Assessment of the Anterior Loop of Inferior Alveolar Nerve at the Mental Foramen in Jaipur Population – A Comparative Study Using Panoramic Radiograph and Cone Beam Computed Tomography

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Abstract

Introduction: Knowledge of alveolar loop of inferior alveolar canal is important to prevent any post operative complications after mandibular surgery or any prosthesis placement in mandible para symphysis region. The aim of this study was to visualize anterior loop in Jaipur (Rajasthan) population comparing digital orthopantomogram (OPG) radiographs and cone beam computed tomography (CBCT) and the objective was to evaluate the frequency of anterior loop between OPG and CBCT, frequency in different age groups, genders and unilateral and bilateral presence in the mandible.

Material and Methods: The study was done in the Department of Oral and maxillofacial surgery of Jaipur Dental College. A total of 100 panoramic and 100 CBCT radiographs were examined. Anterior loop was examined in all 200 radiographs. The collected data were subsequently processed and analyzed using SPSS statistical package version 20.

Results: CBCT is more reliable as compared to OPG. Anterior loop was most commonly seen in younger age group. As the age advanced visibility of anterior loop was reduced. Bilateral presence was most common.

Conclusion: In the present study, a total of 400 sites were examined on radiographs. Out of 115 male subjects, anterior loop was visible in 64 subjects and out of 85 female subjects, anterior loop was visible in 39 subjects only. A significant value is observed in bilateral presence and decrease in loop frequency with age. With advancement in modern diagnostic tools, it has become an essential part for the clinician to incorporate modern technologies and provide better treatment options to the patient as well as for the clinician to prevent iatrogenic injuries.

Keywords: Anterior loop, Cone Beam Computed Tomography, Inferior Alveolar Canal, Mandible, Panoramic Radiograph.

INTRODUCTION

Oral and maxillofacial region of an individual is one of the most complex anatomical structures of whole body.[1]

Mandible when compared to maxilla is more compact and dense bone. In mandible, mandibular nerve enters through mandibular foramen in mandible. The mandibular foramen is present on the ascending mandibular ramus. As it passes through mandibular canal it is called inferior alveolar nerve (IAN).

It runs downward and forward, generally below the apices of the molar till first and second premolar. Inferior alveolar neurovascular bundle leaves the canal via mental foramen where it splits into two branches, incisive and mental nerve branch. The section of the nerve in front of the mental foramen and just before its ramification to the incisive nerve is called the anterior loop (AL) of IAN.[2]

In Sicher's Oral Anatomy, the anterior loop is described as 'the mental canal which rises from the mandibular canal and runs outward, upward and backward to open at the mental foramen.[3]

The considerable variation in the course, the shape, the curve and the direction of the nerve as well as the terminal segment of IAN complicates the regional anatomy. The anterior loop cannot be seen clinically, but can be detected in radiographs which includes dental panoramic or orthopantomogram (OPG), cone beam computed tomography (CBCT) or magnetic resonance imaging (MRI).[4]

The precise knowledge of mental foramen, mandibular foramen, inferior alveolar canal, mandibular neurovascular bundle is of utmost importance for desired outcome of different types of mandibular surgery, implant or any prosthesis placement in mandible region.[5]

Any surgery in para symphysis region without proper knowledge of anterior loop in that region may cause iatrogenic damage which may result in neurosensory disturbances in the area of lower lip and chin.[6]

Radiographs are the diagnostic tool which provide precise information about the visibility of anterior loop and presence of it as well. Some studies have been done from a few dental institutes in India to evaluate different anatomical variants of anterior loop of inferior alveolar nerve.[6]

However, with the Indian population being heterogenous with a diverse gene pool, different geographic locations may sometimes show slight anatomical variations. Hence, this study is planned and to be conducted with an aim to visualize anterior loop radiographically in Jaipur, Rajasthan which has a population of about 4.2 million people.

