

ORIGINAL ARTICLE

Prevalence and Extent of Anterior Loop of the Mandibular Canal Using Cone Beam Computerized TomographyShoaib Rahim¹, Nighat Haroon Khan², Saira Bilal³, Nadia Hanif⁴, Uzma Habib⁵, Fahad Haroon⁶**ABSTRACT**

Objective: To determine the presence of mandibular canal anterior loop and its length in patients reporting to a tertiary care center using Computerized Cone Beam Tomography (CBCT).

Study Design: Descriptive cross-sectional.

Place and Duration of Study: Prosthodontics Dept., Armed Forces Institute of Dentistry, From 1st February 2019 to 30th November 2019

Materials and Methods: A total of 126 subjects, between the age of 16-60 years, were selected using nonprobability consecutive sampling technique from Prosthodontics Department. Patients in whom CBCT investigation was required were selected based on exclusion and inclusion criteria. With the help of NNT viewer software presence of mandibular canal anterior loop determined. The Extent of anterior loop anteriorly into the mandible was analyzed using the measuring tool in the NNT viewer software.

Results: Out of 126 patients, anterior loop was found in 19% (n=24) patients among which 7.1% (n=09) patients had on the left side and 3.9% (n=05) on the right side. A total of 7.9% (n=10) patients had anterior loop present bilaterally. The Mean \pm SD extent of anterior loop on left and right side were 3.87 ± 0.88 and 3.96 ± 0.84 respectively.

Conclusion: A low prevalence of mandibular canal anterior loop was observed in subjects of present study with variations in the extensions of anterior loop. Computerized Cone Beam Tomography (CBCT) imaging modality was found to be effective in the detection of anterior loop.

Key Words: Cone Beam, Computerized Tomography, Mandible, Mental Foramen.

Introduction

The mandibular anterior/ para-symphyseal region is a common sight for surgical procedure like dental implant therapy, especially in edentulous mandible, thus sound knowledge about clinical anatomy is of great importance. Even though the region between both the mental foramina anteriorly in mandible is a safe location for such procedures, but anatomical variations do exist among different populations.^{1,2} These variations maybe in the form of accessory mental foramen (AMF), anterior loop of mandibular canal or the presence of incisive branch of the nerve. Mental foramen (MF) provides a pathway for the

terminal branch of inferior alveolar nerve (IAN) which is known as the mental nerve. The IAN may also continue into the anterior mandibular region in the form of Incisive nerve.³ Certain studies have suggested that after giving off the incisive branch, it reaches postero-superiorly to the mental foramen to continue as the mental nerve, which can be seen in the form of radiolucent loop also known as anterior loop of mandibular canal (MC) or anterior loop of mental nerve.^{4,7} In study conducted by Pradeep out of 85 patients, anterior loop was found to be present in 11.76% patient with a mean length of 2.79 mm.⁴ In another study the mean extent of anterior loop was found to be 0.89mm.⁸ Yet in another study the mean length of anterior loop was found to 4.13mm (range 01 to 11mm).⁹

Although these anatomical variations are rare but inadvertent damage during surgical implant placement can occur if such variations are ignored thus leading to sensory dysfunction.¹⁰ Therefore, it is of utmost importance to appreciate the anatomy of this region to avoid any injury to the neurovascular bundles. Orthopantomograms (OPG) is among one of the commonly advised investigation in dentistry to

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get an overview of all the dentition and its surrounding hard tissues. Although the accuracy and precision of OPG in detection of accurate location of MF and the presence of anterior loop of MC and AMF maybe considered questionable⁷. Study have also been done to determine the anatomical variability in the dried mandible of cadavers which is also considered to be accurate for that population.⁹ It is therefore necessary to have a clear vision/image of the jaw to prevent these damages, which can be achieved with the 3D imaging technique, that is, Cone beam computed tomography (CBCT). CBCT provides a better image quality/resolution and an accurate representation of the structures with a low radiation dose as well as the ability to use different tools available in the software.^{2,11,12}

Keeping in view the above background, the rationale of our study was to use CBCT imaging modality for determining the variability anterior loop of MC as it corresponds to clinical practice and provides images of greater accuracy and low dosage to satisfy the presurgical planning requirements and hence the present study was designed to determine the prevalence and extent of anterior loop of MC using CBCT.

