Prevalence of Anterior Loop and other Patterns of Mental Nerve in a Sample Population of an Indian City: A Retrospective Study

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Abstract

Introduction: The final portion of the inferior alveolar nerve (IAN), the mental nerve (MN), is a general somatic afferent nerve that provides sensation to the lip, chin, and gingival tissue. Three patterns of MN have been observed – straight, perpendicular or vertical, and anterior loop (AL) of MN. The interforaminal region of the mandible possesses a MN with a path that creates an AL before entering the mental foramina. The aim of the study is to evaluate the presence of AL of MN using cone-beam computed tomography (CBCT) and to measure the length of the AL of MN, if present, also to evaluate the prevalence of other anatomical patterns of MN – straight and vertical patterns. **Materials and Methods:** Mandible CBCT of 400 patients with the age of 20 years onward was included in the study. The images obtained were assessed for the different patterns of MN – straight, vertical, and ALs. The statistical analysis was done using the Chi-square test, paired *t*-test, and sample *t*-test. **Results:** Out of 400 CBCT scans comprising 800 hemimandibles, straight pattern was observed in 67.1%, vertical pattern in 26%, and Anterior Loop in 6.9%. The prevalence of AL pattern was 6.9%. AL length was found to be in a range of 2.4–6.6 mm. **Discussion:** Surgical trauma or injury to the AL of MN is possible during implant surgery in the interforaminal area of the mandible if AL is not assessed preoperatively.

Keywords: Anatomical variation, anterior loop, interforaminal region, mental nerve

Introduction

The mental nerve (MN), which is one of the terminal branches of the inferior alveolar nerve, emerges through the mental foramen to supply the skin and mucous membrane of the buccal vestibule of the lower jaw from the medial border of the masseter muscle to the midline.[1] In the mental canal, the MN continues upward and emerges from the mental foramen in conjunction with blood vessels. The mental portion of the inferior alveolar canal is also classified into three types according to the course of the canal: straight, vertical, and anterior loop (AL) [Figure 1]. The final portion of the inferior alveolar nerve sometimes passes below the inferior border and the anterior wall of the mental foramen and after giving off a small incisive branch, it curves back to enter the foramen and emerge into the soft tissues becoming the MN. This anatomical feature is also known as “anterior loop” of the MN.[2] Beltrán *et al*.[3] have described the interforaminal region of the mandible as possessing a MN with a path that creates an AL before entering the mental foramina and another division in this point (anterior to AL) as mandibular incisive canal.

Failure to identify this loop preoperatively may result in iatrogenic damage to the nerve. Damage to the AL results in paraesthesia, anaesthesia, dysaesthesia, or even overt pain in the area innervated by the MN. To avoid injury to this entity, varying safety margins from the mental foramen of up to 6 mm have been advocated by different authors.[4]

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Hence, the study was intended to estimate the prevalence of AL and other patterns as well as the morphometric analysis of AL relative to the defined standard references using cone-beam computed tomography (CBCT).

Materials and Methods

It was a retrospective study where the data was collected from a randomly selected CBCT centre during 2016 - 2017. Four hundred eighty-seven (487) CBCT scans were visualised, of which four hundred CBCT (400) scans which met the inclusion criteria were included in the study. Four hundred (400) CBCT scans consisting of 800 hemimandibles bilaterally were analysed.

The Ethical Clearance (OMR-IX-3/2015-16) was obtained from the Institutional Ethical Committee of Bharati Vidyapeeth (deemed to be university) Dental college and Hospital, Pune, India. All procedures performed in the study were conducted in accordance with the ethics standards given in 1964 Declaration of Helsinki, as revised in 2013.

The scan time of the machine used ranged from 13 s to 18.6 s. Resolution ranged from 90 μm to 180 μm and slice thickness range was from 0.09 mm to 0.18 mm. CBCT scans made for any dental or maxillofacial diagnostic or treatment planning purpose with small-to-medium field of view were included in the study.

