Detection of Anatomical Discrepancy in Mandible by Digital Panoramic Radiography: A Retrospective Study

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Abstract

Background: The imaging modality that has been converted to a seldom-used in dental practice and can be appreciated diagnostic tools in the dentist's exploitation is panoramic radiography. It is a two-dimensional (2D) image that is steadily used for innumerable investigative tenacities as it provides broad coverage of the maxillofacial region in a single image. To dodge injury to several vital structures in the maxillofacial region, the precise locality of the structures should be recognized prior to any invasive surgical procedures expending apposite radiographic technique.

Aim and objectives: The aims and objectives of this study were to assess the radiographic discrepancy of anatomical landmarks in the mandible on digital radiographs and to define how frequently different maxillofacial structures are perceived on digital panoramic radiography.

Materials and methods: A total of 200 panoramic radiographs were studied for normal anatomical disparities, such as mandibular canal, mental foramen, the anterior loop of mental nerve, and incisive canal. Two autonomous observers assessed the scores recorded and further was tabulated according to the desired criteria.

Results: In the present study, with a trial size of 200, the mandibular canal was evident in 92%. In 3% of the cases, with poor perceptibility anterior looping of the mental nerve was visible. The mental foramen showed good visibility in 77%. In 32% of the cases, the incisive canal was witnessed. The Chi-square test applied displayed the statistical variance considering p value <0.05 as statistically significant value.

Conclusion: According to the results of the present study, it could be established that panoramic radiographs provided sufficient information for mental foramen and mandibular canal. They remain the most essential tools used for assessment of anatomical landmarks and appear to have the best fiscal, edifying process.

Keywords: Anatomical landmarks, Anterior loop of mental nerve, Incisive foramen, Mandibular canal, Mental foramen, Panoramic radiography.

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Introduction

The name panoramic radiography originates from the panorama, which means an unchecked sight of the zone in all mandatory way.[1] Panoramic radiography is the most repeatedly implied imaging choice in a dental practice that can offer the distinguishability of anatomical structures in great deviations of the maxillofacial structures.[2] The informal procedure of panoramic radiographs and the observability of the anatomical structures of the lower jaw are one of the purposes that makes it loftier for its liking.[3] Nevertheless, panoramic radiography is a two-dimensional (2D) imaging modality with little evidence in the buccolingual direction with intensification in equally vertical and horizontal directions.[4]

However, the datum that panoramic imaging is largely used for estimation of the jawbone, preserves the curiosity in defining the reflectivity of functional edifices on these flicks. It is hypothetical that the locality of anatomical structures diverge between various populations.[5] Awareness of the morphological and anatomical variations linked to anatomic landmarks of the mandible is crucial, completely for the inferior alveolar nerve bundle then it occurs in numerous positions and has countless disparities. Individual, sex, race, age, radiologic practice, and the quantity of edentulous alveolar ridge knowingly affect these variations.[6]

With this contextual, the present study was piloted with the aim to assess the radiographic discrepancy of anatomical landmarks in the mandible on digital radiographs.

Materials and Methods

The present study consisted of 200 randomly selected digital panoramic radiographs, irrespective of age and sex, which were

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stockpiled as lenient replicas in the extra oral digital Panoramic (allengers synergy) radiographic machine with 70 kilovoltage peak in the Department of Oral Medicine and Radiology, Institute of Dental Sciences, Bareilly. The sample size was determined statistically and included in the study. The procedure convoluted in the study was agreeing to the standards of the institutional ethical committee with clearance. The inclusion criteria included great valued radiographs with respect to symmetrical accurateness with an ideally contrasted image with no associated projection errors. Patients with poor quality radiographs, presence of jaw fracture or several pathologies of maxilla or mandible were excluded from the study. With a digital panoramic system under standard exposure factors, anatomical edifices scrutinized comprised mandibular canal, the anterior loop of mental nerve, mental foramen, and incisive foramen which was gauged by two separate expert oral

Fig. 1: Mandibular panoramic image displaying a well-defined anterior looping of mental canal as well as the lingual foramen

radiologists with a shared consensus of interpretation to evade the inter- and intraobserver variabilities.

Four-point grading scale agreeing to Singh et al., was used to assess the visibility and discrepancy of these landmarks as stated below[7] (Fig. 1):

- Good visibility (above average),
- Moderate visibility (average),
- Poor visibility (below average), and
- No visibility (not seen).

