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Research Article

Position of the Mental Foramen in a Northern Regional Palestinian Population

Abstract

Background: The mental foramen is one of important anatomical features frequently encountered in maxillofacial surgical procedures in premolars area. Its position has been shown to vary according to race. In this study researchers aim to study the position, shape, and appearance of the mental foramen, as seen on panoramic radiographs of Palestinians, and to compare our findings with international values.

Materials and methods: A randomly selected panoramic radiographs (368 with 736 sides) from the records of dental patients attending three dental services in north of Palestine, the mental foramina's anterior–posterior position, shape, and radiologic appearance were subjected to analysis.

Results: The most frequent anterior–posterior position was in the area between the long axes of first and second mandibular premolar teeth. The most frequent appearance was the continuous type and majority of foramina were rounded in shape.

Conclusion: The position of the mental foramen on panoramic radiographs in this selected group of Palestinians was most commonly between the mandibular premolars. The continuous type and rounded shape of the mental foramen was founded in majority of cases. These results are similar to previous findings in Caucasian populations.

Introduction

Mental foramen is a small foramen situated in anterolateral aspect of the body of the mandible. Normally, mental foramen is located below the interval between the premolars [1]. It transmits mental nerve, artery and vein. Mental nerve is a branch of inferior alveolar nerve which supplies sensation to lower lip and the labial mucosa and lower canines and premolars. The most useful injection for anaesthetizing the mandibular teeth is the inferior alveolar nerve block [2]. To anaesthetize the anterior teeth, including the premolars and canines, it is possible to avoid giving inferior alveolar nerve block by injecting anesthetic solution adjacent to the mental foramen. So the study of position and morphological variation of mental foramen is very important because it will be helpful to localize the important neurovascular bundle passing through the mental foramen [1,2] (Figure 1).

The mandibular nerve (V3) originates from the trigeminal nerve and enters the mandibular foramen, which is located at the medial aspect of the ramus and horizontally forward in the body, along with the inferior alveolar artery and vein. The inferior alveolar nerve (IAN) proceeds obliquely downward and forward through the mandibular canal, from the lingual to the buccal aspect of the mandible. In the molar area, the IAN generally branches into an extraosseous terminal mental nerve and the intraosseous terminal incisal nerves [3]. Once in the mental canal, the nerve proceeds upward and emerges from the mental foramen located mostly next to the second premolar apex, along with blood vessels. Moiseiwitsch found 90% of mental foramina being located either at the second premolar apex or abruptly mesial or distal to this position [4]. On average, the mental nerve exiting the mental foramen gives off three branches deep to the depressor anguli oris muscle, one of which innervates the skin of the mental area, and the remaining two innervate the skin of the lower lip, mucous membranes, and the gingiva as posterior as the second premolar [5]. Mesial to the mental foramen, studies were able to confirm the existence of an incisive canal, which can be an extension of the mandibular canal [4,5]. It is usually hard to identify, and its neurovascular structures may be running through the trabecular network. A very small percentage of the population (1%) has bifurcating mandibular canals, which proceed anteriorly into an inferior superior and medial lateral plane [6]. Therefore, the bifurcated mandibular canal will exit in two separate mental foramina. In these case clinicians have to be cautious since a panoramic or perapical film may not reflect it. Furthermore, Dario et al. suggest that the clinicians planning a surgical implant placement procedure above the inferior

Figure 1: Mental Foramen in Human Mandibles.

alveolar canal, should obtain a CBCT prior to the surgery, to avoid any possible nerve injury [6] (Figure 2).

The shape of the mental foramen was studied by Mbajiorgu et al. who found it to be round in 43.7% and oval in 56.3% of the mandibles investigated [7]. The mental foramen size was analyzed in morphometric skull analyses which found that the average height of the mental foramen is 3.47 mm and the average width is 3.59 mm. Other researchers had similar findings [8].