The patients included in the study were in the age range of 20–60 years; good-quality CBCT scans showing all the mandibular teeth present from the left second premolar to the right second premolar, as well as the mental foramen area, were included in the study.

CBCT scans with any fracture or pathology around the mental foramina and mandibular canal region and with retained teeth, impacted teeth, and missing teeth were eliminated as there may be the possibility of permanent tooth buds which obscure the mental foramen region.

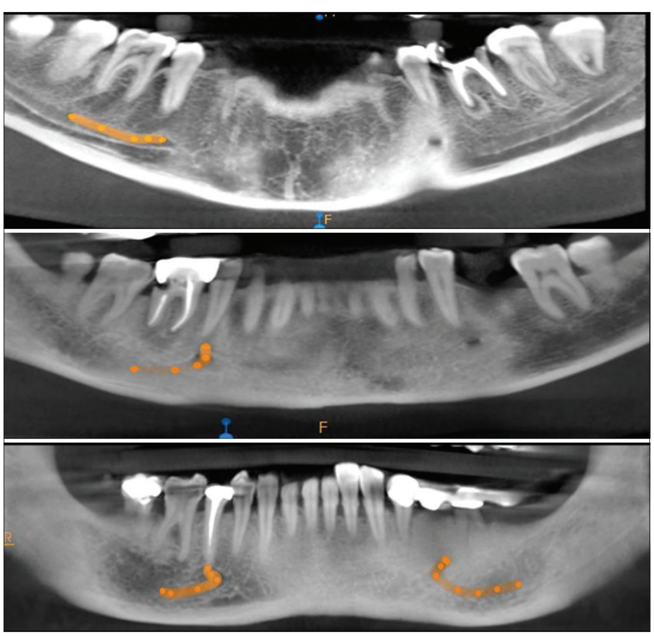


Figure 1: Reconstructed panoramic images showing different patterns of mental nerve

Multiplanar reconstructions including axial, coronal, and sagittal images were obtained and evaluated concurrently by two trained and calibrated observers. Disagreements were discussed and a consensus was reached. The intergroup comparison of continuous variables was done using an independent sample test for two groups. The inter-rater reliability analysis was performed using intraclass correlation analysis. The inter-rater agreement was performed using Cohen's kappa statistic. There was a significantly higher inter-rater agreement between the two observers.

The criteria given by Iyengar *et al*.[1] and Sahman and Sisman[5] for the assessment of different patterns of MN were used in the study. Iyengar *et al*.[1] catergorised the MN pattern as straight, looping, or perpendicular using panoramic radiography, while Sahman and Sisman[5] categorised the patterns as straight, vertical, and ALs using CBCT.

On reconstructed panoramic image[1,5] [Figure 1], the presence of different patterns of MN – straight, vertical, and ALs was evaluated.

On coronal view[6] [Figure 2], the distance between the AL and the fixed landmarks on the mandible was calculated. The fixed landmarks considered were Buccal cortical plate (BCP), Lingual cortical plate (LCP), and Inferior border of the mandible (IBM).

