

Assessment of Position and Bilateral Symmetry of Occurrence of Mental Foramen in Dentate Asian Population

SNEHA KETAN GADA¹, SUHASINI J. NAGDA²

ABSTRACT

Introduction: The mental foramen shares its significance in various fields of dentistry. Being a strategically eminent landmark, an understanding of the variation of its position is important

Aim: To radiographically evaluate frequently occurring position of mental foramen and its distance with reference to the lower premolars and the lower border of mandible on standardized panoramic radiographs.

Methods: The inferior alveolar canal, upto the mental foramen, was traced over 300 orthopantomographs (OPGs) which were selected by using specific criteria. The mandibular plane and the long axis of the premolars were used as references to measure perpendicular distance of foramen.

Results: The most common position was found to be between the two premolars (63% cases), which scaled approximately 15.46mm above the lower border of the mandible, with an average proximity to the 2nd premolar (5.51mm) than the 1st premolar (8.21mm). This was followed by position behind the second premolar, which scored 20.67%. Both the foramina were noted in the same vertical plane of reference, and they showed bilateral occurrence of the most common position of the mental foramen, with respect to 45.67% cases.

Conclusion: The most common location was reported to be between the two premolars, with a definite bilateral symmetry on both left and right sides. No gender preferences were observed. An average distance of 15mm from the lower border of the mandible was calculated.

Keywords: Mental Foramen, Mandibular plane, Panoramic radiographs, Bilateral symmetry

INTRODUCTION

A strategically eminent landmark, the mental foramen (MF) shares its significance in various fields of dentistry. Being defined as- "A funnel like opening on the lateral surface of the mandible at the terminus of the mandibular canal", it transmits mental nerves and vessels, providing sensory innervations and blood supply respectively [1].

Accurate identification of the mental foramen is important for both diagnostic and clinical procedures. Repeated failures which are witnessed during mental nerve blocks indicate its variability of location in a given population [2, 3]. Its radiographic misdiagnosis as a radiolucent lesion in the apical area of the mandibular premolars can lead to iatrogenic injuries. Treatment concepts for dental implant patients identify mental foramen and its anterior loop as a critical surgical landmark and essential reference point during treatment planning. It has also been acknowledged through various studies, that surgical trauma caused to the mental nerve bundle as a result of inappropriate prior assessment, would result in altered sensation from 8.5% to 24% during periods of upto 3-16 months post-operatively following implant surgeries [4,5].

A survey of published literature, investigated the location of MF directly on dry mandibles or by using radiographs of dry mandibles or patients. Debate initiates, as standard anatomical and radiological textbooks contain conflicting statements on location of MF. Contrasting results over the most common position of the foramen brood over positions between the two premolars and below the apex of second premolar. These, in addition to the illustrating presence of positional variability, also highlight existence of racial variability, as was documented in multiple studies, further intensifying complications of pre-surgical judgment [6-25].

Considering these factors, a retrospective study on the variability of the position of the mental foramen was carried out on standardized orthopantomographs of dentulous patients. Panoramic radiography is a curved plane topographic technique which allows broad coverage of oral structures with low radiation exposures (about 10% of full-mouth radiographs). However, major drawbacks include low image resolution, high distortion, and presence of phantom images. Despite developmental advancements in radiological examinations such as

computed tomography, conventional panoramic radiographs are more commonly used, since advances in imaging techniques not only expose the patient to higher doses of radiation, but also are an expensive affair [17-19]. Need for economically reasonable yet accurate radiographical technique continues. This study was done to investigate the position of mental foramen which was relative to the mandibular premolars and the inferior border of the mandible, its bilateral symmetry, gender differences, if any and the presence of the anterior loop.

MATERIALS AND METHOD

A total of 1123 panoramic radiographs of patients, which were taken for diagnostic purposes at Smile Care Center in Mumbai City (India), over the period which extended from Jan 2009 to Dec 2011, were examined in this study by a single examiner. Of the 1123 radiographs of patients whose ages varied from 18 years to 66 years, 300 radiographs were chosen, which best met the inclusion criteria.