Materials and Methods

The data collection for this Cross-Sectional Study (Descriptive) was carried out in the Prosthodontics Department at Armed Forces Institute of Dentistry. The study duration was 09 months (February 2019 to November 2019). A sample size of 120 subjects was calculated to be the minimum sample for this study using the WHO calculator. A total of 126 patients were selected for this study. Sampling technique used for collection of data was Non-probability Consecutive Sampling. Inclusion criteria consisted of patients of both male and female gender with age ranging from 16-60 years, patients for whom CBCT has been advised as part of their treatment, patients with no history of mandibular symphyseal or Para symphyseal fracture, both dentate and partially dentate patients with all lower anterior teeth and premolars present, patients with who had their CBCT investigation done previously were also considered in this study provided they fulfill the criteria. Exclusion criteria consisted of patients with a history of tumor, cyst or any other bony lesion or deformity involving the anterior portion of the mandible within

the region of right and left mandibular, patients with any identifiable syndrome, patients on bisphosphonate therapy, patients with osteoporosis and non-visualization of the mental foramen bilaterally, Patients undergoing orthodontic treatment or patients with crowding of mandibular anterior teeth and/or root resorption.

Prior approval from Ethical Review board was obtained (Ref. no. ERC-5/25-2019). As a protocol all patients presenting to hospital were examined in dental OPD/ diagnostics department and patients with prosthodontic needs were referred to Prosthodontics department. Those patients who fulfilled the criteria (Exclusion and Inclusion) were selected for the study. CBCT investigation was advised to patients as a part of their treatment. CBCT was recorded using Newtom vgi CBCT (Verona, Italy) and analyzed with the help of radiologist. Position of MF was identified using Multiplanar view, panorex view and or 3D model and its relationship with the teeth was noted. Presence or absence of anterior loop of MC and AMF was noted. Patients in whom anterior loop was found to be present, its extent was measured using a measuring tool in CBCT software (NNT viewer). SPSS version 20 was used analyze the data. For qualitative and quantitative variables descriptive statistics were calculated. For variables like position of MF, presence of anterior loop of MC, gender, and accessory mental foramen (qualitative). For quantitative variables like age, distance/extent of anterior loop mean \pm SD were calculated. To determine the association between the location of MF on left and right-side chi square test was applied. To analyze the difference in the extent of mandibular canal anterior loop independent sample t test was applied.

Results

Out of 126 patients, 52 (41.3%) were males and 74(58.7%) were females. The age range was 16 to 58 years. The Mean of age of patients was 34.40 ± 10.49 years. The location of MF in relation to the teeth on the left and right side have been given in Table-I and Table-II. Out of 126 patients, anterior loop of mandibular canal was found in 24 patients (19%). Out of these 24 patients 19 (15.07%) were female and 5 (3.96%) were male. Anterior loop was present in 10 patients (7.9%) bilaterally and 09 (7.1%) patients had anterior loop only on left side and 05

(3.9%) had on right side. The Mean distance/extent of anterior loop was 3.87 ± 0.88 millimeters (mm) on left side and 3.95 ± 0.84 mm on right side. The minimum and maximum extent of anterior loop on left side was 2.33 mm and 5.36 mm respectively and on right side it was 2.20 mm and 5.11 mm respectively. Accessory mental foramen (AMF) was found in 09 (7.1%) patients on left side and 06 (4.8%) on right side.

To determine the association between the location of MF on left and right-side chi square test was applied and p value < 0.001 was found to be significant (Table-III). Independent sample t-test was applied to determine the difference in the extent/distance of anterior loop of Mandibular canal between Left and Right side. Statistically no significant difference was found with p value of 0.784 (Table-IV).

Table I: Frequency of Position of Left Mental Foramen in Relation to Teeth (n= 126)

| Sr. No. | Location/Position of Mental foramen | Frequency | Percentage |
|--------------|---|------------|-------------|
| 1 | Canine | 17 | 13.5% |
| 2 | Between Canine and 1 st Premolar | 12 | 9.5% |
| 3 | 1 st Premolar | 36 | 28.6% |
| 4 | Between 1 st Premolar and 2 nd Premolar | 28 | 22.2% |
| 5 | 2 nd Premolar | 33 | 26.2% |
| Total | | 126 | 100% |

Table II: Frequency of Position of Right Mental Foramen in Relation to Teeth (n= 126)

| Sr. No. | Location/Position of Mental foramen | Frequency | Percentage |
|--------------|---|------------|-------------|
| 1 | Canine | 10 | 7.9% |
| 2 | Between Canine and 1 st Premolar | 06 | 4.8% |
| 3 | 1 st Premolar | 44 | 34.9% |
| 4 | Between 1 st Premolar and 2 nd Premolar | 25 | 19.8% |
| 5 | 2 nd Premolar | 41 | 32.5% |
| Total | | 126 | 100% |

Table III: Chi Square Test for Location of Mental Foramen

| Association of Location of Mental Foramen on Left and Right side | Pearson Chi Square Test | | | Strength of Association | | | |
|--|-------------------------|----|-------------|-------------------------|--------------|------------|--------------|
| | Value | df | Asymp. Sig. | Phi | | Cramer's V | |
| | | | | Value | Approx. Sig. | Value | Approx. Sig. |
| | 54.968 | 16 | <0.001 | 0.66 | <0.001 | 0.33 | <0.001 |

