Visibility of Mandibular anatomical landmarks in Orthopantamogram - A Retrospective Study

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ABSTRACT

AIM: To assess the visibility of mandibular anatomical landmarks in orthopantomograms.

OBJECTIVE: To determine the frequency, visibility and gender variations of Mandibular anatomical structures such as mental foramen,incisive canal, anterior loop of mental nerve, and mandibular canal in different age groups using Orthopantamograms.

BACKGROUND:- Panoramic radiography has become a commonly used imaging modality in dental practice and it can be considered as one of the important diagnostic tool in dentistry.Orthopantamograms are used for producing a single tomographic image of facial structures, which includes the maxillary and mandibular arches and their supporting structures. For a Successful interpretation of panoramic radiographs understanding of the normal anatomy of the head and neck is very essential. OPG has been recommended as the primary radiographic investigation of choice in the pre-operative assessment of the mandibular teeth and their surrounding structures.

REASON: Orthopantamograms provides a better information of anatomical landmarks of both maxilla and mandible.OPGs were checked for the appearance of anatomical structures in the mandibular region for implant planning and also in various other surgical procedures. Hence it is important to know about the variations in the visibility of anatomical structures in radiographs since it serves as valuable tool for treatment planning.

KEYWORDS: Anatomical landmarks, Orthopantamograms, panoramic radiograph, maxilla, mandible

INTRODUCTION

Pantamography is one of the frequently used radiographic technique in dentistry, for producing a single image of facial structures that includes both maxillary and mandibular dental arches and their supporting structures. This provides numerous anatomic relationships in the image that are not found in any other kind of radiographic projection. It is mainly used to estimate the anatomical and structural relationship of mandibular canal, anterior loop of mental nerve, incisive canal, and mental foramen.

Mandibular canal is an important landmark that should be considered before any surgery in the posterior mandible. It is also crucial to locate the mandibular canal and other associated anatomical landmarks for implant surgery.Preoperative radiological diagnosis can provide the exact location of the mandibular canal and thus prevent complications during any surgical procedures.The course of the mandibular canal has been investigated in several studies, and frequent anatomic variations have been found in the intrabony course of the inferior alveolar Further, the radiographic appearance of the mandibular can be variable.

The visibility of the mandibular canal may vary significantly, even within the same individual.9-11 Wadu et al11 found that in a reasonable number of cases, the radiopaque border is disrupted in radiographic images, and it is invisible in some other cases. The mandibular canal is usually formed by a thin trabecular bone with many circumferentially located voids, and there is a thin layer of cortical bone in only a few mandibles.12,13 Radiological analyses have suggested a correlation between alveolar bone quality and the presence of the mandibular canal wall.14

Panoramic imaging is also called pan tomography. [1]. certain peculiarities of the panoramic system result in unique projection of many anatomic structures in the image [2]. [3]. Placement of mandibular endosseous implants can be problematic especially in the area of neurovascular bundles. The complications, such as altered sensation, numbness and pain, often occurred if these vital structures, such as inferior alveolar nerve (IAN) and mental foramen (Figure 1), incisive foramen (Figure 1) if they are not properly identified. Hence, it is critical to determine the location and configuration of the mandibular canal (MC) and related anatomical structures so these types of damages can be minimized [4]. The mental canal (Figure 2) which rises from the mandibular canal and runs outward, upward and backward to open at the mental foramen has an anatomical variation called anterior loop (Figure 3). Prevalence of the anterior loop is quite variable in literature, occurring in between the range of 28% and 71% [5].

MATERIALS AND METHODS

This study consisted of 150 randomized digital OPG which was stored as soft copies in the extraoral radiographic machine in the Department of Oral Medicine and Radiology of saveetha dental college. The radiographs were selected based on the following criteria.

Inclusion criteria

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

Exclusion criteria

- Poor quality radiographs
- Presence of processing artifacts
- Presence of jaw fracture in mandible
- Presence of any pathology in the mandible.

The radiographs were randomly selected between the age of 20 and 50 years. All radiographs were taken with a digital machine.The mandibular anatomical structures such as mandibular canal, anterior loop of mental nerve, mental foramen, and incisive canal were analyzed. A four-point grading scale was used to note the visibility of these landmarks.

- Good (Above average)
- Moderate (Average)
- Poor (Below average)
- No visibility (not seen).

Statistical analysis

Observed data were recorded and analyzed using statistical software. The observations were blinded by single and double observers and calculated using statistics which showed good agreement with both the observers. Chi-square test was done to note the relationship of age and gender with visibility.