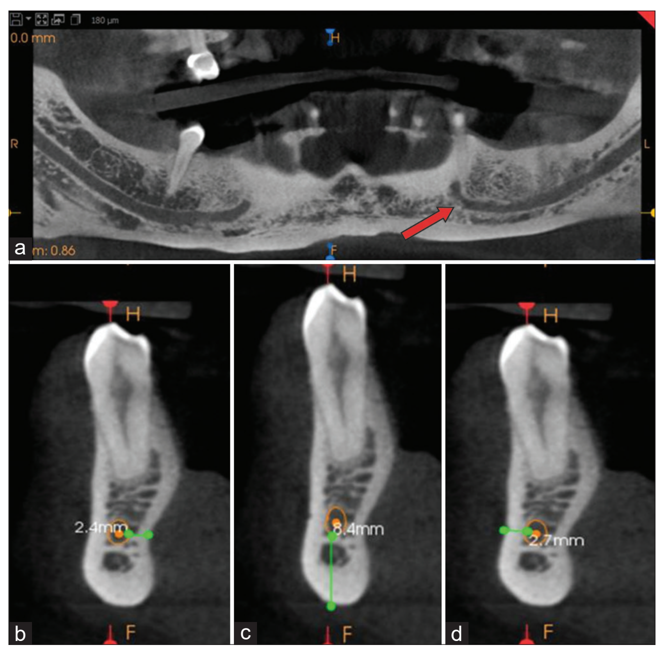


Figure 2: (a) Reconstructed panoramic image showing the presence of a straight pattern on the right side and anterior loop on the left side (red arrow). Coronal section showing the distance between the most anterior point of the anterior loop and the (b) Buccal cortical plate (BCP) (c) Lingual cortical plate (LCP) (d) Inferior border of the mandible (IBM)

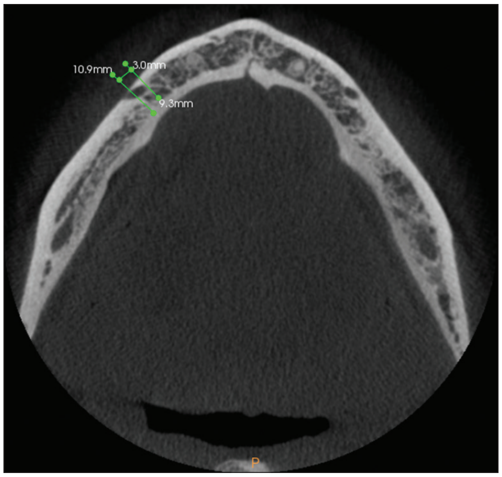


Figure 3: Axial section showing the length of the anterior loop (AL length = 3.0mm)

On axial view[7] [Figure 3], the presence or absence of the AL was evaluated. If AL is present, the length of the AL was measured, i.e., the distance from the medial margin of the mental foramen to the most anterior part of the loop in millimeters.

In the entire study, the value of $p < 0.05$ was considered to be statistically significant. All the hypotheses were formulated using two-tailed alternatives against each null hypothesis (hypothesis of no difference). The entire data were statistically analysed using the Statistical Package for the Social Sciences (SPSS version 23.0, IBM Corporation, USA) for Microsoft Windows.

Results

The CBCT scans of 400 cases comprising 800 hemimandibles were evaluated. In the present study, the straight pattern was the most common type observed in a total of 537 sides (67.1%) which comprised 270 (67.5%) on the right side and 267 (66.8%) on the left side.

The vertical pattern was observed in a total of 208 sides (26%), 101 (25.3%) on the right side and 107 (26.8%) on the left side. The distribution of right- and left-sided patterns of MN did not differ significantly ($P > 0.05$) [Graph 1].

A total of 55 (6.9%) ALs were detected in 42 (10.8%) cases. The prevalence of AL pattern was found to be 29 (7.3%) on the right side and 26 (6.5%) on the left side. Of these cases, 29 (7.5%) had a unilateral AL and 13 (3.3%) had bilateral AL. The overall (both sides) prevalence of AL pattern was 6.9% [Table 1].

The straight pattern was more common in females, whereas the vertical pattern and the AL were more common in males. The distribution of overall (on either side) pattern of MN was highly significant between male and female participants studied ($P < 0.01$) [Graph 2].

AL length was found to be in a range of 2.4–6.6 mm. The mean length of the AL was 3.3 ± 0.63 mm. AL was longer

Table 1: Represents the prevalence of the anterior loop of mental nerve

Anterior loop (sides)	*n*	%
Right	16	29.1
Left	13	23.6
Bilateral	26	47.3
Total	55	100

on the right side than on the left side [Graph 3]. The length of the AL was found to be more in males than the females, i.e., 3.46 ± 0.865 mm in males and 3.2 ± 0.6 mm in females. However, this difference in the measurement was not statistically significant ($P > 0.05$).

