anterior point of mental foramen and anterior point of anterior loop were drawn using length measuring option on Galileos software. The space between these two lines was then measured by drawing a perpendicular line on them and was considered as the length of anterior loop. (Fig.1) To measure the length of MIC, on each amplification, axial slices were redesigned parallel to the inferior border of the mandible. On the most appropriate axial slice, all the measurements were taken just mesial to the mental foramen or of the anterior loop (where identified). Vertical cross sections to the mandible were reconstructed with a slice thickness of 1 mm and a step of 0.5 mm and the sections were taken with the starting point noted just mesial to the mental foramen or of the anterior loop (where identified). The last slice for measurement was considered to be the last slice where the canal appeared. This number of sections was multiplied with the step of the slices, and the resultant value was the precise length of MIC. (Fig. 2) All results were statistically analysed.

RESULTS

Out of 250 CBCT Images, presence of anterior loop was 10.4 %(26 images). (Table 1 and Graph 1). Out of the total anterior loop observed, 12(46.2%) showed presence of anterior loop on right side & 10(38.5%) showed the presence of anterior loop on the left side. However, 4.0(15.4%) showed the presence of anterior loop on both sides. When comparing

presence of anterior loop, there was statistically no significant difference between the right and left side, (P value was 0.670). Also there was no statistically significant association of presence of anterior loop with age (P value was 0.228) and gender (P value was 0.191).

Overall presence of MIC was 75.2%. (Table 2 and Graph 2) Out of total MIC observed, 50(26.6%) showed the presence of MIC on right side & 26(13.8%) showed the presence of MIC on the left side. However, 112 (59.6%) showed the presence of MIC on both sides. When comparing presence of MIC, there was a statistically significant difference between the right and left side (Right>Left), with (P value was 0.006). (Table 3 and Graph 3) However, there was no significant association of age (P value was 0.074) and gender (P value was 0.273) with presence of MIC.

The mean length of anterior loop on the right side was 3.1206 ± 0.99440 mm & the mean length of anterior loop on the left side was 3.2264 ± 1.00606 mm. The maximum length of anterior loop on right side was 4.77 mm & minimum length of anterior loop on the right side was 1.61 mm. The maximum length of anterior loop on the left side was 5.33 mm & minimum length of anterior loop was 1.81 mm.

The mean length of MIC on right side was 4.743 ± 2.1226 mm (162) & the mean length of MIC on left side was 4.431 ± 2.0613 mm (138). The maximum length of MIC on right side was12.0 mm & minimum was 1.5 mm. The maximum length of MIC on the left side was 11.5 mm & minimum length was 1.0 mm. (Table 4 and Graph 4)

The mean length of MIC in males was 5.127 ± 2.2929 mm on the right side & 4.544 ± 2.0348 mm on the left side. Similarly, the mean length of MIC in females on the right side was 4.274 ± 1.8009 mm, 4.276 ± 2.1051 mm on the left side. Statistically, there was significant association of gender (M>F) with length of MIC on the right side (P value was 0.010). However, statistically there was no significant association of gender with length of MIC on left side (P value was 0.453). (Table 5 and Graph 5).

The study did not show any association of age with length of anterior loop and MIC (P value was 0.05).

DISCUSSION

Mental Nerve Tear is one of the provocation for Implant Surgeons in the anterior mandibular region leading to paraesthesia of lips & chin. To refrain nerve injury during surgery of the anterior mandible, CBCT is done. It finely visualizes the anatomical variations of the IAN and prevents nerve damage and the resultant complications during surgery.[3] Furthermore, the incisive canal is better visualized in CBCT scans in comparison with conventional radiographic techniques, and even when some lengthy incisive canals are invisible on panoramic radiographs, they can be clearly seen on CBCT views.[4]

Evaluating the possibility of morphological variations occurring in the mandibular incisive canal and the anterior loop in different populations and the desire to avoid damage to the above structures during surgical procedures in the mental interforaminal region, we examined these structures in a specific Indian population i.e. subjects living in the Northern India with the aim to assess prevalence & length of the anterior loop of inferior alveolar nerve & mandibular incisive canal using Cone Beam Tomography[5].