RESULTS:-

Table-1

Anatomical landmarks	Total visibility
Mental foramen	81
Incisive canal	69
Mandibular canal	79
Anterior loop	29

Table-2

Anatomical landmarks	Male	Female
Mental foramen	38	43
Incisive canal	33	36
Mandibular canal	47	42
Anterior loop	15	14

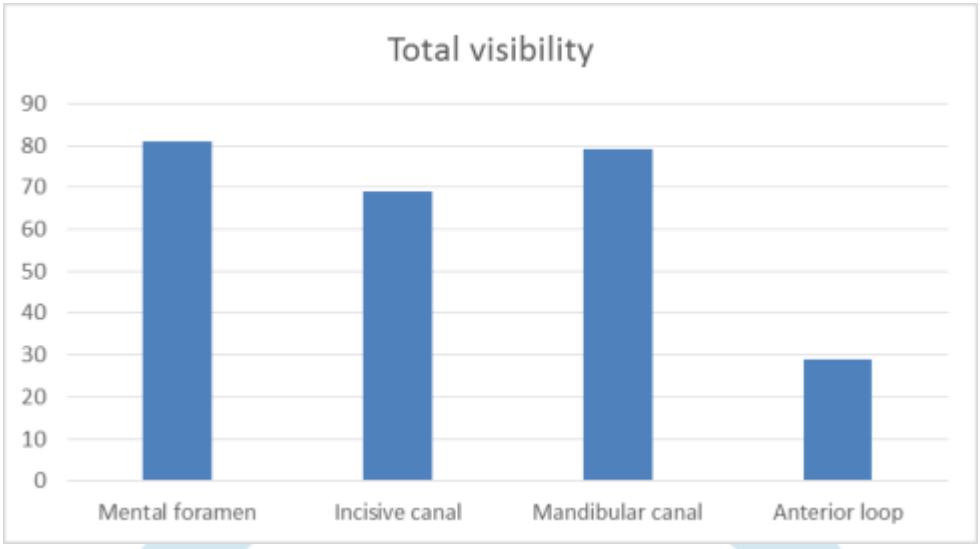
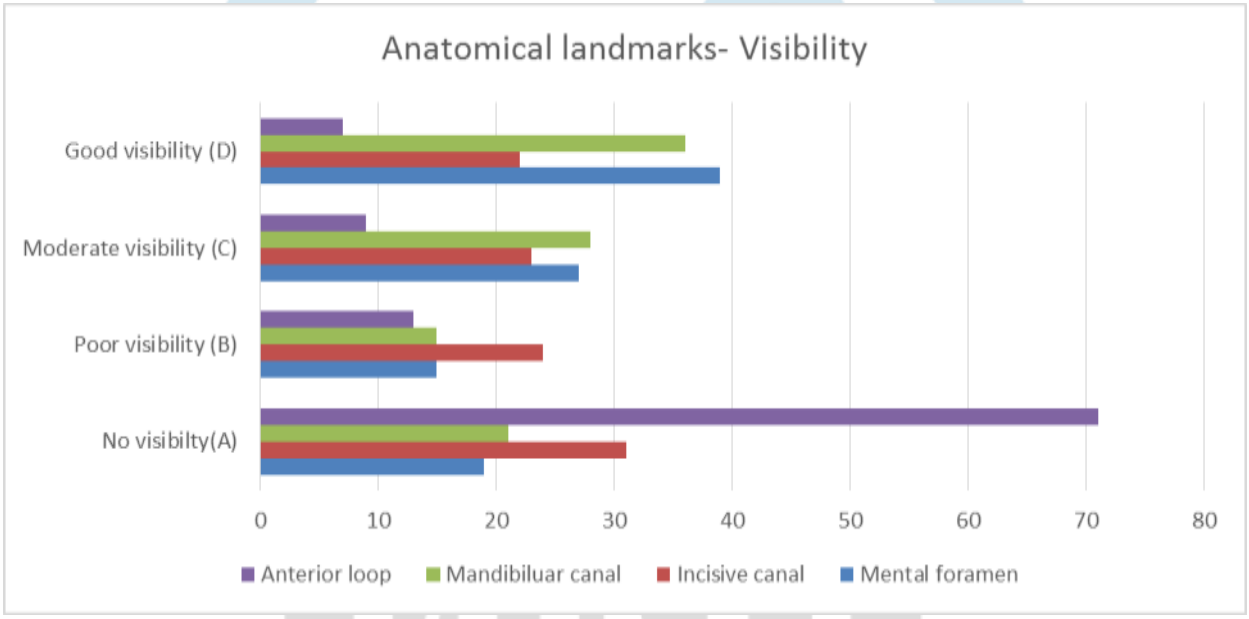