The inclusion criteria were presence of a minimum of 22 teeth, including the lower canines, premolars and first molars, diagnostic images which clearly showed visible and traceable borders of mandible which had acceptable density and contrast, with minimal positioning errors and minimum or no superimposition of structures. Radiographs with mixed, unerupted or incomplete dentitions, and those showing a presence of radio-opaque/ radiolucent pathological lesions in the body of mandible, anywhere in the area which extended from right third molar to the left third molar, were excluded.

Classification of MF, based on interpretation from panoramic radiography, which was stated by Yosue and Brooks [20] is of Four types:

- Type I- Mental foramen being continuous with mandibular canal.
- Type II- Mental foramen being distinctly separated from the mandibular canal.
- Type III- Mental foramen being diffused with an indistinct border.
- Type IV- Unidentified type, in which the mental foramen could not be identified on panoramic radiographs under ordinary exposures and

viewing conditions.

The radiographs in which the mental foramen was difficult to identify (Type IV) under ordinary exposures and viewing conditions were also excluded from examination.

All panoramic radiographs were taken by using Sirona X-ray unit ORTHOPHOS 3 (tube potential: 60-80 kV, tube current: 4-12 mA, focal size: 0.5 mm, exposure time: 11.3 s and magnification factor of 1:1.25) and high quality processing (Sirona Dental Systems, Bensheim, Germany). The values obtained from the panoramic measurements were corrected for their magnifications.

Tracing of the canal upto the foramen, including the anterior loop of the nerve, if it was present, was done on OPGs, viewed on an X-ray viewer. Mandibular plane was drawn by a line which connected the gonion and lowermost point of lower border of mandible was considered as the horizontal reference. Long axes of the premolars served as the vertical references. The position of the image of the mental foramen was recorded according to the categories which were put forward by Jasser and Nwoku [21], which were as follows:-

Position 1: Anterior to the first premolar,

Position 2: Below the first premolar,

Position 3: Between the premolars,

Position 4: Below the second premolar,

Position 5: Posterior to the second premolar,

In terms of the perpendicular distance between the arbitrary centre of mental foramen and the reference line [Table/Fig-1,2].

Few anatomical variations, such as unilateral and bilateral bifid mental nerves which terminate in the respective mental foramen, were gauged by using the mean centre of the two foramina.

The approval for the prerequisites was taken from the ethics committee of Nair Hospital Dental College. The radiographs were investigated and the readings were tabulated for statistical analysis, which was performed using Analyse-it 3 statistical software.

RESULTS

The 300 panoramic radiograph which were evaluated, were grouped



[Table/Fig-1]: Orthopantomograph of the patient before tracing
[Table/Fig-2]: Orthopantomograph after tracing depicting the constructed mandibular plane (red arrow) as vertical reference and the long axis of the two premolars (dotted lines) as the horizontal reference

Position w.r.t. the long axis	Mean (Std. Deviation)			
	1 st Premolar		2 nd Premolar	
	Right	Left	Right	Left
Behind	9.12 (4.44)	8.92 (3.99)	1.25 (2.80)	1.07 (2.40)
Ahead	5.72 (3.45)	7.48 (1.58)	6.10 (3.44)	5.85 (2.91)
Along	9.23 (3.32)	4.67 (2.78)	4.24 (2.85)	4.57 (2.56)

3 (A)

	Lower border of Mandible	
	Right	Left
Mean	15.52	15.26
Std. Deviation	2.74	2.89
%Probability	70.67	67.33

3 (B)

[Table/Fig-3a]: (A) Horizontal reference
[Table/Fig-3b]: (B) Vertical references
[Table/Fig-3a,b] Table showing the mean and the standard deviation values (in mm) and the number and percentage of patients falling within the range of Mean ± Standard Deviation

into those of 150 males and females each.

The most common position was found to be between the two premolars, i.e. Position 3, in approximately 63% cases, which also showed bilateral symmetry in 45.67% cases. This was followed by position 5, i.e. behind the second premolar, which scored 20.67%.

On assessing the vertical reference, the mean distance from the mental foramen was found to be on an average of 15.39mm from the vertical border of the mandible [Table/Fig-3a,3b], [Table/Fig-4,5].