AIMS & OBJECTIVES

The aim of this study is to visualize anterior loop in Jaipur (Rajasthan) population on digital panoramic radiographs and cone beam computed tomography and the objective is to evaluate the frequency of anterior loop between CBCT and Panoramic radiograph, in different age groups, genders and unilateral and bilateral presence in the mandible.

MATERIALS AND METHOD

Patients visiting the Outpatient Department of Oral and Maxillofacial Surgery of Jaipur Dental College from 2020 to 2023 will be considered for the study. These individuals were subjected to CBCT and Panoramic radiograph examination for reasons such as presurgical implant planning and third molar impactions.

400 mandibular sites from 200 images (100 Panoramic and 100 CBCT images) of 200 patients were obtained with demographic details.

Panoramic radiographs were obtained from Kodak 8000C (Model OPX105) Digital Panoramic and Cephalometric System using standard exposure parameters (Tube Potential – 73 kV, Tube current – 12 mA, Total filtration-2.5 mm, Time- 13.9 sec) as recommended by the manufacturer.

CBCT radiographs were obtained from Carestream CS8200 3D machine using Field of view (FOV: 12x5cm), Voxel size: 150. Operating parameters were at 4.00 mA, 90 kV and exposure time set at 20.0 seconds.

All radiographs were made and evaluated in the same manner.

Inclusive Criteria –

1. Patients from the age group of 16 and 65 years.
2. No pathology that could affect the position of the mandibular canal and mental foramen.
3. No evidence of any trauma or surgery that could affect the position of the mandibular canal and mental foramen.
4. Adequate quality of images.
5. Patients who are predominant residents of Jaipur.
6. Dentulous patients.

Exclusive Criteria –

1. Presence of systemic diseases.
2. Pregnancy/ Lactating patients.
3. Patients undergoing radiotherapy.
4. Presence of implants or mental artifacts in foramen region.
5. Edentulous patients.

Parameters

1. Frequency of anterior loop in Panoramic and CBCT.
2. Visibility of anterior loop according to age group

   Age Group categories (16-25, 26-35, 36-45, 46-55, 56-65)
   - Present
   - Absent
3. Number of subjects with anterior loops according to sex
   - Male
   - Female
4. Age – Gender Distribution
5. Visualization of anterior loop
   - Only on Right side
   - Only on Left side
   - Present on Both sides
   - Absent

