

A Radiographic Study on the Visualization of Anterior Loop in dentate subjects using Orthopantomograph - An Original Research

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Abstract

Aims and Objectives: The aim of this study is to visualize the anterior loop, which is an anatomical variation of the inferior alveolar canal, wherein the canal proceeds anteromedially creating a loop before exiting through the mental foramen. This study was conducted using orthopantomographic radiographs and the objective was to evaluate the frequency of anterior loop in different age groups and gender.

Materials and methods: A total of 215 OPGs were analysed to check for the presence of the anterior loop. They were traced to identify the extent and prevalence in

relation to the side, age and sex and whether it is seen unilaterally or bilaterally.

Results: It was found that the loop was present in 33% of the OPGs. Unilateral occurrence accounted to 58%, only a quarter of which was noted in the right side. Also, it was noted more in males.

Conclusion: There was a higher prevalence of anterior loop unilaterally, more on the left side, frequently observed in the male of the middle aged population.

Clinical significance: Locating the anterior loop is an essential step for placing implants in the interforaminal region. Understanding the prevalence and course of the

anterior loop can prevent any inadvertent damage to the inferior alveolar nerve.

Keywords: Orthopantomograph, anterior loop, mental foramen, inferior alveolar canal, anatomical variation

Introduction

Over the course of years, the anatomy of the face has been a dynamic region in which a lot of changes have been noted as a part of evolution. ⁽¹⁾ The inferior alveolar nerve, a branch of the mandibular division of the trigeminal nerve, is an important structure as it supplies all the mandibular teeth and its associated structures.

The inferior alveolar nerve and blood vessels enter the mandible through the mandibular canal, maintaining an intraosseous course as it supplies the posterior teeth and then it terminates by branching out to give the incisive nerve, that supplies the anterior teeth and exits the mandible through the mental foramen as the mental nerve. ⁽²⁾ This foramen is mostly located between the roots of the first and second premolars. The mental nerve supplies the somatic afferent fibres to the gingiva which are anterior to the premolars, lower lip and chin. ⁽³⁾

Thus, any damage to the inferior alveolar nerve can lead to the loss of sensation to all the mandibular teeth and the related structures, which makes the understanding of the nerve and its ramifications very important. ⁽¹¹⁾ However, a dissimilitude of the inferior alveolar canal, called the anterior loop, is noted routinely in the literature.

The anterior loop is where the mental neurovascular bundle crosses the mental foramen anteriorly and then double backs to exit the same. Although it not seen clinically, it is often noted in the OPGs and other radiographic methods. Visualizing the anterior loop can also help overcome the failure of anesthetization in the anterior teeth ⁽⁴⁾ and for paraendodontic surgeries. ⁽⁵⁾ Hence, this study focuses to discern the Anterior Loop in

dentate subjects of different age groups and gender by using orthopantomograph with respect to the south Indian population.

For doing this study Orthopantomographs were studied as they are extensively used in dentistry. They also have some added advantages of being readily reproducible, consuming much lesser time for the entire process and also causes minimal radiation exposure. ⁽⁶⁾

Materials And Methods

This study was conducted in the Department of prosthodontics in Sri Venkateswara Dental College and hospitals. The study was approved by ethical committee of the institute.

An observational, retrospective study was carried out through OPGs that were selected of patients who had various complains like periodontal pathologies, TMJ problems, impacted third molar, mal-aligned teeth, etc.

A total of 250 panoramic radiographs were obtained from the archives of the college as soft copies.

Panoramic radiographs were obtained from Genoray Papaya Extor-C digital panoramic system using standard exposure parameters (Tube Potential: 66–85 kv, Tube Current: 6–10 mA, Total Filtration: 2.8 mm, time: 12 sec.) The magnification factor for the region from the posterior border of ramus to canine, as reported by the manufacturer, is 1.25.

For taking the OPG, the patients were asked to remove all facial accessories, like spectacles and were provided with a lead apron and/or thyroid collar. Care was taken so that the X-ray generator was not placed way too high at the back of the neck, as it may interfere with the primary beam and image. Next, the patient was made to stand upright such that the frankfort's horizontal plane is parallel to the floor, the midsagittal plane of the patient's face is perpendicular to the floor and the canine light is aligned with the mesial contact of the maxillary canine.

Finally, the patients were asked to keep their maxillary and mandibular teeth in the notch of the bite block, without producing any protrusive movement of the jaw while asking them to stick up their tongue against the palate. Then, adjusting the kVp, mA and exposure time, the OPG is taken. This whole process, including the infection control takes about 2-3 minutes.

