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Assessment of the anterior loop of the inferior alveolar nerve among Sudanese patients using CBCT-Scan in Khartoum state

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Abstract

Neurosensory disturbances due to anterior loop (AL) injury are common postoperative complications from intraoral surgery in the premolar area, such as dental endosseous implants, genioplasty and open reduction of a mandibular fracture, so awareness by anatomical variations of the vital structure of the mandible is very important. Therefore, this study was carried out to analyze the AL of inferior alveolar nerve (IAN) by evaluating the CBCT-based characteristics of AL among Sudanese patients focusing on sex and bilateral differences.

A retrospective cross-sectional study of 50 cone beam computerized tomography (CBCT) images of the mandible of patients who attended the dental clinics in Khartoum city for different procedures in the lower jaw. Using Planmeca Romexis viewer 3D imaging software, the length of the anterior loop was calculated by measuring the distance in millimeters (mm) between the most anterior region of the loop and the medial margin of the maximum anterior portion of the mental foramen.

Twenty-six percent of the participants in this study had the anterior loop. The average lengths of the inferior alveolar nerves on the left and right ALs were 2.436 mm and 2.467 mm, respectively. It was more prevalent in the mesial to second premolar 5 (61,5%). A significant difference was found between gender and the presence of AL was more prevalent in female than male (P value = 0,0122).

The anterior loop of the inferior alveolar nerve does not have the same length on either side. Both male and female variations were equal.

Keywords: Anterior Loop, Inferior Alveolar Nerve, CBCT-Scan, Khartoum

Introduction

The mandibular branch, known as the inferior alveolar never (IAN), splits into the incisive and mental branches. The mental branch senses the inferior lip and jaw's dermis and mucous membranes. In addition to the anterior teeth, including the first premolar, the incisive branch innervates the vestibular gingiva of the lower jaw's anterior teeth [1,2,3,4]. Before (IAN) departures through the mental foramen as a mental nerve, it may extend anteriorly and inferiorly, forming a loop by curving back to the foramen; this is known as an anterior loop (AL) of IAN [5,6]. The mental foramen is situated close to the apical region of the canine and the first deciduous molar during the embryonic stage. The mental foramen displaces anteriorly during mandibular growth up until the eruption of deciduous molars, but following the eruption of the second deciduous molar it redirects posteriorly. This shift may be the reason why the IAN develops an anterior loop before it becomes the mental nerve [7]. Neurosensory disturbances and hemorrhage are common postoperative complications from intraoral surgery, such as dental end osseous implants, genioplasty and open reduction of a mandibular fracture [8,9,10,11,12], so awareness by anatomical variations of the vital structure of the mandible is very important [13] Various safety margins from the mental foramen of up to 6 mm have been recommended by various authors to prevent injury to this entity [14]. Studies have utilized cadavers, patient CT scans, and cone beam computed tomography (CBCT) to determine and calculate the anterior loop length on panoramic radiographs [15]. CT scans and CBCT are recommended prior to surgeries in the interforaminal region because, according to multiple studies, panoramic radiographs are inaccurate and have a high risk of false positive or false negative interpretations. Due to its lesser radiation exposure, CBCT is the recommended method among them [6,10,16-21]. In accordance with the Solar classification, there are three varieties of AL. Type 1 is characterized by its Y-shaped morphology, absence of an AL, and incisive branch, which is typically as broad as the principal branch. In front of the mental IV foramen, the IAN gives rise to the mental branch. Type 2 is characterized by a T-shaped morphology and an incisive branch that is typically perpendicular to the main branch due to the absence of the AL. Upon entering the mental foramen, the mental branch of the IAN branches off perpendicularly. The incisive branch of type 3, which is identified by its Y-shaped architecture and AL, is typically just as little as the principal branch [13,22].

For dental professionals, population-specific data is crucial, hence this study was conducted to evaluate the CBCT-based characteristics of AL among patients from Sudan to determine the presence of the AL of the IAN, measure the length of the AL if present, compare the length of the AL in both the right and left sides and calculate the various nerve placements to decrease the probability of surgical nerve injury during different surgical operations, such dental implants.

Methods:

Study Area and Duration

This study was conducted by using CBCT images of the mandible of patients (male and female) who attended different procedures in the lower jaw at Dentogenic Dental Clinic Center, Salah Dafallah Dental Clinic, Dantalia dental clinic and radiology Department of Ribat National University clinics, Khartoum State during the period from 2020 to 2022, the age of the patients was ranged between 30 to 80 years.

Inclusion Criteria

Throughout the study period, all of the patients' CBCT pictures were present in the study areas.

Exclusion Criteria

Included systemic disorders that impact growth and development, a history of injury or operation including the craniofacial area, and clinical or radiographic signs of growing abnormalities or pathologies upsetting the maxillofacial area.