Anterior loop of mental nerve was found to be present in 45.3% cases on the right side and in 55.3% cases on the left side, with a bilateral occurrence in 35 % cases.

DISCUSSION

There has been a relentless battle with regards to the most common

Position	Male		Female		Total
	Right Frequency (%)	Left Frequency (%)	Right Frequency (%)	Left Frequency (%)	
1	7 (4.67)	7 (4.67)	5 (3.33)	3 (2)	22 (3.67)
2	4 (2.67)	5 (3.33)	3 (2)	2 (1.33)	14 (2.33)
3	100 (66.67)	90 (60)	87 (58)	101 (67.33)	378 (63)
4	11 (7.33)	17 (11.33)	20 (13.33)	14 (9.33)	62 (10.33)
5	28 (18.67)	31 (20.67)	35 (23.33)	30 (20)	124 (20.67)

[Table/Fig-4]: Frequency and percentage as calculated for the male and female individually for each side and a total value for the whole sample size

		No. of cases (Percentage) occurring on the left side						
		Position						
No. of cases (Percentage) occurring on the Rightside	Position	1	2	3	4	5	Total	
	1	1	1	0	6	2	3	12
		3.33%	0.00%	2.00%	0.67%	1.00%	4.00%	
2		0	1	2	2	2	7	
			0.00%	0.33%	0.67%	0.67%	0.67%	2.33%
3		7	5	137	11	27	187	
			2.33%	1.67%	45.67%	3.67%	9.00%	62.33%
		4	1	0	21	3	6	31
		0.33%	0.00%	7.00%	1.00%	2.00%	10.33%	
5		1	1	26	13	22	63	
		0.33%	0.33%	8.67%	4.33%	7.33%	21.00%	
	Total	10	7	192	31	60	300	
	3.33%	2.33%	64.00%	10.33%	20.00%	100.00%		

[Table/Fig-5]: Showing the number and percentage cases showing occurrence on the right and left side under various positions as classified by Jasser and Nwoku [21]

position of the mental foramen in view of its variations in different populations and ethnic groups.

The results of this study, which reported the most common location of the foramen to be between the two premolars, showed similarity with the findings of recent studies done in the Central Asian population, hence giving confirmatory evidence of the presence of a racial predilection over the location of the foramen [22-25]. However, variances have also been published in the studies which were done over other populations which described the MF to be most frequently aligned with the second premolar [6-16].

A summary of the recent studies done on various racial and ethnic groups has been summarized in [Table/Fig-6].

Measurements of the vertical distance, which were calculated by Sankar et al., which scaled to 16.5 mm and 14.3 mm respectively on the right and the left sides (giving an average distance of 15 mm) [22], matched the average value of 15.46mm, which was accounted for in

Sample size	Year	Distribution					Population	Reference	Technique	Journal
		1	2	3	4	5				
169	2003	0	3.4	19.6	69.2	7.7	Malay	Ngeow et al., [11]	Pan.*	J. Oral Sci
70	2005	0	2.8	10	62.9	24.3	Malawian	Igbigbi et al., [12]	DM†	West Afr J Med
361	2006	1.2	3.2	71.5	22.4	1.33	Turkish	Gungor et al., [6]	Pan.	Coll. Antropol.
72	2006	-	-	26.8	64.3	-	Korean	Kim et al., [13]	Pan.	Implant Dent
100	2007	-	-	-	45	35	Tanzania	Fabian et al., [14]	DM	Ital J Anat Embryol.
70	2008	-	-	30	-	-	Turkish	Yesilurt et al., [7]		Folia Morphol
400	2009	0	1.6	47.3	46	5.1	Iranian	Haghanifar et al., [8]	Pan.	Indian J Dent Res
500	2011	40		55		33.2		Pria et al., [9]	Pan.	J Contemp Dent Pract.
500	2013	-	4.4	44.4	43.2	8	Kosovarian	Kquiku et al., [10]	Pan.	Coll. Antro.
377	2013	0.4	1.32	30	62.8	5.3	Moroccan	Chkoura et al., [15]	Pan.	Imaging Sci Dent

[Table/Fig-6]: Comparison showing the percentage position of the mental foramen in different populations and ethnic groups

*Pan= Panoramic radiograph , †DM= Dry mandible

the present study, which ascertained that the referencing from the lower border of the mandible remained undeviated, even with the relocation of the MF closer to the alveolar crest, which was attributed to the post extraction resorption of the alveolar bone [15]. The bilaterally symmetrical occurrence of the mental foramen, which was commonly observed between both the premolars in this study, has obtained an assorted review of references [26-28].