The foramen was found to be 28 mm from the midline of the mandible, and 15 mm from the inferior border of the mandible [8]. Studies investigating the same measures found that the mental foramen was 13.2 mm and 12.4 mm above the lower mandibular border. Distance did not vary by side, but showed significantly higher measures for males than females. The location of the mental foramen can vary, but it is usually found more coronal than the mandibular canal. Ethnic differences in the location of the mental foramen have been published. Since the mandibular canal ascends and curves crestally from its lowest part below the first molar to the mental foramen, the mental foramen is located close to root apices of adjacent teeth. In the vertical view, the mental foramen might even be located more crestally to the apices of the adjacent teeth [9]. A group of researchers studied 100 patients using CT scans and evaluating the distance from the mental foramen to the alveolar crest. They found the mean distance being 14.2 mm, with side and gender showing no significant difference [9]. Von Arx et al., showed that the mean measure from the alveolar crest to the mental foramen was 12.6 mm, however this distance might not have been consistent since alveolar bone loss was not taken into consideration. They also reported that there was a significant difference for gender regarding the vertical position of the mental foramen, with male patients exhibiting greater values than females [10]. Some authors have suggested the use of the cementoenamel junction (CEJ) of adjacent teeth as a more reliable landmark. The controversy remains that in cases where those teeth are tipped, the CEJ might not present an accurate reference point [8]. Other studies have found the foramen being halfway between the crest of bone and the inferior border of the mandible. However, this measure can be influenced by the amount of crestal bone loss [5]. The mental foramen location in the horizontal plane could be race related, but is usually found to be by the apex of the lower second premolar [11]. Yet, Fishel et al., concluded that the foramen's location is not constant in the horizontal and vertical planes. When performing immediate placement of dental implants, caution is advised since the foramen may be coronal to the apex of the root of the second premolar 86. The mental foramen becomes closer to the alveolar crest as teeth are extracted and remodeling of the alveolar ridge takes place [9]. In severe cases, the mental foramen can even be in very close proximity with the alveolar ridge. In situations like this, the inferior alveolar nerve can be surgically relocated to avoid damage prior to osteotomies or oral surgical procedures. Transpositions would allow the surgeons to place dental implants in cases with insufficient vertical amount of bone. Some authors found these procedures to be highly predictable and successful, while others noted a high rate of sensory dysfunction post operatively [12].

Figure 2: Orthopantomogram showing type and position of mental foramen.

Angel et al., studied the position of the mental canal and mental foramen in adults with different age and gender, employing CBCT images. The authors found that increasing age and sex dimorphism does not have any influence on the position of the associated canal and foramen [13].

Mental foramen`s anatomical position is of significant importance in giving local anesthesia, treatments of fractures related to parasymphysis area, osteotomies required for orthognathic and implant placement, giving complete denture in mandible etc [7]. Inferior alveolar nerve gives mental and incisive branch inside the canal. Mental nerve emerges from mental foramen and supply sensory innervations to the soft tissues of the chin, lower lip and gingival on the ipsilateral side of the mandible foramen [14].

The aim of this study was to study the position, shape, and appearance of the mental foramen, as seen on panoramic radiographs of Palestinians, and to compare our findings with international values.

Materials and Methods

Six hundred digital panoramic radiograph images were randomly selected from the records of dental Palestinian patients attending three dental private services in North of palestine. Due to the nature of the study (random selection of panoramic radiographs taken over many years from multiple centers), the radiographic systems and criteria used and the exposure time all varied among the radiographs studied. However, all radiographs were taken according to the manufacturer's operation manuals and were all considered to be of optimal viewing qualities. The radiographic films were studied by our dentist team by direct observational method.

The following parameters were investigated:

- Shape of mental foramen: (oval, round or irregular shape).
- The radiologic appearance of the mental foramen as it was classified into four types described by Yosue T and Brooks SL,1989 (Table 1).
- The antero-posterior position of *mental foramen* with respect to the teeth of the lower jaw as it was classified according to the method of Tebo HG and Telford IR,1950 (Table 2).

