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RESEARCH ARTICLE

RADIOGRAPHIC EVALUATION OF POSITION OF MENTAL FORAMEN IN WESTERN INDIAN POPULATION

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ABSTRACT

Knowledge of the position of the mental foramen is important when administering regional anesthesia, orthodontic tooth movement/surgery and performing periapical surgery in the mental region of mandible. The mental foramen has been reported to vary in different ethnic groups.

Objectives: The objectives of the present study were to identify the most common position of mental foramen on panoramic radiograph in the western Indian population. Its symmetry of location on right and left sides and gender differences were also analysed.

Methods: 400 digital panoramic radiographs of randomly selected western Indian population were evaluated with the consideration that mental foramen was clearly visible.

Results: In the analysis of the sample, it was found that the mental foramen is located anywhere between the long axis of 1st premolar to the long axis of 1st molar tooth, the most common location of mental foramen in the present study was in line with the 2nd premolar.

Conclusion: The most common location of mental foramen drawn from this study is in line with 2nd premolar followed by between 1st and 2nd premolar tooth which is most of the times symmetrical on both right and left sides. There are no statistically significant differences regarding position and symmetry of mental foramen with gender.

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INTRODUCTION

The mental foramen (MF) is defined as the entire funnel like opening on the lateral surface of the mandible at the terminus of the mental canal. (Phillips *et al*., 1992) The MF marks the termination of the mandibular canal in the mandible and transmits the mental nerve which provide the blood supply and sensory innervations to lower lip, buccal vestibule, gingiva mesial to the mandibular first molar and the anterior aspects of the chin on the ipsilateral side of the mandible. (Bavitz *et al*., 1993) The accurate identification of the MF is important for both the diagnostic and clinical procedures. The radiographic appearance of MF may result in a misdiagnosis of a radiolucent lesion in the apical area of the mandibular premolar teeth. Clinically the mental bundle could be injured during orthognathic surgery especially sliding genioplasty and periapical surgery. It is a strategic landmark during osteotomy

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procedures. (Hwang *et al*., 2005) The regional anesthesia of the terminal incisive branches of the inferior alveolar and mental nerves can be obtained effectively if the MF is identified correctly. As the jiachenjiang point lies within the mental foramen, it is also of vital importance to the practice of acupuncture, in the treatment of trigeminal neuralgia. (Oliveira Junior *et al*., 2007) The recent trend of using dental implants have greatly increased the interest in MF localization as the mental nerve can be damaged during implant surgery. (Benson and Brooks, 2001) This injury can be avoided if the implant is placed one millimeter anterior to the anterior border of mental foramen. (Bavitz *et al*., 1993) Mental nerve injury can cause transitory or permanent sensitive, thermal and tactile changes. These altered sensations are preventable if the mental foramen is located and this knowledge is employed when performing surgical procedures in foramen area. (Greenstein and, Tarnow 2006) Generally, the MF is difficult to locate due to lack of consistent anatomic landmarks for reference and foramen cannot be clinically visualized or palpated. (Phillips *et al*., 1992) Panoramic radiography has gained popularity in the last four decades and is probably the most utilized diagnostic modality in dentistry for localization of mental foramen. Based on its radiographic appearance MF has been classified by Yosue and Brooks (1989) into four types.

Type 1- Mental canal is continuous with the mandibular canal
Type 2- Foramen is distinctly separated from the mandibular canal.
Type 3- Diffuse with a distinct border of the foramen.
Type 4- Unidentified type, in which the mental foramen cannot be identified on panoramic radiographs under ordinary exposure and viewing conditions.

Dental anthropologic studies of the origin and the variation of the human dentitions, is a useful tool because the physical anthropologist relies upon the MF in the identification of species, races and determining age. Most textbooks describe that the MF is commonly found between the apices of the first and second premolars. Although this teaching is in accord with the results of early studies of some European populations. The present study was undertaken to determine the most common position of MF in a randomly selected western Indian population using panoramic radiographs.