Identification of presence of anterior loop is imperative for surgical interventions in the area, particularly for implant placements and hence a safety zone establishment has been reviewed in all surgical procedures as the surgical rationale of the mental foramen's position, as well as, when the anterior loop is suspected of being present [29].

CONCLUSION

In conclusion, the most common location of the foramen for the south Asian population was found to be between the two premolars. However, inter and intraracial variations have been reported. Hence, comprehending the significance of being aware of possibility of anatomical variations of the foramen as well as determining its location during the pre-operative radiological examinations were included in planning of the following surgery. The findings of this study could aid as the most common orientation of the mental foramina in the Indian population and they could help in gauging a safety limit during surgical procedures.

REFERENCES

- Shaik HS, Muralidhar P Shepur, Desai SD, Thomas ST, Maavishettar GF, Haseena S. Morphological and morphometric study of mental foramen south indian mandibles. *Indian Journal of Medicine and Healthcare*. 2012; 1(3):64-66.
- Pokhrel R, Bhatmagar R. Position and number of mental foramen in dry human mandibles: Comparison with respect to sides and sexes. *Open Access Anatomy*. 2013 Dec 1;1(4):31.
- Siddiqui AU, Daimi SR, Mishra PP, Doshi SS, Date JY, Khurana G. Morphological and Morphometric analysis of mental foramen utilizing various assessment parameters in dry mandibles. *Int J Stud Res*. 2011;1(1):19-22.
- Massey ND, Gaili KA, Wilson TD. Determining position of the inferior alveolar nerve via anatomical dissection and micro-computed tomography in preparation for dental implants. *J Can Dent Assoc*. 2013;79:d39.
- Greenstein G, Tarnow D. The mental foramen and nerve: clinical and anatomical factors related to dental implant placement: a literature review. *J Periodontol*. 2006 Dec;77(12):1933-43.
- Gungor, K, Ozturk M, Semiz M, Brooks SL. A radiographic study of location of mental foramen in a selected Turkish population on panoramic radiograph. *Coll Antropol*. 2006; 30: 801-05.
- Yesiluyurt H, Aydinlioglu A, Kavakli A, Ekinci N, Eroglu C, Hacialiogullari M, et al. Local differences in the position of the mental foramen. *Folia Morphol (Warsz)*. 2008 Feb;67(1):32-5.
- Haghanifar S, Rokouei M. Radiographic evaluation of the mental foramen in a selected Iranian population. *Indian J Dent Res*. 2009; 20: 150-52.
- Pria CM, Masood F, Beckerley JM, Carson RE. Study of the inferior alveolar canal and mental foramen on digital panoramic images. *J Contemp Dent Pract*. 2011 Jul 1;12(4):265-71.
- Kquiku L, Weiglein A, Kamberi B, Hoxha V, Meqa K, Städtler P. Position of the mental foramen in Kosovarian population. *Coll Antropol*. 2013 Jun;37(2):545-9.
- Ngeow WC, Yuzawati Y. The location of the mental foramen in a selected Malay population. *J Oral Sci*. 2003 Sep;45(3):171-5.
- Igbigbi PS, Lebona S. The position and dimensions of the mental foramen in adult Malawian mandibles. *West Afr J Med*. 2005 Jul-Sep;24(3):184-9.
- Kim IS, Kim SG, Kim YK, Kim JD. Position of the mental foramen in a Korean population: a clinical and radiographic study. *Implant Dent*. 2006 Dec;15(4):404-11.
- Fabian FM. Position, shape and direction of opening of the mental foramen in dry mandibles of Tanzanian adult black males. *Ital J Anat Embryol*. 2007 Jul-Sep;112(3):169-77.