Inclusion criteria are;

1. Palestinian origin, Age 18 and above
2. Film should show no radiographic exposure and processing artifacts.

3. OPG of adult patient of both sexes with permanent dentition at least having first molar teeth bilaterally.
4. Radiographs having bilaterally visible mental foramina taking by same machine.

Exclusion criteria for this study were poor film quality, the patients under 18 years and with orthodontic treatment or presence of periodontal lesions in the mandibular area between 36–46 (distance from the right to the left first mandibular molar), radiographs showing supernumerary teeth in the mental foramen region, and radiographs showing processing or exposure errors and artifacts obscuring visibility of structures in the mandible. Regarding the antero-posterior position of mental foramen, another criterion was excluded, which is unerupted premolar teeth or missing mandibular teeth, i.e, the two premolars and the first molar should exist on each side of the mandible.

Of the six hundred panoramic images, five hundred sixty four were included. Of the five hundred sixty-four radiograph images included in the study, three hundred sixty-eight were selected to investigate the antero-posterior position of the mental foramen. All calculations were performed with SPSS 16 programme and descriptive statistics were performed. Frequency distributions and cross tabulation were obtained, and chi-square test was used to perform analyses of the mental foramina's anterior-posterior position, shape and symmetry. P-value of <0.05 was considered as significant.

Results

The antero-posterior position of the mental foramen in relation to mandibular teeth:

The most common position of the mental foramen was between the first and second mandibular premolar in 41.6% for right and 39.7% for left side of mandible, followed closely by location in line with the longitudinal axis of the second mandibular premolar 37.5% for right and 39.4% for left side of the mandible (Table 3).

The shape and radiographic appearance of the mental foramen:

The shape of *mental foramen* was round in 51.6 % for right and 51.6% for left side of mandible; oval in 8.3 % for right and 10.5% for left side of mandible; and irregular in40.1% for right and 43.6% for left side of mandible. (Table 4).

The most common radiographic appearance of the *mental foramen* was the continuous type with prevalence of 77.8% for right and 73.8 % for left side of mandible (Table 5).

Discussion

Mental foramen is a key factor in many of the surgical as well as clinical procedures in routine clinical practice [11]. Mental foramen represents the termination of the mental canal [12]. The mental nerve passes through the mental foramen, supplying sensory innervation to the lower lip, buccal vestibule, and gingiva mesial to the first mandibular molar [13]. The mental foramen has been reported to vary in position in different ethnic groups [4].

Matsuda (1927) reported on the location of the mental foramen in three hundred and twenty nine mandibles. The age at death, sex,

Table 1: The radiologic appearance of the mental foramen.

Category	Radiograph Appearance
Continuous	Foramen has continuity with the mandibular canal
Separated	Foramen distinctly separated from the canal
Diffuse	Foramen has indistinct border
Unidentified	Foramen cannot be identified

Table 2: Position of Mental Foramen in relation to teeth.

Classification	Description
I	Foramen lying on a longitudinal axis of passing between the canine and first premolar.
II	Foramen lying on the longitudinal axis of the first premolar.
III	Foramen lying on the longitudinal axis passing between first and second premolar
IV	Foramen lying on the longitudinal axis of the second premolar
V	Foramen lying on the longitudinal axis passing between the second premolar and first molar
VI	Foramen lying on the longitudinal axis of first molar.

Table 3: The antero-posterior position of mental foramen.

Position	Right %	Left%
I	2.7%(n=10)	3.8%(n=14)
II	7.9%(n=29)	7.3%(n=27)
III	41.6%(n=153)	39.7%(n=146)
IV	37.5%(n=138)	39.4%(n=145)
V	9.5%(n=35)	9%(n=33)
VI	0.8%(n=3)	0.8%(n=3)
Total 100% (n=368) 100%(n=368).		

