RESEARCH ARTICLE

MORPHOLOGICAL AND MORPHOMETRIC ANALYSIS OF MENTAL FORAMEN IN DRY HUMAN MANDIBLES

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ABSTRACT

Background: The position and its morphological variations of Mental Foramen are very important because it will be helpful to localize the important maxillofacial neurovascular bundle passing through. It is landmark to facilitate surgical, local anaesthetic and other invasive procedures for dental surgeons performing peri-apical surgery in the mental region of mandible.

Aims & Objective: To Study morphological and morphometric analysis of mental foramen in dry human mandibles.

Material and Methods: 50 dried adult human mandibles with complete dentition and intact alveolar margin of unknown sex were used for this study. The shape of MF observed was either oval or rounded. The morphometric measurements which were recorded using Vernier callipers.

Results: The most commonly present position of the MF as related to the lower set of teeth was in line with the second premolar, i.e. Type 4 (64.7 % cases on the right and 66.7 % cases on the left side). Next common position was Type 3, i.e. between the premolars (21.6% on right and 19.6% on the left sides. The mean distance between symphysis mentii and anterior margin of MF was 23.3 mm and 22.5 mm, on the right and left sides respectively. Mean distance between posterior margin of MF and posterior border of ramus was 61.3 mm on the right side and 62.5 mm on the left side.

Conclusion: The present study reveals valuable insights on the information concerning the morphology of mental foramen in various populations and races. The knowledge of the distances from surgically encountered anatomical landmarks in the present study provide valuable information to dental surgeons that will facilitate effective localization of the neurovascular bundle passing through mental foramen thus avoiding complications from local anaesthetic, surgical and other invasive procedures.

KEY-WORDS: Mental Foramen; Human Mandible; Morphometric; Morphological; Measurements

Introduction

Mental Foramen (MF) is an important anatomical landmark to facilitate surgical, local anaesthetic and other invasive procedures for dental surgeons performing peri-apical surgery in the mental region of mandible. The mental foramen (MF), from which the mental nerve and vessels emerge, lies below either the interval between the premolar teeth, or below the second premolar tooth.[1] The mental foramen marks the termination of the mandibular canal in the mandible, through which the inferior alveolar nerve and vessels pass. At this point, the mandibular canal bifurcates and forms the mental and incisive canals.[2] The mental bundle passes through the mental foramen and supplies sensory innervation and blood supply to the soft tissues of the chin, lower lip and gingiva on the ipsilateral side of the mandible.[3] To anesthetise the anterior teeth, including the premolars and canines, it is possible to avoid giving inferior alveolar block, by injecting anaesthetic solution adjacent to the mental foramen.[4] Although this is termed mental injection or mental nerve block, the aim of the injection is to affect the inferior alveolar and incisive nerves in that region.[4] Studying the position and its morphological variations of MF is very important because it will be helpful to localize the important maxillofacial neurovascular bundle passing through the MF.

Considering the importance of the MF, this study was undertaken to investigate the morphology and variations in the position of the MF by the morphometric assessment of the relation of MF to the lower teeth, body of the mandible, mandibular symphysis and to the posterior border of the ramus.

Materials and Methods

50 dried adult human mandibles with complete dentition and intact alveolar margin of unknown sex were used for this study. Out of which 40 were procured from the first year students while 10 were from the departmental collection. The study was conducted in the Department of Anatomy, Smt NHL municipal medical college and V.S. hospital, Ahmedabad from November 2011 to July 2012.

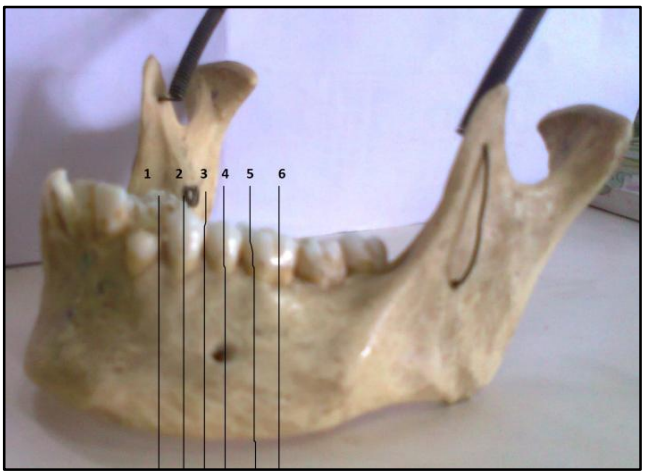

Figure 1: 1/2/3/4/5/6- the lines showing relation of mental foramen to the lower teeth/interdental space (Types 1 to 6 as mentioned in Table No 2).