Figure-1



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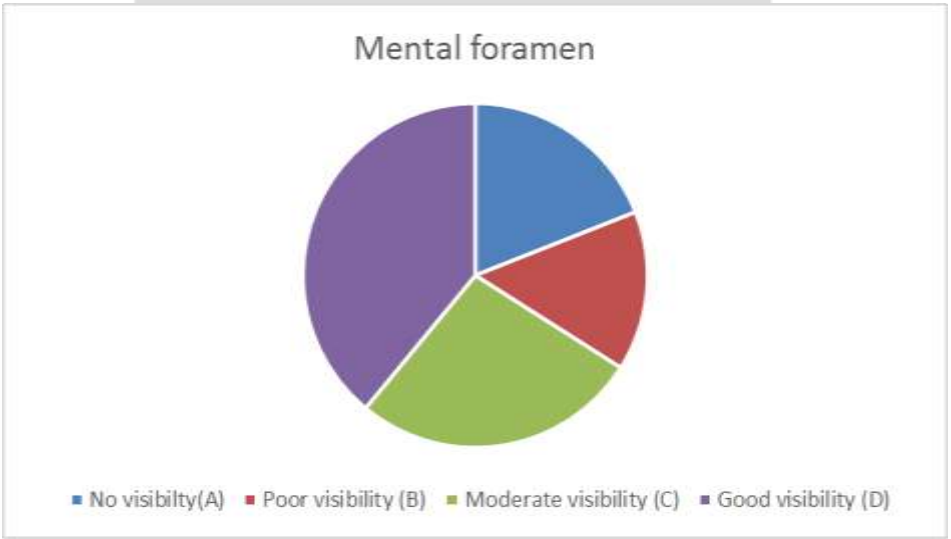

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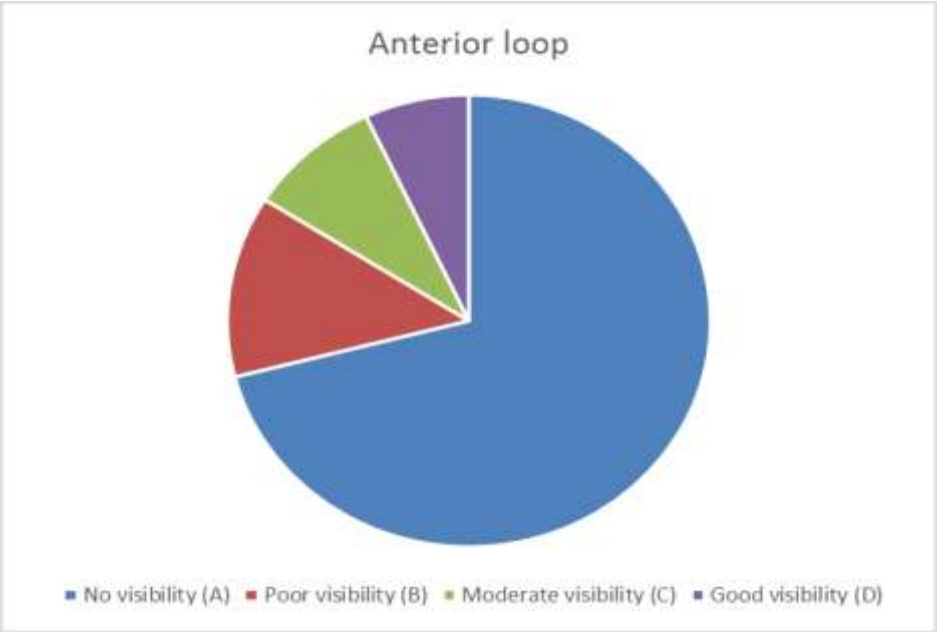