MATERIALS AND METHODS

This observational study was conducted in the Department of Oral Medicine and Radiology of Dr D Y Patil Dental College and Hospital, Pune, India. The study population considered for this study was drawn from the patients referred to the Department of Oral Radiology for panoramic radiograph. The protocol of the study was approved by the ethical and the scientific committee of the institution. We evaluated 400 digital panoramic radiographs of patients for the position of mental foramen. Out of these 295 panoramic radiographs were selected for study. These are subject to the consideration that the position of the mental foramen is clearly seen on the radiograph.

Procedure

Panoramic radiography was performed with the patient in a standing position & the mandible placed on the chin rest of the machine. The patient's head was tilted 5^{o} downwards with reference to Frankfort's plane so that mandibular canal and mental foramen is visualized properly. The OPG machine Used in this study is "PANMECA proline XC" with specifications: 72 kVp, 10 mA and 15 seconds.

Exclusion criteria

1. Persistence of radioluscent lesion in the lower jaw anywhere in the area extending from the right 1st molar to left 1st molar.
2. Presence of missing teeth in the lower jaw between right 1st molar to left 1st molar.
3. Non visualization of mental foramen bilaterally.
4. Incomplete eruption of permanent teeth.
5. Patient under 18 years.
6. Presence of periodontal lesion.
7. Patients with previous orthodontic treatment.
8. Presence of crowding and spacing of lower jaw.

The position of the image of the mental foramen was recorded as follows:

Position 1: Situated anterior to the first premolar.
Position 2: In line with the first premolar.
Position 3: Between the first and second premolar.
Position 4: In line with second premolar.
Position 5: Between second premolar and first molar.
Position 6: In line with first molar.

The edge of a ruler was used to identify the longitudinal axis of the nearest tooth and the position of MF was recorded. If the MF is too large or situated between two teeth the position of the foramen was established after drawing an imaginary line parallel to the long axis of tooth. The location of the MF was recorded on the basis of gender, symmetry or asymmetry. Statistical analysis was done by applying chi-Square Test.

RESULTS

400 randomly selected OPG's were evaluated. Out of 400 OPG's, 105 radiographs were excluded according to the exclusion criteria previously mentioned. Out of 295 OPGs 191 were males and 104 were that of females (Table 1). These 295 OPGs were assessed for position of mental foramen on both sides and hence assessment of 590 (295x2) mental foramens were done. In the analysis of the sample, it was found that the MF is located anywhere between the long axis of 1st premolar to the long axis of 1st molar tooth (Tables 2 and 3). Out of 590 samples, 14 were in position 2, 185 were in position 3, 318 were in position 4, 71 were in position 5, 2 were in position 6 and none were in position 1. However, the most common location of mental foramen in the present study was in line with the 2nd premolar. This is in accordance with many other studies conducted by different researchers. Position of MF was the second most common location in our study. In the present study MF was symmetrical in 238 radiographs out of which 156 were in males and 82 were in females, which is in accordance with the other studies. No MF was found in Position 1 which is anterior to first premolar and only one MF was located below 1st molar tooth (Position 6) in this study.

Table 1. Position wise distribution of samples

Position	Frequency
Position 1	**0**
Position 2	**14**
Position 3	**185**
Position 4	**318**
Position 5	**71**
Position 6	**2**
Total	**590**

Table 2. Distribution of position of mental foramen on both sides by gender

Position	Males			Female			Total
	R	**L**	**Total**	**R**	**L**	**Total**	
Position 1	-	-	-	-	-	-	-
Position 2	**5**	**6**	**11**	**2**	**1**	**3**	**14**
Position 3	**59**	**66**	**125**	**27**	**33**	**60**	**185**
Position 4	**98**	**93**	**191**	**61**	**66**	**127**	**318**
Position 5	**27**	**24**	**51**	**15**	**5**	**20**	**71**
Position 6	**1**	**1**	**2**	**-**	**-**	**-**	**2**
Total	190	190	380	105	105	210	590