Table 4: Mental foramen shape (oval, round or irregular shape)

Shape	Righ		Left	
	N	%	N	%
Round	291	51.6	259	51.6
Oval	47	8.3	59	10.5
Irregular	226	40.1	246	43.6
total	564	100	564	100

Table 5: The radiologic appearance of the mental foramen: percentage of occurrence:

MF appearance	Right		Left	
	N	%	N	%
Continuous	439	77.8	416	73.8
Separated	74	13.1	84	14.9
Diffuse	49	8.7	63	11.2
Unidentified	2	0.4	1	0.2
total	564	100	564	100

and ethnic group of samples were unknown. The mean distance between the upper borders of the mental foramina to the upper margin of the alveolar process was 10.5 - 18.0 mm and the distance between the lower borders of the mental foramina to the lower border of the mandible was 11.5 - 16.0 mm. The most frequent location of the mental foramen in relation to the lower teeth was below the second premolar [15].

de Freitas et al. (1976), studied the direction of the mental canal in both horizontal and vertical planes on two hundred and seventy five human adult mandibles of one hundred and eighty five men and ninety women from Brazil were used. The age of the samples was not determined. The study showed that the mental canal was oriented postero-latero-superior, antero-latero-superior, and toward both posterolatero- superior and antero-latero-superior in relation to horizontal plane. The posterolatero- superior direction was predominant in both sexes, while an antero-laterosuperior direction was more prominent noted in females than in males [16].

Fishel et al. (1976), examined "1000" full mouth intraoral radiographs to evaluate the location of the mental foramen. The mental foramen was identified in only 936 (46.8%) of the 2000 sides examined, 482 on the left side and 454 on the right side. In 30% cases the mental foramen was clearly identified bilaterally. It was identified unilaterally in 33.6% of cases. In 36.4% the mental foramen could not be identified clearly. In the horizontal plane, the position of the mental foramen was between premolars, in the apical area of the premolars and mesial or distal to the premolar area with 70%, 22% and 7.5 % of the cases respectively. In the vertical plane, the highest percentage of mental foramina was found to be located superior to the level of the apices of the premolars [9].

Gershenson et al. (1986), studied five hundred and twenty five mandibles. The mental foramen was located below the second premolar in 43.66% of cases. Green (1987) reported on the anteroposterior position of the mental foramen in eighty seven southern Hong Kong, Chinese skulls of known sex. The age ranged from 15 to 81 years. They compared their results with those reported for other population groups. The mean position was below the second premolar tooth, a result similar to that reported for other Mongoloid populations and posterior to the position in Caucasoids and anterior to the position in Black African group [17].

Kekere-Ekun (1989), reported that the location of the mental foramen in the horizontal plane was studied in six hundred and four oblique lateral radiographs of Nigerian mandibles. The age and sex were known. The modal position of the foramen was in line with longitudinal axis of the second premolar in 55.63 % of the radiographs, while 26.99 % occurred along the interdental space between the first and second premolars. The author concluded that the location of the mental foramen was asymmetrical in 12.3% of these patients, and more frequently in females in 53% of cases; the right foramen was located more posteriorly than the left foramen [18].

Kjaer (1989), investigated the formation and location of the human mental foramen in forty three human foetuses. The sex and ethnic group of the foetuses were not reported. Histochemical methods supplemented by macroscopic visualization were used. The study indicated that the position of the mental foramen in the very early period was between the primary canine and the primary first molar then it changed posteriorly during the first half of the prenatal period [19].

Yosue and Brooks (1989), studied the position of the mental foramen on panoramic and periapical radiographs taken from four dry skulls of an infant, a teenager, an adult female and an adult male. The study found that any change in exposure conditions affected both appearance and the relative vertical position of the foramen. On the panoramic radiographs, the mental foramen appeared more consistently than on the periapical radiographs. The study concluded that the radiographic diameters of the mental foramina change according to the positioning of dry skulls and the angulation of x-ray equipment [20].