Table IV: Independent Sample t-test For Extent of Anterior Loop

| Extent of Anterior Loop | Side of Mandible | Mean (mm) | Std. Deviation | T test | | |
|-------------------------|------------------|-----------|----------------|--------|----|---------|
| | | | | t | df | p value |
| | | Left | 3.875 | 0.886 | - | 32 |
| | Right | 3.959 | 0.848 | 0.276 | | |

Discussion

The results of current study show that the anterior loop of mandibular canal was present in 19% (n=24) of the patients with the maximum extension of 5.36 mm. No significant difference noted in the extension between left and right side among different patients (p value 0.784). It is critical to identify the exact position of MF along with extent of anterior loop of MC. The MF was most found to be in proximity with the root of the 1st premolar tooth in most of the patients, both on left and right side. Chi square test showed significant association between the location of left and right MF along with strong correlation (p value <0.001). AMF was also found to be present in certain patients alongside MF. These results suggest that adequate investigations and treatment planning is required before proceeding with the surgical treatment in the mandibular interforaminal region to avoid any chance of possible injury to the nerve bundle and vessels during surgery. The precise position of these important structures becomes even important when performing surgical therapy in completely edentulous patients.¹³⁻¹⁵

Certain authors have conducted research to determine the incidence of mandibular canal anterior loop. In a study conducted by Arati, who selected 32 CBCT images of the patients for locating the anterior loop, it was reported to be extant in 41% (n=13) of the subjects with a mean extent of 2.90 ± 2.79 mm.¹⁶ In another study conducted by Pradeep who selected 85 patients, anterior loop was found to be present in 11.76% (n=10) patient with a mean length of 2.79 mm.⁴ Yet in another study conducted by Dimirios on 93 patients, anterior loop was found to be present with a mean length of 0.89 mm in 48% (n=45) of cases.⁸ Other studies have also reported difference in incidence of anterior loop of mandibular canals.^{17,18} The findings in the above mentioned studies do not coincide with one another and neither does the findings of our study coincide with the finding of these studies, that is, 19% (n=24). This suggests that there is variation in the incidence

of anterior loop among different population and geographic dysmorphism has been noted. It is therefore important to carefully observe the radiographic investigations of each patient for presence of anterior loop as its incidence is variable. An opinion from radiologist should always be considered in case of any doubt to avoid undue damage to neurovascular bundle during the surgical procedure. The mean length of mandibular canal anterior loop in our study was slightly more than the mean length reported in these studies. Although the maximum range of length of anterior loop was coinciding with our study.^{4,8,16-18} The difference in the mean values may be due to the difference in sample size, the incidence of anterior loop and the individual length of anterior loop being on the lower side. Smrithi et al found that the anterior loop had more prevalence in male as compared to female whereas in our study it was more prevalent in females. One of the reasons for this difference maybe the gross difference in sample size between the study conducted by Smrithi and our study.¹⁷ Another major reason for this difference is that, in our study more than half of the subjects were female so the resultant incidence might have higher because of that difference.

Numerous studies have been carried out in the past to determine the position of MF in relation to the roots of a tooth namely canine, 1st premolar and 2nd premolar. The limitations of such studies which is also common in our study is that they are only helpful in dentate patient. In our study the MF was most found along the roots of mandibular 1st premolar on both sides followed by 2nd premolar position. The results of our study do not coincide with the results of other studies as most of them report the common location of mental foramen to be coinciding with 2nd premolar followed by 1st premolar.¹⁹⁻²¹ Although further improvements in this finding can be made by increasing the sample size or utilizing more objective and stable landmarks for determining the position of the MF. Whenever a landmark such as tooth is used to determine the position of MF, the factor of unreliability cannot be ignored as the position of teeth is not constant and difference can be expected because of mal-alignment, trauma, missing teeth and many more reasons.

The limitations of our study were that we did not

consider the variation in the size, shape and direction/Classification of Anterior loop of mandibular canal. Numerous variations have been reported in the literature.²²⁻²⁴ The information gained from this study suggests that anterior of the mandible is an area with a variety of anatomical variations when it comes to the vital structures. Careful treatment along with adequate investigations are keys requirements for safely placing dental implants in the interforaminal region without any chances of surgical complications. Some advice from radiologist should always be considered when planning in such cases for better outcome of dental implant therapy.

Conclusion

In conclusion, a low prevalence of the anterior loop of mandibular canal was noted in the present study, with variations in the length of extension of anterior loops. The maximum length observed was of 5.36 mm using CBCT. Keeping in view the limitations of the study it is therefore recommended that, for establishing a safety limit for implant surgical procedure an accurate evaluation using CBCT is necessary.

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