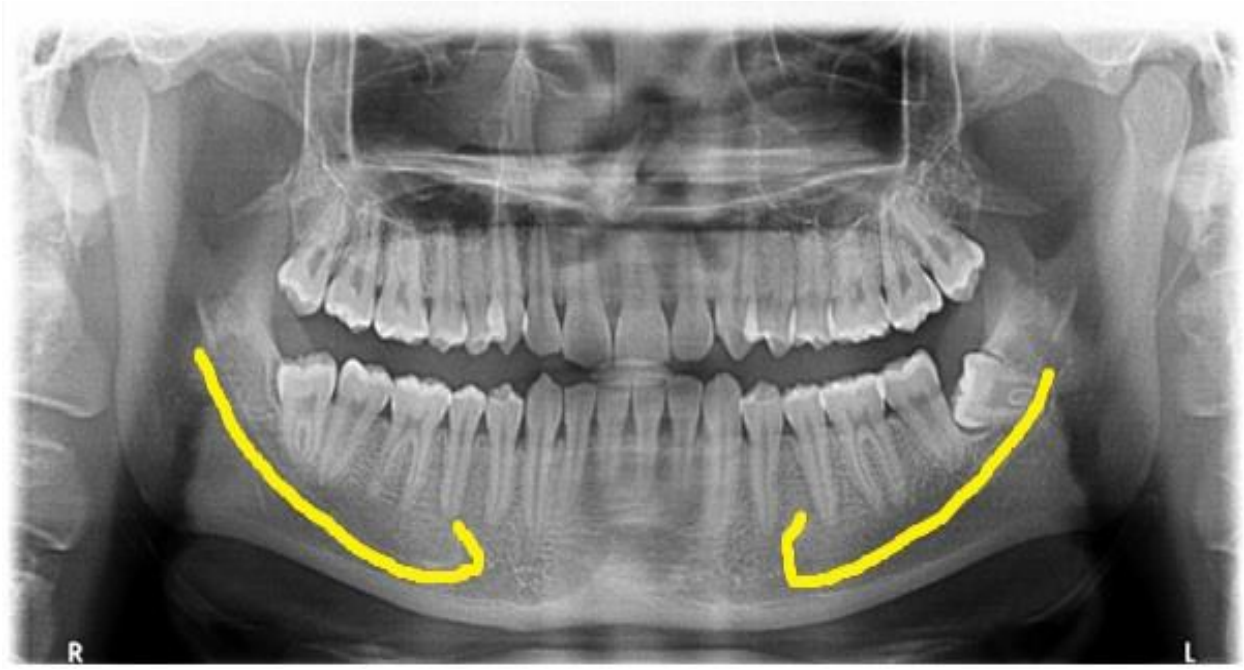


Figure 1: Visibility of anterior loop in Panoramic Radiograph.

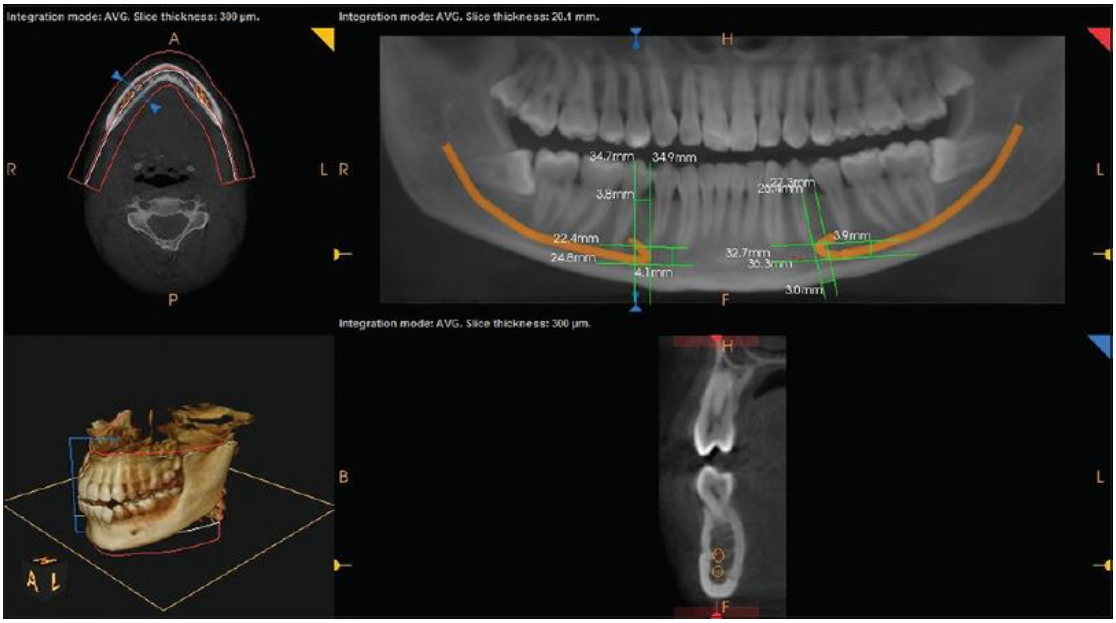


Figure 2: Anterior loop in CBCT showing three linear measurements with 3D reconstruction.

STATISTICAL ANALYSIS (SPSS PACKAGE Version 20.0)

Table 1: Chi-square test for frequency of anterior loop in Panoramic and CBCT

Frequency	Present	Absent	Row total
CBCT	68 (51.50) [5.29]	32 (48.50) [5.61]	100
OPG	35 (51.50) [5.29]	65 (48.50) [5.61]	100
Column Totals	103	97	**200 (Grand Total)**

The chi-square statistic is 21.7996. The p-value is < .00001. The result is significant at p < .05.

