

Radiographic Measurements of Inferior Alveolar Nerve Anterior Loop, Mandibular Interforamen and Interloop for Implant Placement among Saudi Population of Aseer Province

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Abstract

Introduction: The anatomical variation of inferior alveolar nerve anterior loop (IANAL) is benign, but an accurate identification and measurement of anterior loop length is essential for surgical planning in this region.

Purpose: The purpose of this study was to assess the occurrence and extent of IANAL and also to determine mandibular interforamen and interloop measurements for implant placement in Saudi population of Aseer province.

Materials and Methods: The panoramic radiographs were retrospectively accessed for a period of 1 year before start of the study from the patient database system. The presence of IANAL was identified by carefully observing the course of mandibular canal and reverse looping upward and backward. The length of IANAL and interforamen and interloop distances was measured using digital ruler.

Results: Among a total of 236 radiographs, IANAL was visualized in 54 (22.9%) subjects, of which 33 (61%) were males and 21 (39%) females. The length of IANAL was significantly greater in males than females ($P = 0.000$). There was no statistically significant difference found in interloop distance between males and females ($P = 0.361$). The interforamen distance was significantly greater in males than females ($P = 0.000$).

Conclusions: The occurrence of IANAL was found to be 22.9%. The males had greater occurrence of IANAL than females. Interforamen distance was significantly greater in males than females. Author recommends a distance of around 5 mm from the most anterior point of mental foramen could be considered safe for placing implants among Saudi population of Aseer province.

Key words: Anatomic variations, Implant dentistry, Panoramic radiographs

INTRODUCTION

The inferior alveolar nerve is a branch of the mandibular nerve, which, in turn, is a branch of trigeminal the fifth cranial nerve. After once, it enters the mandibular foramen branches out to give sensory innervation to mandibular teeth (molars and second premolars) eventually these form

into the inferior alveolar plexus and give off small gingival branches. The course of the nerve continues anteriorly to give off the mental nerve branch at about the level of the mandibular second premolars, which exits the mandible through the mental foramen and branches out to give sensory innervation to the chin and lower lip.^[1] Sometimes, the inferior alveolar nerve might continue and extends beyond the mental foramen in an anterior and inferior direction, curving back to the foramen and forming a loop, which has been termed as “anterior loop of the inferior alveolar/mental nerve.”^[2-10] While some investigators have evaluated the diameter of anterior loop and the incisive canal to differentiate between these two structures with consideration of minimum 3 mm indicates the presence of inferior alveolar nerve anterior loop (IANAL).^[2,4,11]

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Although the anatomical variation of IANAL is benign, an accurate identification and measurement of anterior loop length is essential for surgical planning in this region.^[2] Recent advancements in dental implants have shifted focus on the characteristics of bone recipient area.^[12] A careful diagnosis of IANAL not only helps to prevent iatrogenic complications but also ensures an effective and uneventful surgical procedures.^[5,9,10] The literature is also inundated with case reports on implant failure and complications owing to improper assessment of the vital structures in interforaminal region during or after surgical intervention.^[13]

The prevalence of IANAL has found to be highly variable ranging from 22% to 94%.^[7,14] In addition, the length of IANAL has shown variations up to a maximum of 11 mm.^[15] Some variations in the prevalence of IANAL also exist between different population and ethnic groups.^[16] The interforamen and interloop distances are other important spaces for strategic planning of dental implants placement.

Understanding the prevalence of IANAL and other traits such as interforamen and interloop distances in a specific population group gives background information to the operating surgeon which are critical during surgical interventions. To the best of our knowledge, there are no studies on the prevalence of IANAL among Saudi population. Hence, the aim of this study was to assess the prevalence and extents of IANAL and also to determine mandibular interforamen and interloop measurements for placement of implants in Saudi population of Aseer province.

MATERIALS AND METHODS

The present study follows a retrospective observation of panoramic radiographs at College of Dentistry, King Khalid University, Saudi Arabia. Ethical clearance was obtained from Scientific Research Committee at the institution (Approval No.: SRC/ETH/2016-17/023).

Data Collection

The panoramic radiographs were retrospectively accessed for a period of 1 year before start of the study (January 2016–December 2016) from the patient database system. The patient's personal information was deidentified. Further, the radiographs were selected by the following inclusion criteria: Completely edentulous patients, images free from any evidence of fracture or with impacted/supernumerary teeth, or bone disease that could occult the appearance of the anterior loop of the mental foramen, images with no positioning errors, and images free from the presence of implants or metal artifacts in the interforamen region.