Santini and Land (1990), studied sixty eight Chinese and forty four British skulls of known or calculated age at death to evaluate the antero-posterior position of the mental foramen. The sex of the British skulls was unknown. The sample was divided into two groups above and under twenty seven years old. This study showed that there were no significant differences in the size of the Chinese and British mandibles. The most common position of the foramen in the Chinese sample was in line with the longitudinal axis of the second premolar tooth, whereas, in the British sample, it was below the space between the first and second premolar. The mean distances of the mental foramen from the symphysis menti was 27.6 (± 1.6) mm and 25.9 (± 2.0) mm in the Chinese and British skulls respectively with statistically significant differences and from the posterior border of the ramus was 70.8 mm and 71.2 mm in the Chinese and British skulls respectively. The foraminal position apparently moved distally in both groups with age and this was likely to be associated with mesial tooth drift and age-related attrition [21].

Mwaniki and Hassanali (1992), reported that seventy nine adult Kenyan mandibles were studied to locate the mental foramen. The sex and the age at death were not reported. The result showed 56.1% of the mental foramina were located below the second premolar while 31.1% were between the second premolar and first molar. The mental foramen opened postero-superiorly in 72.5% of the surfaces [22].

Phillips et al. (1992), reported on seventy five adult human skulls, radiographed with a paralleling technique to determine the size and position of the mental foramen. The age and sex of the subjects were not reported. The radiographic size of the foramen was determined and compared with values reported in other studies, and was found to be smaller than the anatomical sizes previously given. There were no significant differences in size and visualization of the mental foramina between the right and left sides. The position of the mental foramen was usually 2.18 mm mesial and 2.41 mm inferior the radiographic apex of the mandibular second premolar [23].

Shankland (1994), investigated a sample of sub-continental Indians of unknown age or sex, the sample being made up of one hundred and thirty eight mandibular sides. This study revealed that the position of the mental foramen was located directly below the second premolar in 75.36% of cases. In addition, 6.62% of the mandibles had accessory mental foramina [24].

Soikkonen et al (1995), reported on a study in which the distance of the mental foramen and mandibular canal from the lower cortex of the mandible were compared in a radiographed series of forty edentulous elderly women with advanced alveolar atrophy and 40 elderly women who had 10 or more lower teeth. The ethnic group or age of patients was not reported. The study showed that the mental foramen was positioned in edentulous jaws on average 3.8 mm lower than in dentulous jaws. The authors concluded that the mental foramen seems to descend as a result of alveolar atrophy [25].

Mbajiorgu et al. (1998), described the position of the mental foramen using thirty two mandibles derived from adult Black Zimbabweans of unknown age and sex. The position of the mental foramen was most frequently located below the lower second premolar tooth on the right side and posterior to it on the left side. In the vertical plane, the mental foramen lay slightly below the midpoint of the distance between the lower border of the mandible and the alveolar margin in 44.1% on the right and 45.5% on left sides respectively. In the horizontal plane, the mental foramen was situated approximately one quarter of the distance between the mandibular symphysis and the posterior border of the ramus of the mandible with 27.3% on the right and 27.4% on the left sides. The authors concluded that the location of the mental foramen in Black Zimbabweans, in relation to lower teeth, was at variance with other population groups, and that this should be considered when undertaking surgical anaesthetic procedures [7].

Al Jasser and Nwoku (1998), studied four hundred and fourteen panoramic radiographs of a Saudi population of age ranged from 14 to 64 years old to demonstrate the most common position of the mental foramen. After twelve males and five females were excluded because the mental foramen could not be identified on both sides, finally a total of three hundred and ninety seven panoramic radiographs were analysed there being two hundred and thirty five males and one hundred and sixty two females. The modal position of the mental foramen was along the longitudinal axis of the second premolar in 45.3% of cases and along the space between the first and second premolars in 42.7% of cases. The authors found that the mental foramen was symmetrical in 80% of cases [26].

Berge and Bergman (2001) noted the position and bilateral symmetry of the mental foramina in a hundred randomly selected skulls. The age, sex and ethnic group of samples were not identified. The mean size of the foramen was 2.43 x 1.76 mm. There were no significant differences between the mean size of the mental foramen on the right and left sides. The result found, only 1% of the mental foramina had double openings and another 1% had triple openings [27].