- Chkoura A, El Wady W. Position of the mental foramen in a Moroccan population: A radiographic study. *Imaging Sci Dent*. 2013 Jun;43(2):71-5. doi: 10.5624
- Neiva RF, Gapski R, Wang HL. Morphometric analysis of implant-related anatomy in Caucasian skulls. *J Periodontol*. 2004 Aug;75(8):1061-7
- Bahlis, Alexandre, et al. Accuracy of periapical radiography, panoramic radiography and computed tomography for examining the mental foramen region. *Rev Odontol Ciênc*. 2010; 25 (3) [cited 2013-12-06];282-87.
- Misch CE. Rationale for Implants. In: St. Louis: the CV Mosby Company Misch CE Implant Dentistry, 3rd ed.; Part 1: Chapter 3, 2008; 56.
- White SC, Heslop EW, Hollender LG, Mosier KM, Ruprecht A, Shrout MK. Parameters of radiologic care: An official report of the American Academy of Oral and Maxillofacial Radiology. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2001 May;91(5):498-511.
- Yosue T, Brooks SL. The appearance of mental foramina on panoramic radiographs I. Evaluation of patients. *Oral Surgery Oral Med Oral Pathol*. 1989; 68:360-64.
- Jasser NM Nwoku AL. Morphometrical and morphological study of mental foramen in dry dentulous mandibles of South Andhra population of India. *Dentomaxillofac Radiol*. 1998; 27 :341.
- Sankar DK, Bhanu SP, Susan PJ. Morphometrical and morphological study of mental foramen in dry dentulous mandibles of South Andhra population of India. *Indian J Dent Res*. 2011;22:542-6.
- Rupesh S, Winnier J, John SA, JoyT, Rao AP, Reddy V. Radiographic study of the location of mental foramen in a randomly selected Asian Indian population on digital panoramic radiographs. *Journal of Medical Sciences*. 2011 Feb;2: 90-95.
- Carlos M Pria, Farah Masood, Joy M Beckerley, Robert E Carson. Study of the inferior alveolar canal and mental foramen on digital panoramic radiographs. *The Journal of Contemporary Dental practice*. 2011;12(4):265-71.
- Shah P, Parikh K, Shah M, Khan F. Radiographic study of mental foramen in a selected Indian population in Kheda District, Gujarat. *Journal of Indian Academy of Oral Medicine and Radiology*. 2013; 25(1): 13-17.
- Mbajiorgu EF, Mawera G, Asala SA, Zivanovic S. Position of the mental foramen in adult black Zimbabwean mandibles: a clinical anatomical study. *Cent Afr J Med*. 1998 Feb;44(2):24-30.
- Singh R, Srivastav AK. Study of Position, Shape, Size and Incidence of Mental Foramen and Accessory Mental Foramen in Indian Adult Human Skulls. *Int J Morphol*. 2010; 28(4):1141-46.
- Oguz O, Bozkir MG. Evaluation of location of mandibular and mental foramina in dry, young, adult human male, dentulous mandibles. *West Indian Med J*. 2002 Mar;51(1):14-6.
- Misch CE. Root form surgery in in the edentulous mandible: Stage 1 implant insertion. In: St. Louis: the CV Mosby Company Misch CE Implant Dentistry, 2nd ed.; 1999; 347-70.

PARTICULARS OF CONTRIBUTORS:

- 3rd Year B.D.S. Student, Nair Hospital Dental College, Mumbai, India.
- Dean, Nair Hospital Dental College, Director, Medical Education and Major Hospitals, Brihanmumbai Mumbai Nagar Palika, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Sneha Ketan Gada,
A/2, Gita Building, P. Ramabai Road, Gamdevi, Mumbai – 400007, India.
Phone: +918097086613, E-mail: snehagada@yahoo.co.in

FINANCIAL OR OTHER COMPETING INTERESTS: None.

Date of Submission: **Aug 03, 2013**

Date of Peer Review: **Nov 29, 2013**

Date of Acceptance: **Jan 18, 2014**

Date of Publishing: **Feb 03, 2014**