The images were acquired using CLINVIEW™ software utilizing the industry-standard DICOM format (Instrumentarium Dental, USA). The density and contrast of the images were adjusted at a fixed value to standardize the radiographic interpretation. All the radiographs were interpreted by a single investigator. The presence of IANAL was identified by carefully observing the course of mandibular canal and reverse looping upward and backward. The length of IANAL was measured by digital ruler measuring distances between the two points: Most anterior point of mental foramen to most anterior point of anterior loop [Figure 1]. Similarly, interloop and interforamen distances were estimated on each side by measuring the distances between the most anterior point of mental foramen and the most anterior point of anterior loop, respectively.

Statistical Analysis

The information collected was entered into the computer (MS-Excel Sheet) and analyzed using SPSS, Version 20. The results were obtained for descriptive statistics and inferential statistics using unpaired Student's *t*-test. The alpha (α) was set at 0.05.

RESULTS

A total of 236 panoramic radiographs fulfilled the inclusion criteria among whom 118 (50%) were male and 118 (50%) were female, with age ranging between 50 and 77 years. The IANAL was visualized in 54 (22.9%) radiographs [Table 1 and Graph 1]. Among the total 54 radiographs, 33 (61%) were males and 21 (39%) females.

The average loop length was found to be 4.3 ± 0.4 mm with a range from 2.2 to 6.5 mm. The length of IANAL was significantly greater in males than females ($P = 0.000$). There was no statistically significant difference in length of IANAL between right and left sides ($P = 0.420$) [Table 2].

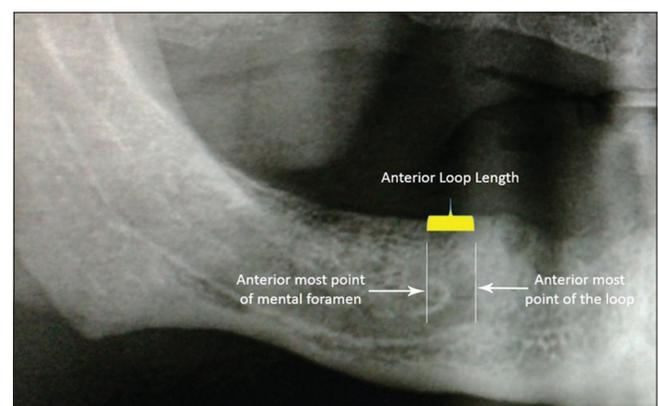
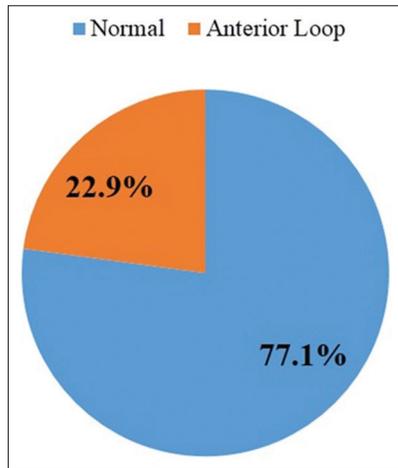


Figure 1: Reference points for measuring inferior alveolar nerve anterior loop length

The average interloop distance was found to be 42.5 ± 1.7 mm with a range from 38.8 to 48.8 mm. There was no statistically significant difference found in interloop distance between males and females ($P = 0.361$). The average interforamen distance was found to be 51.3 ± 1.7 mm with a range from 47.7 to 56.5 mm. The interforamen distance was significantly greater in males than females ($P = 0.000$) [Table 3].



