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Anatomical Variations and Biological Effects of Mental Foramen Position in Population of Saudi Arabia

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Abstract

Background: Understanding the anatomical variations in the position of the mental foramen is significant for different dental procedures. This study identified the position of the mental foramen among a Saudi population in the western region of Saudi Arabia.

Methods: A total of 950 panoramic radiographs (PAN) were selected from a total of 1195 radiographs. The mental foramen location was determined by drawing imaginary lines parallel with the long access of the lower premolars and mesial root of the first molar on the same side. The mental foramen location was then classified into six classes (Class I-VI).

Results: In the Saudi population, more than half of the mental foramina were located between the lower premolars (Class III, 57.89%), followed by class IV (41.70%) of the mental foramen was located under the second premolar apex. None of the radiographs showed that the mental foramen was located in front of the first premolar (Class I).

Conclusion: For successful and secure mental nerve blocking, the anesthetic solution should be injected between the first and second premolars or under the lower 2nd premolar in the Saudi population. Additionally, caution should be taken when operating close to these areas to avoid mental nerve injury.

Keywords: Panoramic radiograph; PAN; OPG; Mental foramen; Saudi population

Introduction

The mental foramen is a round or oval opening present in the middle anterior part of the mandible that allows passage of the mental nerve and vessels [1]. The mental nerve is a division of the inferior alveolar nerve that exits from the foramen toward the anterior part of the mandible. It services the lower lip, teeth, buccal and the gingival tissue of the premolar and the anterior region of the mandible with sensory innervations [2].

Understanding the anatomical position of the mental foramen is significant for different dental procedures [3-5]. Misdiagnosed mental foramen locations during dental treatment may damage the foramen content involving the mental nerve [6]. Anatomically, the nerve fibers are surrounded by many layers and tissues to protect and support the nerve fibers. Thus, harming these layers and tissues will induce sensory disturbances due to interrupted neural transmission [7]. The altered sensation will disturb speech, eating, drinking or facial expressions and can cause serious social and psychological effects [8]. Damaging this nerve is associated with paresthesia, anesthesia, and numbness of the teeth or lower part of the lip as well as skin and mucosa near to the damaged nerve [9]. In addition, knowing the exact location of mental foramen will help in acheiving better local anesthesia and pain control during dental treatment.

Only few studies have reported the distribution of mental foramen locations in their populations. Chkoura et al. showed that the mental foramen is commonly located in line with the second premolar in a Moroccan population [10]. Similar results were seen in a Malay population [11]. However, an Iranian study concluded that in majority of people, the mental foramen was between the two premolars [12].

Therefore, the goal of our study was to identify the anatomical variations of mental foramen positions via panoramic radiograph (PAN) in patients attending governmental hospitals in Jeddah, Saudi Arabia.

Materials and Methods

This study was conducted using the records from the Department of Dentistry at King Abdulaziz Medical City, National Guard Hospital, and the King Abdulaziz University, Faculty of Dentistry (KAUFD), Jeddah, Saudi Arabia. This study was reviewed and approved by the research ethical committee board at KAUFD, and was in full accordance with the World Medical Association Declaration of Helsinki.

A total of 1195 digital panoramic radiographs were evaluated by two examiners at the same time, and rechecked by a senior radiology consultant. Of these, 950 met the inclusion criteria. These criteria included; dentulous area, a presence of two premolars and a first molar without periapical radiolucency on both sides, and a clear radiograph in terms of density and opacity. If one of these criteria was missing, then the radiograph was not considered. In addition, malocclusion cases were excluded from this study. All radiographs were assessed on a laptop using (ACDSeePro3). The mental foramen location was determined by drawing imaginary lines parallel with the long access of the lower premolars and mesial root of the first molar on the same side using the software. Relative to the drawn line, the mental foramen position was documented (Figure 1).