Aktekin et al. (2003), stated that the position of the mental foramen was studied in fifty eight adult Turkish skulls of unknown sex. Based on the age, these skulls were divided into two groups. The most common position of the mental foramen was below the space between the first and second premolars. The distances of the mental foramen from the mandibular symphysis and the inferior border of the mandible were measured. With regard to these distances, the study found there were significant differences between the two groups [28].

Ngeow and Yuzawati (2003) reported on the position of the mental foramen in a selected Malay population, determined by using one hundred and sixty one panoramic radiographs of Malay patients. The age ranged from 14 to 43 years old. The most common position of the mental foramen was in line with the longitudinal axis of the second premolar in 69.2% followed by along the space between the first and second premolar in 19.6% of cases. The right and left foramina were bilaterally symmetrical in 67.7% patients [11].

Roopa et al. (2003), reported that one hundred and forty two South Indian mandibles of unknown sex and age were examined to assess the variations in location of the mental foramen. Accessory mental foramina were also assessed [29].

Olasoji et al. (2004), reported on one hundred and fifty seven panoramic radiographs, randomly selected from Nigerian adults of known sex. The commonest position of the mental foramen was along the interdental space between the first and second mandibular premolars in 34% of the cases, followed by the position apical to the second premolars in 25.5% of the cases. There were no significant differences in the distribution between sexes and sides in most cases [30].

Smajilagic and Dilberovic (2004) studied the location of the mental foramen using orthopantomogram radiographs. The age, sex, and the ethnic group were not reported. The study revealed the modal position of the mental foramen was in line with the longitudinal axis of the second premolar. In the vertical plane, on the orthopantomogram, the mental foramen occurred slightly below the midpoint of the distance from the alveolar margin to the inferior border of the mandible. In the horizontal plane, the mental foramen lay approximately one third of the distance between the symphysis menti and the posterior border of the ramus of the mandible [31].

Agthong et al. (2005), studied one hundred and ten adult skulls. Sex was determined and recorded as seventy males and forty females. The distances from the mental foramina to midline and to the inferior border of the mandible were measured bilaterally. The mean distances from the mental foramina to the midline were 28.0 (± 0.2) mm on the right and 27.8 (± 0.2) mm on left side. The mean distances from the mental foramina to the inferior border of the mandible were 14.5(± 0.2) mm and 14.4 (± 0.1) mm on the right and left sides respectively. With regard to these measurements, there were no significant differences between both sides [32].

Apinhasmit et al. (2006), investigated one hundred and six Thai adult skulls there being sixty seven males and thirty nine females to determine the locations of the mental foramen. The age of the skulls ranged between 18 and 83 years old. There was no significant difference between the ages of sexes. The mean distance from the centre of the mental foramen to the symphysis menti was 28.52 (± 2.15) mm. There were significant differences with regard s to all measurements between sexes; the measurements in males were longer than in females. Whereas, there were no significant differences between sides except that the right mental foramen was situated more laterally than the left mental foramen. The modal position of the foramen was observed in line with the second lower premolar followed by the space between the first and second premolars. There

was sex difference with regard to distribution of the foramen position. In 57.3% of cases the mental foramen was situated lateral to the sagittal plane passing through the supraorbital foramen and in 23.4% of the total subjects, the supraorbital, infraorbital and mental foramina were situated on the same sagittal plane. The direction of the mental foramen opening was usually in a postero-superior direction [33].

Prabodha and Nanayakkara (2006) carried out a study on twenty four Sri Lankan hemi mandibles, to determine the location of the mental foramen. There were fifteen male and nine female subjects. The age ranged from 47 years to 103 years old. The measurements were obtained by using a vernier calliper. The mean distances from the mental foramen to the symphysis menti, posterior border of the ramus, and inferior border of the body of the mandible were 26.52 mm, 65.38 mm and 12.25 mm respectively. This study stated that the modal position of the mental foramen was located below the apex of the second premolar (75%) followed by a location between the first and the second premolar tooth (25%) [34].