Data Collection Technique

A total of 50 patients were analyzed for both mandibular sides while all images were examined by a board-certified radiologist at Ribat National University's radiology department. Planmeca ProMax3D was used to collect the CBCT data (PLANMECA OY, Helsinki, Finland). The voxel size was 0.200 mm, and the field of view was 15 × 12 cm. The scans were conducted at 12–16 mA and 84 kV. On a computer screen, Planmeca-Romexis (version 3.8.2.R) was used to analyze every image. The Planmeca Romexis viewer 3D imaging software's measuring tool was used to gauge the length of the AL. The AL's presence or absence was assessed in axial view. When the AL was present, the distance in millimetres between the medial edge of the mental foramen's most anterior section and the loop's most anterior part was measured.

Statistical Analysis

Data was analyzed utilizing statistical package for social science (IBM SPSS version 22); numeric information was showed as mean ± standard deviation, and descriptive data as

V percentages offered in figures and tables. The relationship between categorical variables was obtained using the Chi-square test, and the level of significance was set at a P-value ≤ 0.05. The results were presented with a confidence interval of 95%.

Results

The current study aimed to evaluate the AL of the IAN in Sudanese patients using CBCT images focusing on the presence between sexes and the length difference between both sides.

In this study, 50 CBCT scans were evaluated, 34 (68%) were female and 16 (32%) were male to determine the presence of the AL of the IAN in Sudanese subjects (Table 1). Fifty CBCT images were analyzed, and the results revealed that whereas AL was absent in 37 (74%) of the images, it was present in 13 (26%). The left and right ALs had average lengths of 2.436 and 2.467 mm for the inferior alveolar nerve, respectively (Table 2). In reference to the gender-related presence of the AL, the statistical analysis revealed that 9 out of 34 female images (or 26.5%) had AL detected. However, AL was found in 4 of the 16 male images, or 25% of the total (Table 3). Mesial to second premolar 5 (61.50%) was the most common place for the AL of the mental nerve, followed by mesial to first premolar 4 (30.80%), and finally mesial to first molar 6 (7.70%), as shown in (figure 1). When the presence of AL was correlated with gender, a significant difference was seen (P value = 0.0122).

Table 1. *Shows the presence of AL of IAN in the participants*

Presents of AL	Frequency	Percent
Detected	13	26.0
Not detected	37	74.0
Total	50	100.0

Table 2. *Shows mean length of AL of IAN on right and left sides*

Side	Mean/mm
Right	**2.467**
Left	**2.436**

Table 3. *Shows the existence of AL of mental nerve among genders*

Gender	Present	Absent	Total
Male	**4**	**12**	**16**
Female	**9**	**25**	**34**
Total	**13**	**37**	**50**

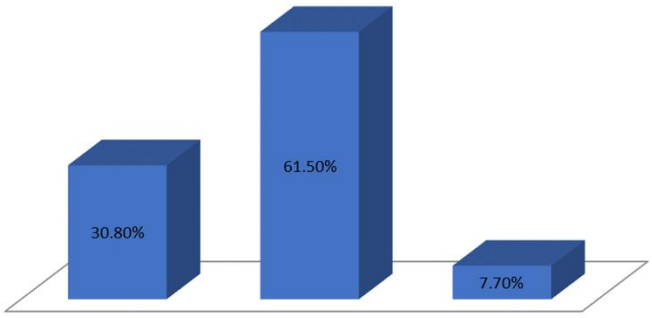

Figure 1*. Shows the position of AL of IAN, in 30.80% mesial to first premolar 4; in 61.50% Mesial to second premolar 5; and in 7.70% mesial to first molar 6.*

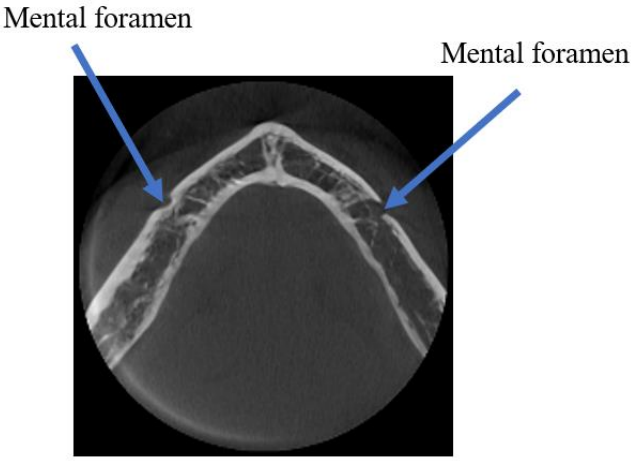

Figure 2. *Both the mental nerve and AL emerged from the mental foramen*

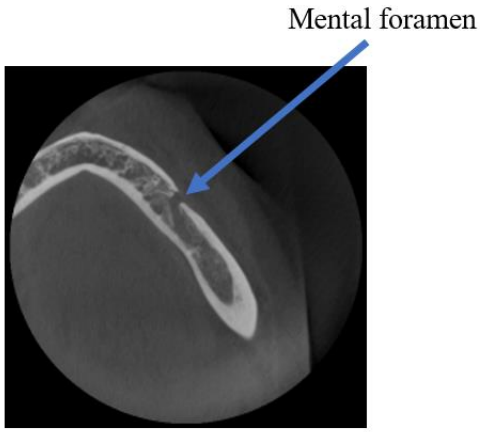

Figure 3. *Without the anterior loop, the mental nerve emerges straight from the mental foramen*