Table 3. Position of mental foramen in present study by gender and symmetry

Position	Sex	Symmetry	Asymmetry	Total	x^2 value	p value
Position 1	**M**	**-**	**-**	**-**	**-**	**-**
	F	**-**	**-**	**-**	**-**	**-**
Position 2	**M**	**6**	**5**	**11**		
	F	**0**	**3**	**3**	**2.864**	**0.091^{ns}**
Position 3	**M**	**108**	**17**	**125**		
	F	**48**	**12**	**60**	**1.256**	**0.262^{ns}**
Position 4	**M**	**162**	**29**	**191**		
	f	**110**	**17**	**127**	**0.199**	**0.655^{ns}**
Position 5	**m**	**36**	**15**	**51**		
	f	**10**	**10**	**20**	**2.669**	**0.102^{ns}**
Position 6	**m**	**2**	**0**	**2**		
	f	**0**	**0**	**0**	-	-
Total		**482**	**108**	**590**		

(Table 2 and 3) However, there was no significant difference between males and females regarding symmetry of mental foramen or its most common location. (Table 3)

DISCUSSION

Radiography is the most commonly used non invasive method for diagnosis and treatment planning of major surgical procedures of the mandible. Panoramic radiographs is the most commonly used radiograph for diagnosis and selection of the best possible surgical approach. In the present study panoramic radiographs are utilized because they have certain advantages over intraoral radiographs. They include a greater area of hard and soft tissue and also the ability to visualize adjacent areas, thus allowing for more accurate localization of the MF on both sides. The periapical radiographs do not reveal the MF if it fall below the edge of the rim. (Phillips *et al*., 1992) Despite the development of advanced radiological examinations such as computed tomography, the conventional radiographs are more commonly used, since advanced imaging techniques exposes the patient to higher doses of radiation[8] In the present study 400 panoramic radiographs were examined. Out of 400 randomly selected radiographs 105 radiographs were excluded according to the exclusion criteria previously mentioned. Out of 295 OPGs 191 were males and 104 were that of females.

Patients above the age of 18 were selected because the study needed patients with completed skeletal growth. The presence of periodontal lesions and also previous orthodontic treatment could cause tooth migration and therefore were omitted from the study.In the analysis of the sample, it was found that the MF is located anywhere between the long axis of 1st premolar to the long axis of 1st molar tooth. The reason for the difference in position could be due to the shape of the foramen itself. The MF is a funnel-shaped opening in the buccal cortical bone of the mandible. The direction of exit through the bone is usually in a posterior and superior direction. The smallest diameter of the foramen would usually be inferior and mesial to the buccal surface of the mandible. It appears that the radiographic foramen corresponds to the smallest diameter of the foramen on the internal surface of the buccal plate. (Phillips *et al*., 1992)

However, the most common location of mental foramen in the present study was in line with the 2nd premolar. (Table1) This is in accordance with many other studies conducted by different researchers. Wang *et al* (1986) in Chinese population, found that most common location for MF was below second premolar (58.98%). (Wang *et al*., 1986) Al Jasser and AL Nwoku (1998) in Saudi population, the most common position of MF was in line with the apex of the second premolar (45.3%). (Al