STATISTICAL ANALYSIS

The data were assembled using Microsoft Excel sheet (Windows 2007) and were studied using Statistical Package for Social Sciences Software (Version 22.0). The Chi-square test was used to define the connotation among the variables. *p* value <0.05 was considered significant value and used for all tests and evaluations.

RESULTS

Out of selected 200 digital panoramic radiographs, the mandibular canal was visible in 92% with good perceptibility in 75% of the cases. In 73% of the cases, the anterior loop of the mental nerve was not visible with 1% moderate visibility. In 3% cases, mental foramen was moderately seen. In 32% of the cases, the incisive canal showed only 25% with good visibility. Based on sample size and using Chi-square test, sex does not affect the appearance of the anatomical structures in the interforaminal region (Fig. 2 and Table 1).

DISCUSSION

Panoramic radiography relics, the most widely used complementary examination in an anatomical exploration of the mandible, dental surgery wisdom, implantology in a tumor, and infectious pathologies.[8] It provides a global vision of the anatomical structures of the facial mass on a spread out plane.[1]

The mandibular canal walls are poised of trabecular bone that arrays from dense to very subtle structures with trabecular dissimilarity among persons and also among diverse localities in the mandible.[9] The changeability in cortication of the canal can upshoot in momentous deviation in the perceptibility of this structure. In certain patients, neurovascular bundles may route over intertrabecular spaces of anterior mandibular cancellous bone.[10]

In the current retrospective study, 200 patients had the visibility and discrepancy of functional structures in mental foraminal zone OPG, which was calculated between age groups ranging from 11 years to 72 years. Almost all studies showed that the most common age group was 27–70 years and 17–27 years. This variation could be attributed to the study population included in the present study.

In the present study, 92% of the mandibular canal was noted in personnel, with 75% of good visibility. Similar observations were found in a research by Jacobs et al.,[2] who also observed mandibular canal in 99% in their study sample, which was analogous to results of the study by Juodzbalys et al.,[11] who inspected 105 corpses and their mandibles and further stated the presence of a clearly defined mandibular canal mesially from the mental canal in 92% of the 70 dentate mandibles.

The probable clarification to the above fact may be as the discernibility of the mandibular canal declined owing to osteoporotic changes in the bone as of advancing age so decreasing the visibility and its discrepancy. However, contrary to the present study, some studies showed the incidence of the mental foramen on panoramic radiographs that was congregated as a continuous, separated, diffuse, or unidentified form, which was prominently noted by Yosue and Brooks et al. in his study. The mental foramen is more frequently positioned at the summit of the second mandibular bicuspid or in amid the periapex of the bicuspid. The mental foramen is a substantial innovatory during various surgical dealings. The inferior dental nerve might be supposed to be seen on the medial aspect of the mental foramen and passes far away from it as an anterior loop near to the bone that ought to be deliberated to avoid injury to the mental nerve previously performing implant surgery.[11]

Results of the current study discovered that visibility and discrepancy of mental foramen in the present study were found to be 82% with moderate visibility in 6% of cases and good in 77% cases in 200 panoramic radiographs. Similar observations were found in studies by Jacobs et al.,[2] who reported the detection of mental foramen in 94% (*n* = 545) of panoramic radiographs, however, good visibility was achieved in 49% of OPGs. This difference could be due to the difference in the number of the study population in both studies.

In human anatomy, mental foramen is described to be situated classically between the apices of 1st and 2nd premolar. In totaling, multiple factors such as muscular biomechanics, tooth morphology, size/shape of face and cranium, habits, environmental and socioeconomic factors, with racial and ethnic miscegenation are likely to affect the anatomical features of jaws.[1,9]

The anterior loop, which can be designated as the leeway of mandibular canal front to the mental foramen, is formed just afore the ramification of the mandibular canal into the incisive canal. It comprises the mental and incisive nerves concurrently; therefore, attentiveness should be reserved in surgical dealings in the interforaminal region to circumvent nerve damage.[4]

In the current study, the frontal periphery of the anterior loop was resolute both centered on the existence of two distinct canals outside the mental foramen and by expending its diameter. As a minimum, one anterior loop was envisaged in over half of the patients (27%) in our sample. Most of the anterior loops were located bilaterally, tracked by the left and right sides, individually. These findings were similar to the reports of Apostolakis and Brown, who observed an anterior loop in approximately 57% bilaterally.[1]