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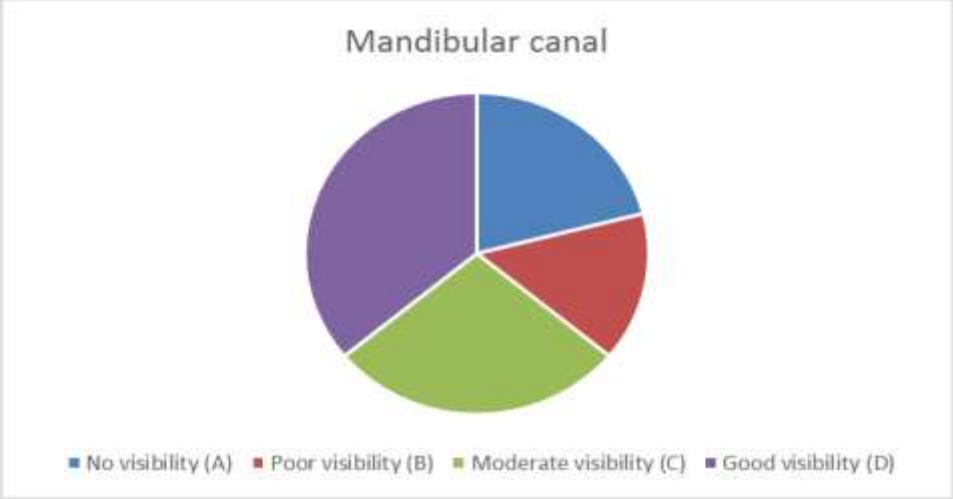

Figure-5

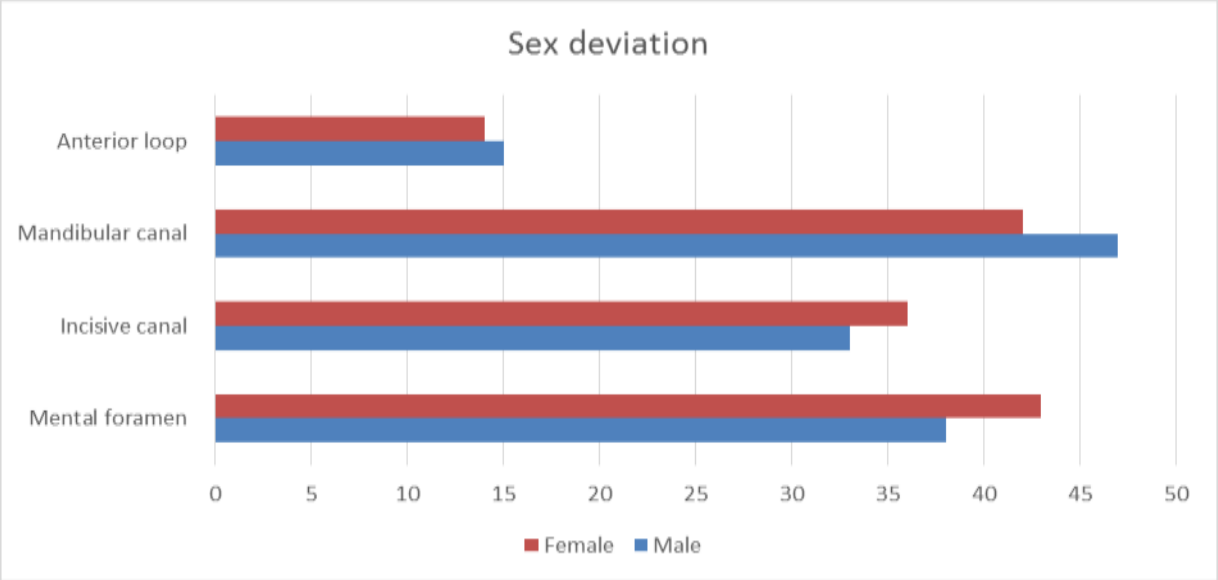

Figure-6

Out of 100 cases, mandibular canal was visible in 98% [Graph 1 and Table 1] with good perceptability in 34% of the cases [Graph 1 and Figure 1]. In 84% of the cases, anterior loop of the mental nerve was not seen [Graph 1 and Table 1] showing 2% moderate visibility [Figure 1]. In 99% cases [Table 1], foramen mentale was moderately seen [Figure 1]. In 24% of the cases, an incisive canal was observed showing only 1% good visibility [Graph 2 and Figure 2]. Based on sample size and using Chisquare test, gender does not exert effect on the appearance of the anatomical structures in the interforaminal region and also revealed, significant statistical difference existed between visibility and age of mandibular canal and mental foramen with a $P < 0.05$.