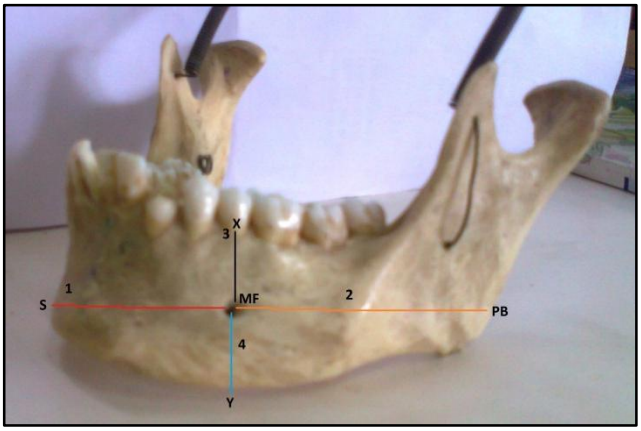

Figure 2: S- Symphysis menti, MF-mental foramen, PB-posterior border of ramus of Mandible, X-alveolar crest, Y-lower border of body of Mandible,1- Distance between S and MF, 2- Distance between MF and PB, 3- Distance between X and MF and 4- Distance between MF and Y. (Refer Table 3)

The shape of MF observed was either oval or rounded. The morphometric measurements were recorded using Vernier callipers. The findings were recorded as:

(1) The relation of MF with the lower teeth (the position of the MF was recorded as lying in line with the long axis of a tooth or interdental space in one of the six relations [5] (Figure 1): Anterior to the first premolar - Type 1; below the first premolar - Type 2; between the premolars - Type 3; below the second premolar - Type 4; posterior to the second premolar - Type 5; and below the first molar- Type 6

(2) Location of MF was identified by using following parameters: (i) Distance between symphysis menti (S) and anterior margin of MF; (ii) Distance between posterior margin of MF and posterior border of ramus (PB); (iii) Distance between alveolar crest X) and superior margin of MF, (iv) Distance between inferior margin of MF and lower border of the body of mandible (Y). (Figure 2)

For measuring the parameters, a standard horizontal plane as defined by Morrant[6,7] was utilized which states that the mandible when placed on a horizontal surface, the lower border of the mandible comes into greatest contact when vertical pressure is applied to the second molar teeth. The measurements were recorded independently by two observers and the mean of the values recorded. The findings were charted, 655analysed and compared with the findings of other workers and studies on different geographical locations and ethnic groups.

Results

Our study indicated the situational variability of the Mental Foramen (MF) as well its morphological parameters. The MF was present bilaterally in all the mandibles. It was predominantly present as an oval opening (69%).This opening was observed as horizontal as well as vertical in disposition. Rounded openings were also observed in 29% of the bones examined (Table 1).

The most commonly present position of the MF as related to the lower set of teeth was in line with the second premolar, i.e Type 4. This position was present in 64.7 % cases on the right and 66.7 % cases on the left side. Next common position was Type 3, i.e between the premolars (21.6% on right and 19.6% on the left sides)-Table 2. Referring to table 3, the mean distance between symphysis mentii and anterior margin of MF was 23.3mm and 22.5 mm, on the right & left sides respectively.

Table-1: Shape of the Mental Foramen (MF) (Comparison with Other Studies)

Shape	Present Study 2012, Eastern India (n=50)	Siddiqui[8] 2010, Western India (n=93)	Ilayperuma[9] 2009, Sri Lanka (n=51)	Fabian[10] 2007, Tanzania (n=100)	Prabodha[11] 2006, Sri Lanka (n=24)
Oval	69(69%)	65(70%)	30(59%)	54(54%)	16(66.67%)
Rounded	31(31%)	28(30%)	21(41%)	46(46%)	8(33.33%)

Table-2: Position of the MF in Relation to Lower Teeth/ Interdental Space (Comparison with Other Studies)

Study	Location	Year	Type 1		Type 2	Type 3	Type 4	Type 5	Type 6
Present Study (n=50)	Eastern India	2012	R			11 (21.6%)	33 (64.7%)	4 (7.8%)	2 (3.9%)
			L			10 (19.6%)	34 (66.7%)	5 (9.8%)	1 (2%)
Siddiqui[8] (n=93)	Western India	2010	R	1 (1.07%)	6 (6.45%)	39 (41.93%)	41 (44.08%)	6 (6.45%)	0
			L	1 (1.07%)	8 (8.60%)	33 (35.48%)	43 (46.23%)	8 (8.60%)	0
Ilayperuma et al[9] (n=51)	Sri Lanka	2009	-		-	26.47%	52.94%	-	-
Yesilurt[5] (n=70)	Turkey	2008	R	-		34.3%	-	-	
			L	-	-	25.7%	-	-	
Fabian[10] (n=100)	Tanzania	2007	-		-	-	45%	35%	-
Kim et al[12] (n=72)	Korea	2006	-		-	26.8%	64.3%	-	-
Ngeow[13] (n=169)	Malaysia	2003	-		-	19.6%	69.2%	-	-
Gingor[14] (n=361)	Turkey	2006	-		-	71.5%	22.4%	-	-

Table-3: Situation of MF with Respect to Mandibular Parameters (Comparison with Other Studies)