The following conditions were considered to provide unimpeded access to the anterior loop.

Inclusion criteria

- Images of good quality with respect to contrast.
- Devoid of any jaw lesions and traumatic injuries to the mandible.
- Images without radiographic exposure or processing artefacts.

Exclusion criteria

- Poor quality radiographs
- Patients under root canal therapy in the premolar region, in order to avoid the hindrance caused by any associated radiopacity in their roots.
- Presence of processing artefacts
- Presence of fracture in maxilla or mandible
- Presence of any pathology in maxilla or mandible.

Finally, out of 250 OPGs 215 were selected and used for the study.

The radiographic image of the mandibular canal is a dark linear shadow with thin radiopaque superior and inferior borders, cast by the lamella of bone that bounds the canal with the mental foramen, usually being the anterior limit of the same. ⁽⁹⁾

The inferior alveolar canal was traced in every OPG in order to determine the presence of the anterior loop. They were classified into 2 main categories: Presence of anterior loop and absence of the same (Fig 1). If present, the OPGs were further classified into Unilaterally present and bilaterally present (Fig 2). Furthermore, they

were divided based on the side- Right side (Fig 3) and Left side (Fig 4).



Fig 1: Absence of anterior loop



Fig 2: Bilateral presence of anterior loop



Fig 3: Right sided, Unilateral presence of anterior loop



Fig 4: Left sided, unilateral presence of anterior loop

Results

Out of the 215 OPGs selected, the anterior loop could be identified in 72 of them, accounting to 33% of the total number.

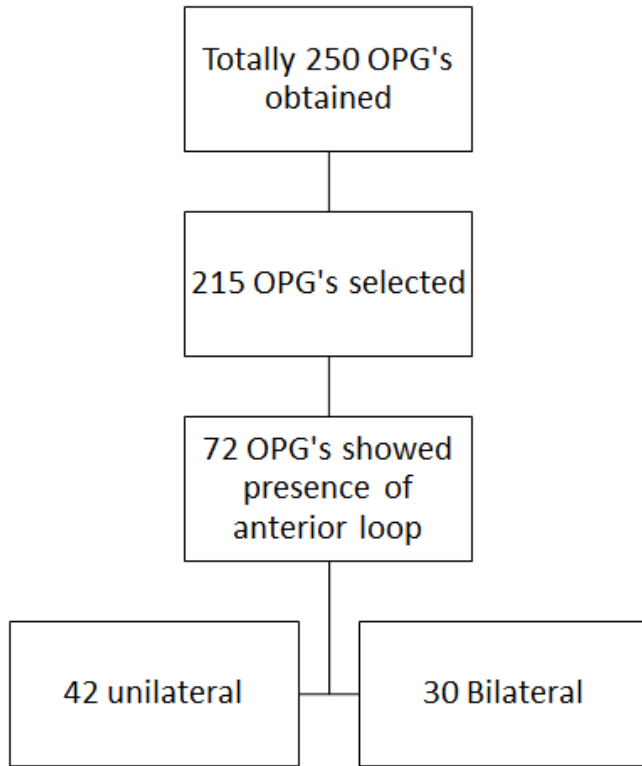
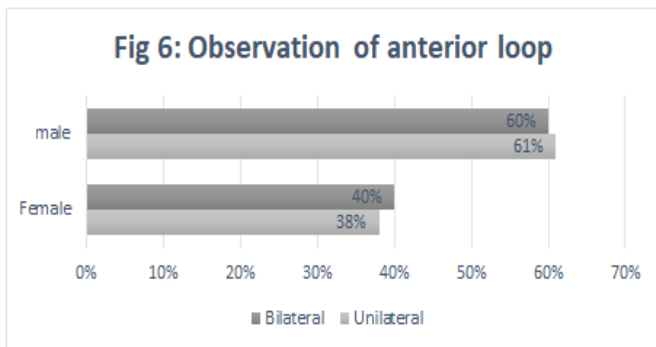


Figure 5: Prevalence of anterior loop

42 out of the 72 OPGs had the presence of the anterior loop unilaterally accounting to 58% of the total. Interestingly, the anterior loop was more prominent in men, whether unilateral or bilateral, reaching over 60%.



Also, the anterior loop was observed more on the left side.