Discussion

The IAL's position serves as a restriction for a number of mandibular surgical operations. A safety margin must be built anteriorly and inferiorly to the location of the mental foramen while doing surgery on the premolar region or anterior

mandible because the nerve reverses course before leaving the mental foramen and forms an AL [23]. After surgical operations like dental implants, paraesthesia to the chin and lower lip due to injury to the AL of the IAN may occur [24,22,25]. Several studies have attempted to estimate the length of the AL using a variety of techniques (morphological, images, and combination) [24,22,25]. Most studies have shown that panoramic radiographs are inaccurate because of the significant risk of false-positive and false-negative outcomes. The AL was examined using computed tomography (CBCT) scans, which are the most commonly utilized radiographs in graft management planning. Furthermore, CBCT has demonstrated its dependability by making it possible to view tissues without superposition, deformations, or exaggerations. This allows for more precise outcomes [22]. Consequently, it's critical to identify the AL of the IAN utilizing a CBCT scan in order to prevent troubles with the lower lip and chin [13]. In the present study, Using CBCT, the AL of the IAN was assessed with respect to the mental foramen in 50 patients, 34 of whom were female (68%) and 16 of whom were male (32%). The most common age group [28%) was 41–50 years old. In our investigation, the AL was identified in 26% of the population, with means lengths in the right and left directions of 2.467 and 2.436, respectively. Its prevalence ranges from 15.2 to 96% in different populations [26-29]. These variations in prevalence could result from biases related to age, sample sizes, ethnic origins, or methodsological variations. The present study's results are in line with another study conducted on an Iranian population, which found that of 180 images, only 59 (32.8%) showed an anterior loop, with a mean length of 2.69 mm on the right and 2.36 mm on the left [13]. Additionally, 50 sites (35.2%) of the other study demonstrated Type III AL [30]. Prakash and colleagues examined 90 patients using CBCT images, finding that 45 of the patients had a 50% prevalence rate [25]. Another study [31] found that 56.0% of the 600 Indian patients had anterior nerve looping in general. Compared to the current study, these two studies' results indicated a larger percentage. According to a Saudi Arabian study, the AL of IAN was discovered in (13.4%) type III on the right side and (11.4%) type IV on the left, which appears to be lower than our findings [13]. The prevalence of the AL pattern was determined to be 29 (7.3%) on the right side and 26 (6.5%) on the left side in an Indian study that used CBCT data from 487 patients. Thirteen (3.3%) and 29 (7.5%) of these instances had bilateral AL. Although the prevalence of the AL pattern on both sides was 6.9% overall, which was significantly lower than in our study, the length of the AL was measured similarly, with the right AL being longer than the left AL [14]. Also, the AL of IAN at the mental foramen was assessed using CBCT in 279 Turkish patients (138 females and 141 males) and found to be type III in 59.5% of the patients. The male and female groups did not differ considerably (the right side's percentage was 58.2% and 62.3%, respectively, while the left sides were 60.3% and 57.2%, respectively), which is much higher than our figure [22]. Few authors [22,32,33] have examined the relationships between gender, age, and side and occurrence of AL of IAN. In their investigation, Uchida discovered that males are more likely than females to have IAC [28,29]. Though the difference between the sexes was statistically significant, we observed in our study that it was more common in females. Prior research revealed a statistically significant correlation between the frequency of AL and age, but not sex [34, 35]. Males were more likely than females to have AL in the Indian population [34, 36]. According to a study by Rodricks et al. (2018), the anterior loop was present in 45% of females and 55% of males. However, a Chinese investigation revealed that the frequency was higher in males (45.5%) than in girls (52.2%) [37]. According to a recent study conducted in the Saudi population, women have a higher prevalence of AL than men [38]. The current study's findings, which indicated that males had a lower prevalence than females, were consistent with those of the Chinese and Saudi investigations. Prior research has indicated that, when placing implants, the safety region in front of the MF should be 2, 3, or 5 mm [6, 27]. Our research did indicate, although, that this could occasionally lead to AL damage. To prevent iatrogenic injuries, CBCT monitoring is advised prior to these procedures; in its absence, A precautionary zone of 8 mm ought to be considered.

Conclusion

In the present study the AL of the IAN was found in 26% of the patients, Male prevalence was lower than that of females. Right AL length was greater than left AL length, and AL of IAN was more frequently found mesially to the second premolar. According to the study's conclusions, CBCT should be performed on each patient prior to any premolar surgery.

Limitation

Sudan lacked sufficient data for this study, and there were insufficient 3D CBCT scan centers to collect the necessary data.

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Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper and that they have approved the final version.

Conflicts of Interest

There is no conflict of interest for the publication of this article.

Ethics Committee Approval

The National University Research Ethics Committee (NU-REC) approved the study on 04/03/2020 by NU-REC 2020/14.

Referee Evaluation Process

Externally peer-reviewed

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