An anterior loop of mental nerve appears as the mental canal, which starts from the mandibular canal and permits in different directions to the summit at the mental foramen.[12] The visibility
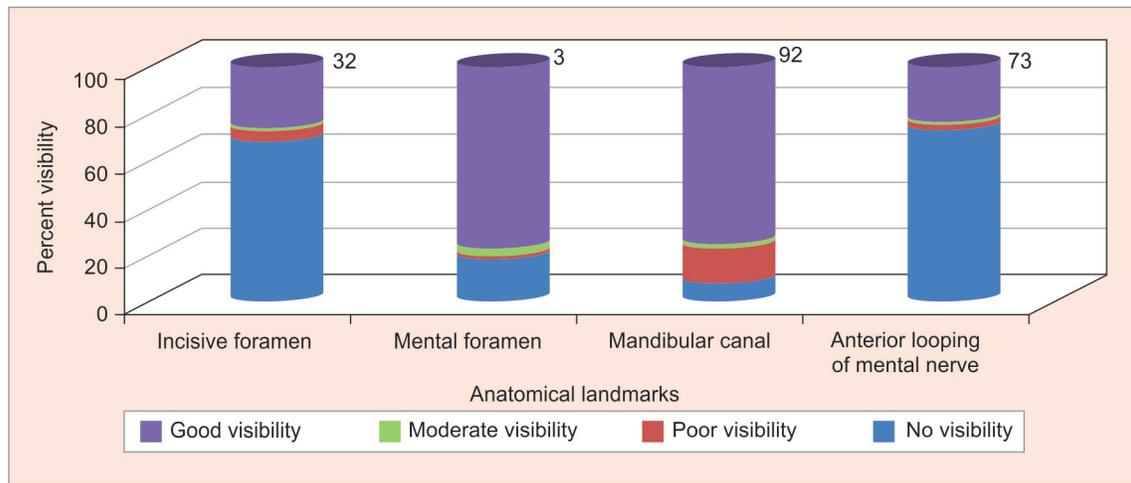
Fig. 2: Percent visibility and discrepancy of different anatomical structures

Table 1: Percent visibility and discrepancy of different anatomical structures

Anatomical structures	No visibility A (%)	Poor visibility B (%)	Moderate visibility C (%)	Good visibility D (%)	Total visibility E = B + C + D
Incisive foramen	136 (68)	10 (5)	4 (2)	50 (25)	64
Mental foramen	36 (18)	4 (2)	6 (3)	154 (77)	164
Mandibular canal	16 (8)	30 (15)	4 (2)	150 (75)	184
Anterior looping of mental nerve	146 (73)	6 (3)	2 (1)	46 (23)	54

and discrepancy of the anterior loop decrease with the increased phase of life. It is due to age related decreased calcification of cortex-associated secondarily with the slower bone remodeling. Also, the cortical porosity and Haversian canals increase markedly showing resorption of bone because of which the bone marrow space enlarges and trabecular pattern matures in a much-disoriented manner that setback the visibility and discrepancy of anterior loop of the mental foramen.[13] The closeness of incisive canal to maxillary central incisor area and a reedy frontal labial bone might end up in the transgression of the canal disposing to sensory dysfunction.[10]

In the present study, panoramic radiographs showed the incisive canal with 32%. Jacobs and colleagues also established that the incisive canal stayed noticeable in 15% of the cases inspected. Because of disparities in the anatomical structures, explicitly in the anterior mandible, conventional radiographic techniques are inadequate with maximum superimposition.

Identification of the incisive canal and lingual foramen influences its importance, as they contain specific neurovascular bundle. Finally has been addressed in added histological studies and substantiated with regard to its neurophysiological implications.[14] In any case, the present study seems to specify that the panoramic image may help in accurate documentation of the mandibular and the mental foramen, and with minor difficulty for perceiving the incisive canal.

CONCLUSION

Depending on the results of the present study, it could be concluded that the mandibular canal was more simply recognized in the posterior areas; visibility regularly lessened near the mental

foramen. Panoramic radiography is thus significant investigation to categorize the landmarks that may need to seek invasive surgical procedures. Recently, cross-sectional imaging has been found to offer an improved substitute for the precise visualization of anatomical structures in the oral section.

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