Table 1: Comparison based on gender, for the bilaterally present anterior loop

| Occurrence | Frequency | Total count | Percentage |
|------------|-----------|-------------|------------|
| Bilateral | 30 | 72 | 41.6% |
| Male | 18 | 30 | 60% |
| Female | 12 | 30 | 40% |

Table 2: Comparison based on gender and side, for the unilateral presence of anterior loop

| Occurrence | Frequency | Total count | Percentage |
|------------|-----------|-------------|------------|
| Unilateral | 42 | 72 | 58.3% |
| Male | 26 | 42 | 61% |
| Female | 16 | 42 | 38% |
| Left side | 32 | 42 | 76% |
| Right side | 10 | 42 | 23% |

Furthermore, the age-wise depiction of the anterior loop was recorded to study for any possible correlation between the age of the patient and visibility of the anterior loop.

Table 3: Age-wise visibility of anterior loop

| Sn. | Age group | Total opg's studied | Presence of anterior loop | Unilateral occurrence | Bilateral occurrence | Percentage of population in which anterior loop is observed |
|-----|-------------|---------------------|---------------------------|-----------------------|----------------------|---|
| 1 | <20 years | 42 | 18 | 12 | 6 | 42% |
| 2 | 20-30 years | 60 | 21 | 9 | 12 | 35% |
| 3 | 30-40 years | 54 | 18 | 11 | 7 | 33% |
| 4 | 40-50 years | 50 | 13 | 8 | 5 | 26% |
| 5 | >50 years | 9 | 2 | 2 | 0 | 22% |

Discussion

The mental foramen is an essential landmark for carrying out many non-surgical and surgical procedures like bone harvesting for mental grafts and hemimandiblectomy. (7) It is especially important in placement of interforaminal implants, as inaccurate information of the nerve can jeopardise the minimum safety margin, leading to improper sensory perception. (11) However, a lot of variations are noted in the course of the inferior dental nerve, which makes its speculation even more challenging. (9)

The mental foramen is often difficult to view in a panoramic radiographs due to various reasons like obstruction of undeveloped tooth buds or due to processing errors like dark radiography, light radiography or due to the structures like the trabeculae of the bone or thin mandible. (8)

Anterior loop is an important anatomical landmark in mandibular region which is often overlooked either because of negligence or poor visualization or even due to lack of knowledge among various radiologist and dentists. However, of late, growing interest has been shown in this structure with the increase in popularity of dental endosseous implants.

To avoid any inadvertent damage to anterior loop which may lead to neurosensory disturbances, a 5 mm distance to the most distal fixture from anterior loop has been proposed. (6)

The result of present study showed that anterior loop was visible in 33% of 215 subjects. This result coincides with the observation made by Ngeow et al who found that the loop was visible in 40.2% of 240 radiographs studied. But studies conducted by Yosue and Brooks et al, Jacobs et al and Arzourman et al showed lower percentage of visibility of anterior loop of 21% of the 297 radiographs studied, whereas other studies showed a prevalence of just 1% and 12%. (7,8)

The anterior loop was observed in 72 patients (33% of 215 patients). Out of which, 30 were of bilateral occurrences (42% Of 72 patients) and the remaining were unilateral, i.e., 42(58% Of 72 patients). The gender wise distribution was 28 females and 44 males.

Higher visibility of anterior loop may be due to use of new panoramic imaging system having high resolution radiographs. Panoramic radiographs were selected for the present study owing to its popularity and it's cost effectiveness; also, larger areas can be compared bilaterally at the same time with additional advantage of its ease of availability. Difficulty in visualization of

anterior loop may be due to presence of relatively thick cortical plates or due to error in patient's head positioning which results in object being outside the plane of focus (focal trough).

It is also observed that the visibility of anterior loop gradually decreases as age of subjects increased. (Table 3) This finding was common with the observation made by Ngeow et al. This might be due to the fact that with age, the bone undergoes various qualitative and quantitative changes with an increase in cortical bone porosity and resorption of haversian canals which can result in enlargement of the marrow spaces. Thus, bone remodeling with advancing age leads to changes in trabecular pattern, which in turn affects the visibility of anterior loop.

Only dentate subjects were included in this study as it has been observed 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.

Conclusion

Dentistry is advancing at an extremely fast pace in recent years. Many new treatment modalities are coming every day with new materials and prosthesis. Diagnostic radiology is also making progress in leaps and bounds. With new imaging modalities coming up, it is very important for dentists to properly examine the area of surgery with thorough knowledge of all anatomical landmarks and the possible deviations in the concerned area, so that it will be beneficial to both, the patient and the dentist. In the present study, anterior loop was found in 33.4% of population and it was also observed that with age, the visibility reduced. However, further studies

are recommended with larger sample size, so that visualization of the anterior loop can be more thoroughly evaluated.

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