Jasse and Nwoku, 1998) Wei Cheong Ngeow and Yusof Yuzawati (2003) in Malay population, found that the most common position for the MF relative to the teeth was in line with the second premolar for both the right and left side (n = 223, 69.24%). (Wei Cheong Ngeow and Yusof Yuzawati, 2003) Apinhasmit *et al*. (2006) in Thai population, found that the most common location of MF was below 2nd premolar. (Apinhasmit *et al*., 2006) Kim I S *et al* (2006) in Korean population, found that in 72 patients (64.3%), the MF was below the second premolar. (Kim *et al*., 2006) Maise Mendonça Amorim *et al*. (2008) on Brazilian population, 71.1% were located below apex of second premolar tooth on right side. (Maise Mendonça Amorim *et al*., 2008) Oliveira Junior *et al.* (2009) work was to study the morphology and morphometry of the MF. As to the localization related to the mandibular dentition, it was localized in similar statistic proportions between the 1st and 2nd premolars and above the 2nd premolar, in 45.17% of the mandibles. (Oliveira Junior *et al*., 2007) Isurani Ilayperuma *et al.* (2009) in Sri Lankan population found that the most common position for the MF relative to the lower teeth was in line with the second lower premolar for both right (58.82%) and left (47.06%) sides as well as genders (male 55%; female 42.86%). (Isurani Ilayperuma *et al*., 2009) Suneel Kumar Punjabi (2010) in Pakistani population, the results revealed position 4, which is below the root of second premolar tooth, to be most common location of MF with frequency 47.2 %. (Suneel Kumar Punjabi *et al*., 2010) Luay N. Kaka *et al*. (2010) in Baghdad population, found that the most common location for MF was below second premolar tooth, in their sample 72 showed this position. (Luay N. Kaka *et al*., 2010) Deepa Rani Agarwal and Sandeep Gupta (2011) in Gujarat population, MF was below 2nd premolar in 85% of cases. (Agarwal and Gupta, 2011) Rajni singh *et al*. (2011) in North Indian population, MF was situated below the apex of second premolar tooth in 68.8% of mandibles. (Rajani Singh *et al*., 2011) Sumit Gupta and Jagdish Soni (2012) in Gujarat, India population, MF was situated below the apex of 2nd premolar in 75.8% of mandibles. (Sumit Gupta and Jagdish,
2012)

Literature also mentions that position 3, which is in between the apices of 1st and 2nd premolars, to be the most common position of MF. This is in agreement with the studies done by some researchers. Santini and land (1990) in British population, results showed that 65% of MF were between 1st and 2nd premolars. (Santini, 1990) Moiseiwitsch (1998) in a North American population, the majority of mental foramina were located between the first and second premolars. (Julian *et al*., 1998) Olasoji *et al.* (2004) in Northern Nigerian Adults, the most common location of MF was the interdental space between the first and second mandibular premolars (radiographs=34%, dry mandibles= 32.8%). (Olasoji *et al*., 2004) Gungor *et al*. (2006) in a Turkish population, found that the most common position of the MF was between the first premolar & the second premolar (71.5%). (Gungor *et al*., 2006) Haghanifar and Rokouei (2009) in an Iranian population, the most common position of MF was position 3, which is between the first and second premolar (47.2%). (Sina Haghanifar, 2009) Rupesh *et al.* (2011) in Asian population, their results showed that 65% were between 1st and 2nd premolars. (Rupesh *et al*., 2011) This position is the second most common position of mental foramen in the present study. In the present study MF was symmetrical in 238 radiographs out of which 156 were in males and 82 were in females, which is in accordance with the other studies. (Tables 2 and 3)

No MF was found in Position 1 which is anterior to first premolar and only one MF was located below 1st molar tooth (Position 6) in this study. However, there was no significant difference between males and females regarding symmetry of mental foramen or its most common location. (Table 3)

The following conclusions can be drawn from the present study:

1) MF is not always seen on the OPG.
2) MF can be located anywhere from the long axis of 1st premolar to the long axis of 1st molar tooth.
3) Position of MF might change with reference to the apices of teeth in conditions like periodontitis, previous orthodontic treatment, missing teeth, age of the patient, etc. hence these should be considered while evaluating for MF.
4) The most common location of MF drawn from this study is in line with 1st premolar (Position 4) followed by between 1st and 2nd premolar tooth (Position 3).
5) MF is most of the times symmetrical on both right and left sides.
6) There are no statistically significant differences regarding position and symmetry of MF with gender.

The present study may prove to be useful for surgeons, implantalogists and anaesthetists while performing surgery or delivering local anaesthesia in this region. This might decrease the complications arising from mental nerve injury. The study may also be useful for anthropologists and acupuncture therapists.

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