In the study conducted by Ramesh et.al 2015[6], the prevalence of mandibular incisive canal was 71.66 % of which 48.33% exhibited canals bilaterally and 23.33% showed unilateral canals whereas 28.33% of the CBCT scans did not exhibit the presence of incisive nerve canal. Similar to the above study, in our study out of 250 CBCT scans, the prevalence of MIC was 75.2% out of which59.6% showed presence of MIC bilaterally and 40.4% showed the presence of MIC unilaterally.

Also, Parnia et.al 2012 [7] conducted a study in which the prevalence mandibular incisive canal was 71.9% which is in agreement with our study.

However, in the studies conducted by Pires et al [8] (83.1% of CBCT scan images) & the study conducted by Sakhdari

et.al 2016 [9] (87.5%, of the study subjects) showed comparatively slightly more prevalence of MIC as compared to our study.

The study conducted by Sakhdari et.al 2016 [9] showed the maximum length of incisive canal to be 5.3 mm which is similar with our study. However, there was statistically significant association (P value 0.010) of gender (M>F) with length of MIC on right side in our study which was not found in their study.

Contrary to, the study conducted by Rosa et.al 2013 [10], showed a higher mean length of MIC to be 9.11 mm. This value was not significantly different when compared using sex, left and right side, and edentulous or dentate state.

Explanation for the varied frequencies of detecting the incisive canal in different studies may be related to the degree of cortication of the canal wall. Precise detection of the canal is usually not possible because of either a low degree or loss of cortication of the canal wall. This adversity with accurate identification also occurs for incisive canals with thicker walls.

The study conducted by Pradeep et.al 2018[11], showed the prevalence of anterior loop in 11.76 % scans which is consistent with our study. Jacobs *et al.* 2002[12] studied 230 spiral CT scans of the lower jaw bone and found anterior looping of the mandibular canal in 7% of the cases which is comparatively lower than the findings of the present study.

Siddiqui et.al 2018 [13] conducted a study in which mean length of anterior loop was 3.6661 mm (± 1.9933) which is in agreement with our study. Similarly, Parnia et.al 2012 [7] conducted a study in which mean length of anterior loop is 3.54 mm (± 1.41) which is in accordance with our study. Also, Pradeep et.al 2018 [11] conducted a study in which the mean length of anterior loop is 2.79 mm which is similar to our study.

Rosa *et al*. 2013[10] studied 352 CBCT scans and reported that in 21 of the CT scan images, the length of loop exceeded 4.5 mm, with the greatest length being 7 mm. (average length of the loop as reported in the literature is between 0.4 and 6mm) [13]. In the present study, the mean length was found to vary from 3.24 mm to 3.83 mm. No significant statistical differences were found between males and females, which is also consistent with our study.

CONCLUSIONS

Plotting the incisive nerve canal & anterior loop will help oral radiologists, to plan cautiously and work out the interforaminal region. This will additionally help general practitioner to escape postoperative neurosensory complications. Hence, it is proposed that treatment planning be carried out on a case-by-case basis using a 3D imaging modality to determine the appropriate location.

LIMITATIONS

However, our study had few limitations as well. As this study was said to be ended within specified time interval, this study was performed at one of the arbitrarily selected diagnostic and research center catering mostly the patients from North India and surrounding regions. Age and sex ratio found in the study corresponds simply to the sample population. A hospital or clinic-based study is not sufficient to conclude about these demographic parameters.

FUTURE PROSPECTS

The advantage of this retrospective cross-sectional study is that it helps dentists to plan surgical procedures in the mandibular anterior region. The results of this study will help and add on to the lawmakers and modern reviewer to rely upon the effective of Cone Beam Computed Tomography (CBCT) scans. The sample is of appropriate size to reinforce the adequacy and assessment of Cone Beam Computed Tomography in determining the prevalence and length of Mandibular Incisive Canal & Anterior Loop of Inferior Alveolar Nerve. In future we recommend further studies to be conducted on relatively large sample size in assessing the presence & path of the mandibular incisive canal and presence of the anterior loop in Cone Beam Computed Tomography (CBCT).

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