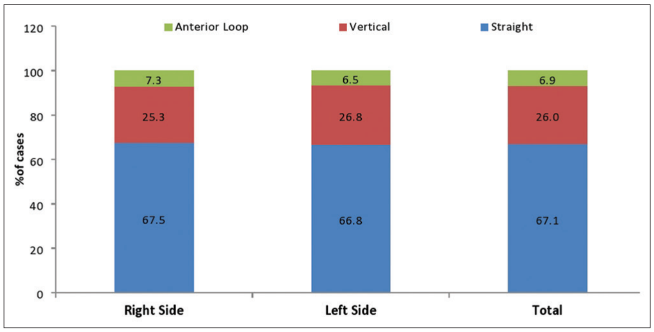
Of the 55 ALs identified, the distance of the AL from the BCP, LCP, and IBM was also calculated. The distance between the AL and BCP was 2.27 ± 0.94 mm on the right side and 2.43 ± 1.36 mm on the left side. The distance of AL from the LCP was 4.50 ± 1.83 mm on the right side and 4.35 ± 1.44 mm on the left side. The distance of the AL to IBM was 10 ± 1.84 mm on the right side and 10 ± 1.93 mm on the left side. The distance between the AL to BCP, LCP, and IBM was not significantly different in terms of sides. The mean distance from the AL to IBM was 10.18 ± 1.805 mm in males and 8.07 ± 1.9 mm in females, respectively. The mean distance from the AL to IBM was found to be significantly higher in males compared to females ($P < 0.05$ for both). These findings were analysed according to the age of the patient [Graph 4].

Discussion

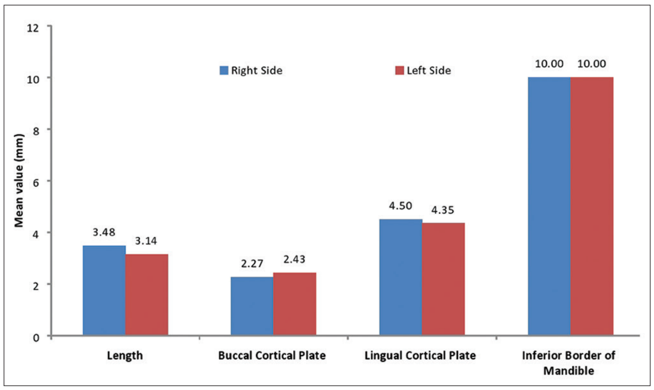
Various studies have been done to determine the different patterns of MN. Many authors have used panoramic radiography to assess the different patterns of MN into straight, perpendicular, and vertical patterns.[5] Al-Mahalawy *et al*.[8] have classified the patterns into linear, perpendicular, and anterior looping.

In the present study, the straight pattern (67.1%) was the most common pattern, followed by the vertical pattern (26%) and AL (6.9%). Al-Mahalawy *et al*.[9] assessed 302 CBCT scans and found linear (straight) patterns in 46.2% of cases followed by perpendicular patterns (vertical) in 38.6%. Sahman and Sisman[5] assessed 494 patients and observed vertical pattern in 34.6% of images, straight pattern in 34.1% and ALs was detected in 28.5% of the cases. However, the study carried out by Demir *et al*.[9] who studied 279 CBCT scans found that the most common pattern was type 3 (AL – 59.5%), followed by type 2 (vertical – 31.9%) and type 1 (straight – 8.6%), which showed a contrast result to the present study.