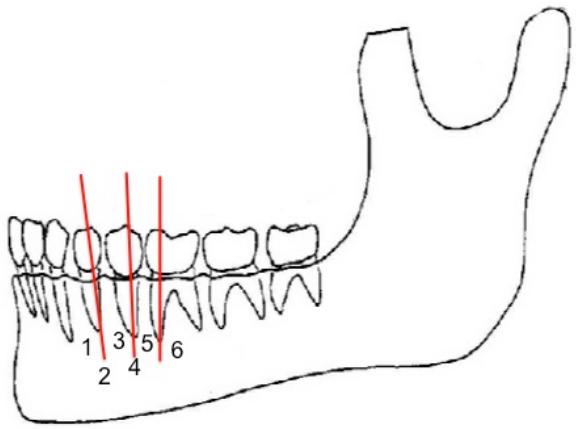

Figure 1: Schematic representation of the mental foramen position relative to the teeth. Imaginary lines using ACDSeePro3 software were drawn with the long access of the teeth. Numbers, 1, 2, 3, 4, 5 &6, represent Class I, Class II, Class III, Class V, Class IV & Class VI, respectively.

The mental foramen location was classified following other studies classification as follows [11,13,14]:

- **Class I:** The mental foramen is located in front of the first premolar.
- **Class II:** The mental foramen is located in line with the apex of the first premolar.
- **Class III:** The mental foramen is located between first and second premolars (Figure 2).
- **Class IV:** The mental foramen is located in line with the apex of the second premolar (Figure 3).
- **Class V:** The mental foramen is located between the second premolar and the first molar (Figures 2 and 4).
- **Class VI:** The mental foramen is located under the apex of the mesial root of the first molar (Figure 4).

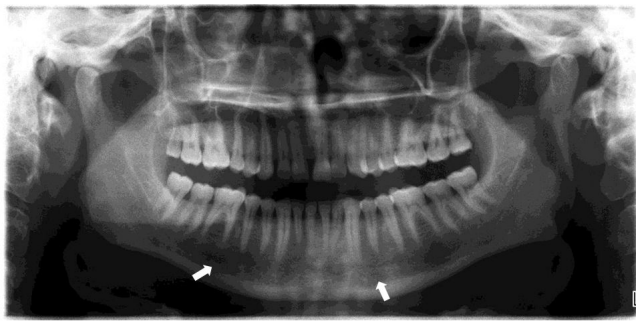

Figure 2: Representative PAN showing Class V on the right side (arrow) and Class III on the left side (arrow).

Figure 3: Representative PAN showing Class IV from both sides.

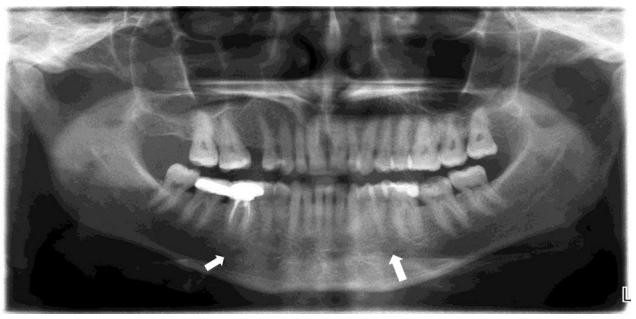

Figure 4: Representative PAN showing Class VI on the right side (arrow) and Class V on the left side (arrow).

Results

Of 950 panoramic radiographs, 476 were males (50.1%) and 474 were females (49.95) (Table 1). The average age was 37.20 ± 15.1 (Table 1). Our results show that the mental foramina were positioned between the first and second premolars (Class III) in 57.89% of the cases followed by Class IV, which is the mental foramen located under the apex of the second premolar (41.70%). Only 0.21% of the mental foramina were found under the apex of the first premolar (Class II),

and 0.1% showed classes V and VI. None of the radiographs were Class I (Figure 5).

Demographics		Min	Max	Mean	SD
Age		18	88	37.2	15.1
		Count		%	
Total		950	100		
Gender	Male	476		50.1	
	Female	474		49.9	

Table 1: Characteristics of the 950 study subjects.