Kim et al. (2006), reported on one hundred and twelve mental foramina of a Korean population of seventy two males and forty females. All patients had fully erupted lower premolars, the age ranged from 12 to 69 years old. The horizontal and vertical locations were evaluated both directly and by radiographic measurements. The most common position of the mental foramen in direct and radiographic measurements was in line with the second premolar in 64.3% and 62.5% of cases respectively. The mean distances from the superior border of the mental foramen to the cusp tip by direct and the panoramic measurements were 23.42 mm and 25.69 mm respectively and to the bottom of the mandible were 14.33 mm and 16.52 mm respectively [35].

Fabian (2007) reported that the location of the mental foramen from a hundred mandibles of adult black male Tanzanians. The location of the mental foramen was determined in relation to the mandibular teeth. The mental foramen was located in most cases either below the apices of the second premolar or more posteriorly. The most common position of the mental foramen was in line with the longitudinal axis of the second premolar tooth in 45% of cases, followed by below the space between the second premolar and the first molar in 35% of cases. In 78% of the mandibles, the right / left side location of the mental foramen was asymmetrical. The direction of the mental foramen opening was mainly superiorly in 44% and postero-superiorly in 40% of cases [36].

AL-Khateeb et al. (2007), conducted a study using eight hundred and sixty panoramic radiographs of Jordanians, with a female to male ratio of 1:1.4. The ages ranged from 12 to 77 years old. The modal position of the mental foramen with regard to the anterior-posterior position was along the space between the mandibular premolar teeth in 47% of cases, followed by the position along the apex of the second premolar in 40% of cases. There was a significant difference between male and female. With advancing age, there was an increase in the frequency of a more posterior and inferior positioning. With regard to the superior-inferior position, the commonest position of the mental foramen was below the level of the apices of the mandibular premolar roots, with no significant difference between the males and females. The foramen moved inferiorly with advancing age [37].

Yesilyurt et al. (2008), determined the position of the mental foramen in different population groups. Seventy adult mandibles from a Turkish population (Eastern Anatolian population) of unknown age and sex were investigated. The most common position of the foramen was along the axis of the second premolar tooth in 55.7% on the right and in 61.4% on the left side. The mean distances from the alveolar crest to the lower border of the mandible crossing the mental foramen was 19.94 mm on the right side and on the left side was 20.10 mm, the distance from the inferior border of the foramen to the lower border of the mandible was 9.44 mm and 9.46 mm respectively, in other words, at the midpoint of the mandibular body height. Also the mental foramen was found at 1:3.5 of the distance from the symphysis menti to the posterior border of the ramus [38].

Oliveira et al. (2009), determined the location of the mental on eighty mandibles of unknown sex and ethnic group. Only adult mandibles were used in this study. The mean distances, from the inferior margin of the mental foramen to the inferior border of the mandible was 12.96 (± 1.57) mm on the right side and on the left side was 12.96 (± 1.32) mm and from the superior margin of the mental foramen to the alveolar ridge were 12.82(± 3.4) mm and 12.82 (± 3.22) mm respectively. The location of the mental foramen related to the mandibular dentition on the right side was localized in similar statistic proportions between the first and second premolars and below the second premolar, in 45.17% of the mandibles. On the left side it was predominantly found between the first and second premolars with 48.48% of the mandibles [39].

Haghanifar and Rokouei (2009) analysed four hundred panoramic radiographs of an Iranian population there being one hundred and seventy eight males and two hundred and twenty two females of known age to demonstrate the most common location of the mental foramen. This study found that the mental foramen was situated along the space between the first and second mandibular premolars in 47.2% of patients and in line with the longitudinal axis of the second premolar in 46%. In 49.2% of males, the mental foramen was below the second premolar. In 50.9% of females the foramen was between the first and second premolars. The position of the mental foramen was symmetrical in 85.7% of cases [40].