DISCUSSION:-

Panoramic radiography has become a commonly used imaging modality in dental practice and can be a valuable diagnostic tool in the dentist's armamentarium. However, the panoramic image is a complex projection of the jaws with multiple superimpositions and distortions which may be exacerbated by technical errors in image acquisition. Furthermore, the panoramic radiograph depicts numerous anatomic structures outside of the jaws which may create additional interpretation challenges. Successful interpretation of panoramic radiographs begins with an understanding of the normal anatomy of the head and neck [6

The mandibular canal is a canal that takes origin in mandibular foramen on the mesial aspect of the ascending mandibular ramus and slants forward and downward in the ramus, then progresses forwardly in the body until foramen mentale which also carries inferior dental nerve.[6,7] The mental foramen is more commonly located at the summit of the second mandibular bicuspid or in between the tips of the bicuspids. Race-related variation is also noted. For instance, it is frequently found at the tip of bicuspids like the second premolar in Chinese subjects. Whereas in Caucasian subjects, it is found between the premolars and by the canine anteriorly or by the f irst mandibular molar posteriorly.[8] The mental foramen is a significant landmark during osteotomy procedures. The inferior dental nerve may seen on medial aspect of the mental foramen and passes far away from it as an anterior loop within the bone that should be considered to prevent injury to mental nerve before performing implant surgery.

In the present study visibility of mental foramen accounts for about 77% visibility which is similar to that of study conducted by Tejavathi Nagaraj et al. in which total visibility was 99% [8]. Visibility of incisive foramen was 25%. One of the most common complications that may occur following the extraction of mandibular third molars is injury to the inferior alveolar nerve canal (IANC). However, the OPG has been recommended as the primary radiographic investigation of choice in the pre-operative assessment of the mandibular third molar teeth and their surrounding structures [9]. OPGs were checked for the appearance of anatomical structures in the mandibular region for implant planning also.

Incisive canal in the mandible is a bilateral canal which passes mesially between lingual and vestibular cortices from both foramen mentale's. It includes nerves and blood vessels which provide innervations to the mandibular incisors, cuspids, and lower first premolar. This area appears to be indistinct and nerve and vascular canals may embrace through a tangle of the intertrabecular meshwork.[12,13]

Multiple studies have measured the length of the anterior loop of the inferior alveolar nerve, using anatomical, radiographically and combined methods. These studies show that the panoramic radiographs do not accurately identify the incidence or the extent of the anterior loop. Wei Cheong Ngeow et al. reported that the anterior loop was present in 40.2% [10] for all subjects, whereas Arzourman et al. [11] and Kuzmanovic et al. [12] reported a lower incidence at 12% and 27% respectively. In the present study it showed good visibility in 20% of cases which is similar to previous studies.

In this current article, OPGs were checked for the appearance of anatomical structures in the mandibular region for implant planning. In 98% of the cases, mandibular canal was visible showing 59% moderate visibility. Jacob et al. also noted mandibular canal in 99% of their cases in their study.[13] In a study by Kamrun et al. noted that the visibility of the superior border was very poorly seen in panoramic images and should be supplemented by three-dimensional computed tomography (CT) images for good visualization. The possible reason could be because as the age advances visibility decreases due to osteoporotic changes in the alveolar bone which reduces the perceptability of mandibular canal.[14] An anterior loop of mental nerve emerges as the mental canal, which begins from the mandibular canal and passes in outer, upper, and backside directions to summit at the foramen mentale. In a study by Solar et al. categorized into two groups, loop and non-loop types depending on the occurrence of loop. Hun et al. in their cadaver study divided the loops into linear (straight) and upright (vertical). The straight pattern was visible as a mild slope of mental canal entering instantly into the foramen mentale and vertical (upright) pattern was visible when it is curved at right angles into the foramen. Literature showed no further radiographic studies on the above-mentioned pattern.[15] Direct radiographs have proven that panoramic radiographic studies are unpredictable in locating the loop. Iyengar et al. in a study noticed a visible anterior loop unilaterally in only 21% of the total images viewed and similarly only 10% appeared in the present study.[16] Different studies have shown that OPGs are considered as unreliable tool in determining the foramen mentale region due to intrinsic drawbacks of imaging plane to record the complete region accurately. Inappropriate postures of persons whom to be exposed also can contribute to the poor visibility.[5,17] Mandibular anterior region is considered as a relatively safer zone for implant placement and length of implant may reach up to the lower cortical border of the lower jaw. However, recent reviews signifies probability of occurrence of complications such as subglossal hemorrhage formation, profuse bleeding, and breathing difficulty in this region.[5,18]

CONCLUSION:-

This study revealed that due to superimposition of various anatomical structures and incorrect patient positioning the visibility of interforamina structures became difficult in the mental region in panoromic images. So for, the better visibility of this mental region and for identification of foramen anatomy precisely for planning implant surgery it may need to be substituted with other imaging modalities such as CT, cone beam computed tomography

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