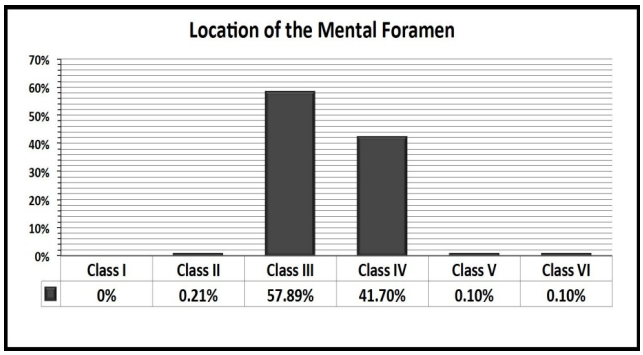

Figure 5: Summary of the results representing the parentage of each class depending on the mental foramen location.

Discussion

The location of the mental foramen has been controversial for many years. The mental foramen is an anatomic landmark positioned on both sides of the mandible-it contains the mental nerve and vessel. This anatomical landmark is very important in many dental procedures regardless of specialty. However, accurately determining the location of the foramen is a problem because there are many disparities in the location of the foramen between different individuals. Some say that it is located between the lower first and second premolars [12], and other locate it near the apex of the lower second premolar [10,11]. Thus, this implies that different geographic populations may have different anatomical variations in the mental foramen. Our results suggest that the mental foramen is most commonly located between the first and second premolars (Class III) followed by (Class IV) in this Jeddah, Saudi Arabia cohort (Western Saudi Arabia)

In 1998, 414 panoramic radiographs from four different dental centers in central Saudi Arabia were studied using the same criteria and classification as this study. They reported slightly different results with the most common mental foramen locations being under the apex of the second premolar (Class IV, 45.3%) and between the first premolar and second premolars (Class III, 42.7%) [13]. In general, classes III and IV were still the most common in both regions.

Other studies have also shown different variations in the mental foramen location among different populations. Class V is commonly observed in a Zimbabwean population [15]. Class III was commonly seen in British and Iranian [12,16], Negroid [17], Central Anatolian [18] and white North American populations [2]. Others studies agree with our results showing that Class IV is most common-these include Chinese [16,17,19], Nigerian [20], Mongoloid [17] and Kenyan Africans populations [21].

Using a panoramic radiograph system to detect the location of the mental foramen is better than periapical radiograph because the panoramic radiographs exposes a larger area of the oral tissue to a consistent view [22]. However, the limitation of this study was that the panoramic radiograph is a two-dimensional image. Thus, the exact position of the mental foramen in a bucco-lingual direction cannot be identified. Therefore, further studies with cone beam computed tomography (CBCT) are needed to determine the exact location of the mental foramen in the bucco-lingual dimension, especially in the Saudi population. This technique is now especially recommended in cases of implant placement, and when treating completed cases in endodontics [23-25].

CBCT has emerged to be an essential tool when it comes to challenging diagnostic and treatment cases in different specialty in dentistry [26]. It was found to be a useful and accurate method to detect bifid mandibular canals, anterior loop of inferior alveolar canal, and mandibular incisive canals [27-29]. In addition, CBCT showed superior visibility of mental foramen and accessory mental foramen compared to panoramic radiographs [30,31]. This implicates the use of CBCT compared to panoramic radiographs, especially in cases where the 3D images would be beneficial for treatment.

In conclusion, knowing the location of the mental foramen facilitates successful and safe dental procedures and anesthetic injections. Using PANs is a simple tool to roughly identify the correct location. In a Saudi population, blocking the mental nerve mesial or under the first premolar tooth would be effectively unsuccessful because the mental foramen is not located in this area. The best location for injection of anesthesia is between the lower 1st and 2nd premolars or under the lower 2nd premolar. Caution must be taken when operating close to these areas to avoid mental nerve injury.

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