Table 2: Chi square test for number of subjects with anterior loops according to sex

Gender	Total	Present	Absent	Row totals
Male	115(115.00) [0.00]	64 (59.22) [0.38]	51 (55.78) [0.14]	230
Female	85 (85.00) [0.00]	39 (43.78) [0.52]	46 (41.22) [0.55]	170
Column Totals	200	103	97	**400 (Grand Total)**

The chi-square statistic is 1.8677. The p-value is .393034. The result is not significant at p < .05.

Table 3: Chi square test on Visibility of anterior loop according to age group

Age Group	Present	Absent	Row Totals
16-25	18(22.14) [0.78]	25 (20.86) [0.82]	43
26-35	40 (32.44) [1.76]	23 (30.56) [1.87]	63
36-45	20 (21.63) [0.12]	22 (20.37) [0.13]	42
46-55	14 (14.94) [0.06]	15 (14.06) [0.06]	29
56-65	11 (11.84) [0.06]	12 (11.16) [0.06]	23
Column Totals	103	97	**200 (Grand Total)**

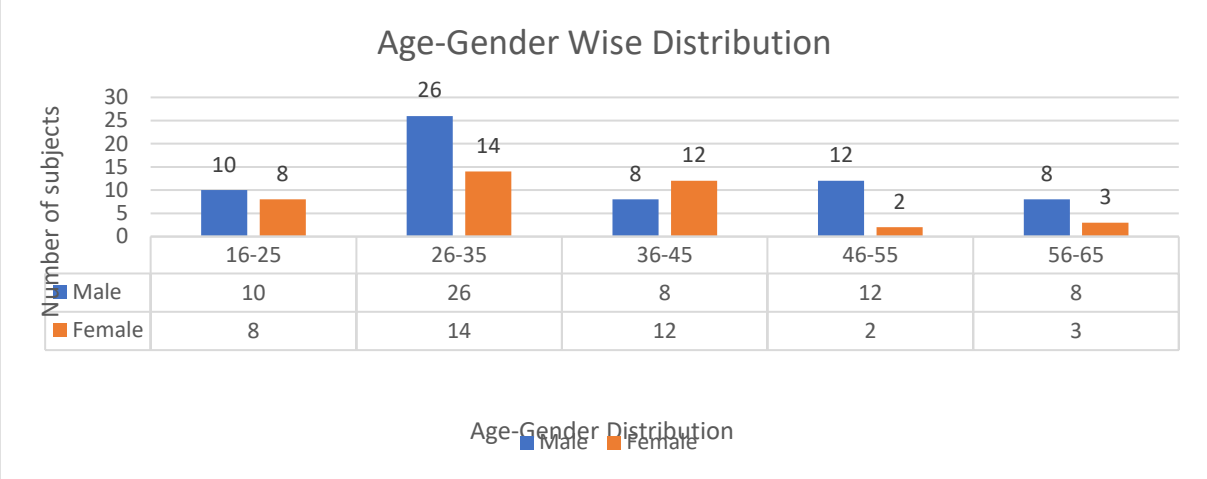
The chi-square statistic is 5.7252. The p-value is .220633. The result is not significant at p < .05.

Table 4: Chi square test for Visualization of anterior loop according to site

Site	Present	Absent	Row Totals
Right Unilateral	7 (49.70) [36.68]	96(53.30) [34.20]	103
Left Unilateral	3 (49.70) [43.88]	100 (53.30) [40.91]	103
Present bilaterally	93 (49.70) [37.73]	10 (53.30) [35.18]	103
Absent bilaterally	90 (43.91) [48.39]	1 (47.09) [45.11]	91
Column Totals	193	207	**400 (Grand Total)**

The chi-square statistic is 322.0844. The p-value is < 0.00001. The result is significant at p < .05.