Graph 1: Prevalence of anterior loop observed in both male and female

Table 1: Prevalence of inferior alveolar nerve anterior loop among the radiograph samples

Inferior alveolar nerve status	n (%)		
	Males	Females	Total
Normal	85 (36.0)	97 (41.1)	182 (77.1)
Anterior loop	33 (14.0)	21 (8.9)	54 (22.9)
Total	118 (50.0)	118 (50.0)	236 (100.0)

Table 2: Comparison of anterior loop length by gender and side

IANAL	Sides	n	Mean±SD	df	t	P
Anterior loop length	Right	54	4.47±0.63	106	-0.810	0.420
	Left	54	4.57±0.64			
	Male	33	4.87±0.32	52	10.0002	0.000*
	Female	21	3.82±0.44			

*Significant at 5% level of significance. SD: Standard deviation

Table 3: Comparison of inter loop and interforamen distances between male and female (in mm)

IANAL	Gender	n	Mean±SD	df	t	P
Interloop distance	Male	33	42.81±2.26	52	0.922	0.361
	Female	21	42.32±1.07			
Interforamen distance	Male	33	52.54±2.12	52	4.767	0.000*
	Female	21	50.10±1.22			

*Significant at 5% level of significance. SD: Standard deviation

DISCUSSION

In the last two decades, implant therapy has seen significant progress in various aspects of imaging modalities for diagnostic purposes. Bone being the crux of implant placement has obviously received lot of attention. Due to the presence of anatomical variations like IANAL in mandibular anterior region, it is very much indicated to incorporate various imaging modalities in diagnostic procedures before proceeding with implant surgeries.

In the present study, the prevalence of IANAL was found to be 22.9% which is comparable to studies conducted elsewhere.^[6,7,17] Few studies, like the one conducted by Jalili *et al.* and Neiva *et al.*, have shown a very high prevalence of 88% and 94%, respectively.^[14,15] The variation in IANAL could be attributed to different assessment techniques used for identifying IANAL. Previous research has used radiographic assessment techniques such as conventional panoramic radiographs and cone beam computed tomography (CBCT) while some have used direct anatomical assessments on skulls.^[2,6,15] Our study used panoramic radiographic imaging techniques since the same is most commonly used method in general dental practice. Although the exact course of IANAL could only be explored through CBCT imaging, the mere presence and length of IANAL could be easily determined by a panoramic radiograph.

The criteria set for defining the IANAL could also have resulted in high variation in its prevalence reported till date. The anterior limit of mandibular canal was identified using anatomical planes by some investigators,^[3,9,10,17] whereas others have evaluated the diameters of anterior loop and incisive canal to differentiate between these two structures.^[2,4,11] In our study, the presence of IANAL was based on measurements between anterior most point of mental foramen to anterior most point of the canal loop irrespective of its length. In one particular study, the authors discarded loops smaller than 2 mm in length as they considered them clinically insignificant.^[7] However, in our study, the minimum loop length was found to be 2.2 mm which indicates the clinical implications among our study population.

In the present study, the prevalence of IANAL was greater in males than in females. This finding is in agreement with other studies.^[2,3,9] Similarly, the interforamen distance was greater in males than in females ($P < 0.05$). Our results also confirmed that there was no statistically significant difference in interloop distance between the genders ($P > 0.05$). This indicates that the bigger jaw size and greater interforamen space in males should not be taken for granted while planning an implant placement. One particular study recommends a safe guideline of 4 mm from the mental foramen for placing implants.^[17] The same might not be

relevant to our study population since the average IANAL length was found to be slightly higher (4.3 ± 0.4). Based on confidence interval values (4.40, 4.64) of the present study, a distance of around 5 mm from the most anterior point of mental foramen could be considered safe for placing implants among Saudi population of Aseer province.

Clinical Significance of IANAL

Failure to recognize the presence of anatomical variation IANAL before placement of implant in the interforamen region might lead to post-operative complications like neuropraxia and disturbances in the sensation of lower lip.

Limitations of the Present Study

- The panoramic images used in the present study were two-dimensional and lesser precise when compared to CBCT imaging.
- In cases where there is overlapping canal loop, the possibility of missing the condition might have led to slight underestimation of the IANAL images.

Hence, the present study emphasizes on the mandatory use of panoramic radiograph as a screening aid for the identification of anatomical variation like IANAL in patients selected for implant placement. On confirmation of such finding, the same patients may be further subjected to advanced imaging modality like CBCT for accurate measurement of IANAL.

However, further research using advanced imaging techniques like CBCT is warranted.

CONCLUSIONS

The occurrence of IANAL was found to be 22.9%. The males had greater occurrence of IANAL than females. Interforamen distance was significantly greater in males than females. Author recommends a distance of around 5 mm from the most anterior point of mental foramen could be considered safe for placing implants among Saudi population of Aseer province.

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