Studies conducted by Rodrigues Genú *et al*.,[10] Najm *et al*.,[11] Panjnoush *et al*.,[12] Eren *et al*.,[6] do Nascimento *et al*.,[13] and Apostolakis and Brown[4] have given a special emphasis on the prevalence of AL using CBCT. Rodrigues Genú *et al*.,[10] conducted a study on 143 CBCT scans and AL was visualised in 18.9% of the images, and Sinha *et al*.,[14] observed AL in 97 scans



Graph 1: The prevalence of different patterns of mental nerve

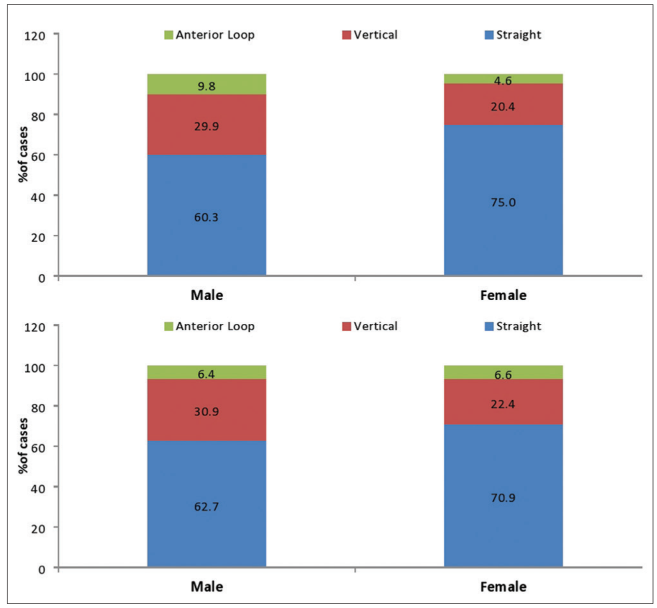


Graph 3: The distribution of the mean of various measurements of the anterior loop to reference points on the mandible according to sides

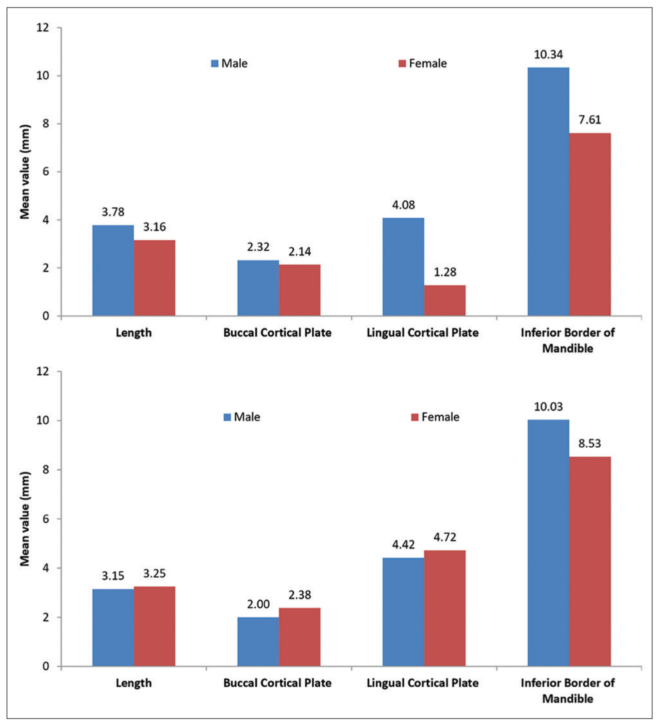
(9.7%) of 1000 scans. Al-Mahalawy *et al*.,[9] observed AL only in 15.2%. These studies showed a low prevalence, similar to the present study. Siddiqui *et al*.,[15] and do Nascimento *et al*.,[13] visualised AL 37.3% and 41.6% of scans. Similarly, Apostolakis and Brown,[4] Najm *et al*.,[11] and other authors have reported a higher prevalence of AL, ranging from 48% to 86%.[12,16,17]