Chart 1: Age-Gender distribution



RESULTS

200 radiographs were evaluated, out of which 100 were panoramic radiograph and 100 CBCT images. A total of 400 hemimandible sites were examined for the presence of anterior loop of inferior alveolar nerve at the mental foramen. We found that anterior loop was visible in 51.5% of studied population.

Frequency of anterior loop was more significant in CBCT radiograph as compared to Panoramic radiographs (Table 1).

Out of the 115 males and 85 females, Male to Female ratio was not significant (Table 2).

Breakdown of subjects into various age groups shows maximum number of subjects is in age group 26-35 (40 subjects) followed by 36-45 (20 subjects), 16-25 (18 subjects), 46-55 (14 subjects) and minimum number of subjects is in 56-65 group (11 subjects) as presented in (Table 3).

According to site, presence of anterior loop on bilaterally sites were most common (Table 4) and Chart table 1 shows the age gender distribution with higher frequency in age group 26-35 which shows decreasing frequency of anterior loop with increase in age.

DISCUSSION

Anterior loop is an important anatomical landmark in mandible region which is often overlooked because of negligence or due to poor visualization of anterior loop or lack of knowledge about anterior loop among various radiologist and surgeons.

However, of late with the advent and increase in popularity of dental endo-osseous implants, this structure has generated interest among clinicians. To avoid any inadvertent damage to anterior loop which may lead to neurosensory disturbances, a 5 mm distance to most distal fixture from anterior loop has been proposed by Suneetha et al (2021) in the south Indian population of Guntur, Andhra pradesh.[22]

Dentate subjects only were included in this study because it has been observed in studies conducted by Kuzmanovic et al that due to poor bone quality in edentulous patients, visibility of anterior loop is extremely difficult.

Also, as the age advances in edentulous patients, resorption of alveolar ridge in edentulous patients may progress to such an extent that mental canal is also resorbed and mental neurovascular bundle is exposed.[23]

Similar study conducted in 2003 by Kuzmanovic et al. on 22 cadavers, the prevalence in OPG was (27%) and the length was ranged between (0.5-3 mm) while in dissected cadaver was present in (35%) and length measurements was (0.4- 3.31) mm. Jacobs et al. in 2004 used OPG only to evaluate the prevalence of anterior loop and the result was 11%.The prevalence was higher and this is due to high accuracy of CBCT (3D) compared to OPG (2D).[23,24]

Lower percentage of anterior loop was noticed with radiographical studies using OPG such as (Kaya , 2008 and Ngeow, 2009) 28% and 40.2% respectively. This due to small sample size and low accuracy of 2D (OPG) compared to the present methods using CBCT and large sample size.[25,27]

Uchida et al. in 2009 performed another study to compare the accuracy of CBCT with that of direct surgical exposure of cadavers and concluded that CBCT was more reliable, and recorded a mean length of 2.2 mm and diameter was 1.9 ±1.7 mm.[26]

Similar to other studies that has been reported in literature, this study also shows that detection of anterior loop has proven to be more superior in cone beam computed tomography as compared to panoramic radiographs and there is no definite significant values in comparison with gender and sex. However more prevalence of anterior loop in age group of 26-35 has been observed in this study which shows more co-relation with the study done by Alok et al in Darbhanga population study in Bihar with prevalence in 20-29 age group as compared to 41-60 age group observed in Suneetha et al in the south Indian population. [22,28]

CONCLUSION

With drastic progression in dental sciences, it has become paramount for a good clinician to utilize modern technologies to keep ahead in modern times. This study also shows that there can be slight variations in prevalence of AL in different age groups according to geographic regions. However more studies need to be done with larger study groups to make a definitive conclusion.

Hence, in any procedure and more specifically relating to dental implants involving the mental foramen area, an ideal radiographic evaluation with Cone beam computed tomography to identify and assess the nerve should be mandatory to prevent unwanted neurosensory complications.

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