Lopes et al. (2010), analyzed variations in the mental foramen position in eighty adult mandibles in Southern Brazil. The sex and the age at death were not reported. The distances from the centre of the mental foramen, to the sagittal midline was 25.98 (± 2.19) mm on the right side and 26.30 (± 2.41) mm on the left side, to the lower border of the mandible was 14.12 (± 1.80) mm and 13.55 (± 1.94) mm respectively. The modal position of the mental foramen in related to the mandibular teeth was posterior to the first premolar and the frequency of the double mental foramina was 7.5% on the right side and 3.8% on the left side of cases. With regard to the distance between the foramen and the midline there was no significant difference between the right and left sides, whereas, there was a significant difference with regard to the distance from the foramen to the lower border of the mandible between sides, greater on the right side [41].

Pria et al. (2011), evaluated five hundred digital panoramic images using only the right side of the mandible of adult dentate patients. The most frequent position of the mental foramen was along

the space between the first and second mandibular premolar in 59% of cases [42].

Rupesh et al. (2011) reported on the most common position and symmetry of the mental foramen in a randomly selected Asian Indian population using digital panoramic radiographs of five hundred cases there being two hundred and fifty males and two hundred and fifty females. The age of subjects ranged from 18 to 79 years old. The results revealed that the modal position of the mental foramen relative to the teeth was in a line between the first and second premolars in 47.6% of cases. The second most common position was in line with the second premolar in 33.5% of cases. The mental foramen was symmetrical in 57%, and asymmetrical in 43% of radiographs. The study concluded that the sex and symmetry did not influence the position of the mental foramen in this population [43].

Parmar et al. (2013), studied fifty adult human mandibles from Eastern Indian population with a complete dentition and intact alveolar margin of unknown sex. The morphometric measurements were taken using Vernier callipers. The modal position of the mental foramen in related to the lower teeth was below the second premolar in 64.7 % of cases on the right and 66.7 % of cases on the left side, whereas, the next common position was between the premolars in 21.6% on the right and 19.6% of cases on the left sides. The mean distances of the anterior margin of the mental foramen from the symphysis menti was 23.3 mm on the right and 22.5 mm on left sides. The mean distance of the posterior margin of the mental foramen from the posterior border of ramus was 61.3 mm and 62.5 mm on the right and left sides respectively. The mean distance of the superior margin of the mental foramen from the alveolar crest was 10.6 mm on the right and 10.3 mm on the left side. The mean distance of the inferior margin of the mental foramen from lower border of the body of mandible was 10.7 mm on the right and 10.7 mm on the left side [44].

The majority of mental foramen was round in shape and bilaterally symmetrical and this result is similar with the result in Jordanian population [37]. *However, it is in contrast to other studies where the most common shape was oval in other populations* [7,36.46]. Many studies have investigated the position of mental foramen using radiograph methods [9], multi-detector computed tomography [45,47], or direct observation in dissected human cadaver mandible . To determine the position, shape, number and radiographic appearance of the mental foramen, conventional radiograph images were used in this study. It has been concluded that the diagnostic performance of conventional and digital panoramic images seems to be equal for the localization of mental and mandibular foramena [9,20,48].

Panoramic radiographs were used in this study because the mental foramen was seen more consistently on the wide field of view in panoramic radiographs of the mandible than on periapical radiographs. A weakness of our study is the use of panoramic radiographs for localization of the mental foramen instead of the use of an anatomic study on skulls. Panoramic radiographs showed a greater displacement of the foramen compared with anatomical measurements; however, the difference in the horizontal position found by the two methods was not statistically significant. Further anatomical studies using skulls should be conducted in a Palestinian population. The limitations of this study are small sample size. A larger sample size would also enable a more detailed assessment of the position and type of mental foramen.

Conclusion

The most common position of the mental foramen in Palestinian population was between the first and second mandibular premolars followed closely by location in line with the longitudinal axis of the second mandibular premolar. The shape of the mental foramen was round in majority of cases, showed as continuous type in radiographic images, and bilaterally symmetrical. These findings are in consistence with previous results in other populations. *It is evident from these studies that location of mental foramen is related with race.* Hence, our study may provide the necessary data of mental foramen among population and may be useful for the surgeons, anesthetists, neurosurgeons and dentists to carry out procedures without complications.

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