The wide range of current values in the literature may be attributed to interindividual anatomical variability associated with gender, age, and race and the use of different measurement techniques. Another relevant factor could be the degree of cortication since it is related to the canal visibility. Better cortication may lead to improved visibility and better visualisation of the canal.[13] The degree of resorption of the mandible dictates the visualisation of the canal on the radiographic examination. The visibility of ALs reduced as the age of subjects increased. As the age advances, there is a marked increase in resorption and the marrow space enlarges, and disordered trabeculae are often seen, affecting the identification of the AL.[18]

The study conducted by Najm *et al*.,[11] Siddiqui *et al*.,[15] Ritter *et al*.,[19] Todorovic *et al*.,[17] and Sinha *et al*.[14] showed a higher AL prevalence in males than in females, similar to the present study. However, the study conducted by Rodrigues Genú *et al*.[10] and Eren *et al*.[6] showed a higher prevalence of AL in females than males which was in contrast to the present study.



Graph 2: The prevalence of different patterns of mental nerve according to the sides (right and left) and gender



Graph 4: The distribution of the mean of various measurements of the anterior loop to reference points on the mandible, according to gender and sides (right and left)

The varied observations found in different studies could be due to the ethnic differences and genetic constitution among the genders.

Various authors such as Rodrigues Genú *et al*.[10] and Najm *et al*.[11] had carried out studies to assess the prevalence of AL based on sides. These studies showed AL to be prevalent on the left side which is in contrast to the present study, as more ALs were seen on the right side. Ngeow *et al*.[18] showed more bilateral ALs than any other study.

Studies conducted by Rodrigues Genú *et al*.[10] and Eren *et al*.[6] found the mean length of AL to be 3.14 mm ± 1.25 mm and 2.9–3.3 mm (mean, 3.15 mm). Apostolakis and brown conducted CBCT study which showed the mean length of AL to be 0.89 mm. Puri *et al*.[17] found that the mean value of the AL was 1.07 mm ± 1.42 mm. The mean length of the AL found in the present study was 3.3 mm, a value close to that has been reported in the literature. The longest AL observed in the present study was 6.6 mm. Despite being clinically relevant in extent, this length was far lower than the maximum length of 11 mm reported by Neiva *et al*.[20]

Not many studies were found in regard to various parameters related to AL. The study conducted by Eren *et al*.[6] found that the distance between the AL to BCP was 1.9–2.54 mm (mean, 2.24 mm), AL to LCP was 3.8–4.9 mm (mean, 4.24 mm), and AL to IBM was in the range of 8.2–9.0 mm (mean, 8.63 mm), which was similar to the present study. Another study conducted by Najm *et al*.[14] considered the similar parameters and found that the mean distance between AL to BCP was 1.06 ± 0.3 mm, AL to LCP was 4.25 ± 0.4 mm, and AL to IBM was 7.69 ± 0.9 mm. These values were found to be slightly lower than in the present study. It is found that the distance of the AL from BCP, LCP and IBM was slightly larger in males than females. The possible cause for this variant finding in males could be due to the larger volume of the mandible, greater height and buccolingual width of the mandible.[9] The length of AL was found to be significantly longer in males than females. Also, race related physique could be an important influencing factor while considering the length of AL.[21]

Conclusion

The parameters discussed in the study help to determine the morphology, course, and exact location of the mandibular canal and mental foramen which will help in preimplant and presurgical planning. Surgical trauma or injury to the AL of MN is possible during implant surgery in the interforaminal area of the mandible if AL is not assessed preoperatively. The length of the AL plays a significant role in the use of tilted implants. The most distal implant should be placed at least 2 mm anterior to the anterior-most portion of the loop to allow for surgical error. In this case, the AL becomes the landmark rather than the foramen itself.[22] Furthermore, the vertical distance below the mental foramen/anterior border must be determined to enable safe sliding osteotomy.[23] Awareness about the AL helps to avoid anatomical risks in the interforaminal region of the mandible. The most important being the possible damage to the AL of the MN.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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