	Present Study (n=50)	Siddiqui[8] (n=93)	Yesilurt[5] (n=70)	Kim et al[12] (n=72)	Prabodha[11] (n=24)	Apinhasmit et al[15] (n=69)	Singh et al[16] (n=96)
Location	Eastern India	Western India	Turkey	Korea	Sri Lanka	Thailand	North India
Year	2012	2010	2008	2006	2006	2006	1992
Variable studied	Mean values	Mean values	Mean values				
Distance between S and MF	R=23.3	R=18.8	R= 19.18		26.52	28.83	23.6
	L=22.5	L=19.6	L= 19.37				
Distance between MF and PB	R=61.3	R=48.8	R= 48.58		65.38	68.85	76.2
	L=62.5	L=47.9	L= 48.27				
Distance between X and MF	R=10.6	R=10.2	R= 10.5				15.3
	L=10.3	L=10	L=10.64				
Distance between MF and Y	R=10.7	R=9.9	R=9.44	14.33	12.25	14.88	14.0
	L=10.7	L=10.1	L=9.46				

All values in mm. S- Symphysis menti, MF-Mental Foramen, PB- posterior border of ramus, X- Alveolar crest, Y- Lower border of the body of mandible

Mean distance between posterior margin of MF and posterior border of ramus was 61.3 mm on the right side and 62.5 mm on the left side. Mean distance between alveolar crest and superior margin of MF was 10.6 mm on right side and 10.3 mm on the left side. Mean distance between inferior margin of MF and lower border of the body of mandible was 10.7 mm on the right side and was 10.7 mm on the left side. Similar findings have been reported in Western indian[8] and Turkish mandibles[5]. The variability in the readings may be attributed to the chewing habits, age, mesiodistal tooth size and the attrition of the proximal surface.

Discussion

Profound anaesthesia of the mental nerve is imperative for endodontic treatment and thus the credibility of this study lies in the fact that the accurate knowledge of the various morphologic and morphometric parameters of the MF can be of immense help in proper localization of the important maxilla-facial neurological structures in and around the MF. Also, it is of clinical assistance during surgical interventions.

In the present study, the most commonly encountered shape of the MF was oval (69%) followed by a rounded shape in 31% cases. Referring to table no 1, this predominance of the val shape has also been reported by other workers, though the values vary in different populations.[8-11]

The most commonly seen position of the MF in relation to the lower teeth/interdental space was seen below the 2nd premolar (Type 4) in 64.7% cases on the right and 66.7% on the left. Referring to Table No 2, this commonest position has been described in 52.94% cases in Sri Lankan cases [9], 44.08% (R) and 46.23% (L) cases in western

India[8], 55.7% (R) and 61.4% (L) cases in Turkish mandibles[5], 45% in Tanzanian studies[10], 64.3% in Koreans[12] and 69.2% in Malay populations[13].

Yesilyurt et al (2008)[5] in their study have quoted that the most common positions for the MF were (i) below the second premolar tooth (Type 4) in Chinese, Kenyan Africans, Nigerians and Mongoloid populations; (ii) posterior to the second premolar (Type5) in Caucasians and Zimbabweans, between the premolars (Type 3) in Negroid, British, Central Anatolian and North American white populations. A very similar scenario for Types 3 and 4 was present in Saudi population.

Haghanifar and Rokouei (2009)[17] in their radiological study of the MF, reported that the most common position of the MF was between the two premolars (as in Type 3 in our case), it being 47.2%. Another study from Turkey has shown that the most common position of the MF was between the two premolars, Type 3, (71.5% cases).[14] As regards the situation of the MF with respect to mandibular parameters (Table No 3), differences are seen amongst Western India[8], Turkish[5], Korean[12], Sri Lankan[11], Thai[15] and North Indian samples[16].

The review of the available literature shows that the MF shows racial and ethnic variations. Moreover the variations in the values indicate towards the variational mandibular dynamics of the population under consideration. Many of the differences can also be attributed to the variability in the chewing habits of different populations, leading to differential development of the mandible.

The restoration and form and function without violating important anatomic structures are the fundamental goal in the surgical management of any patient. One of these is the Mental Foramen. Its identification and preservation in periapical surgery, implant surgery, maxillofacial surgery and orthographic procedures is of utmost importance.[18] Moreover, it also aids in interpreting landmarks in oral pathology and forensics.[19] To avoid nerve injury during surgery in the foraminal area, guidelines should be developed based on the literature with respect to verification of the position of the MF.[20]

Dental anthropologic studies of the origin and the variation of the human dentitions, is a useful tool because the physical anthropologist relies upon the mental foramen in the identification of species, races and determining age. Structures useful for identification purposes include size, number and location of cusps, occlusal pattern, root configurations, number and arrangement of teeth, and individual tooth measurements [21].

Conclusion

The present study reveals valuabled insights on the information concerning the morphology of mental foramen in various populations and races. The knowledge of the distances from surgically encountered anatomical landmarks in the present study provide valuable information to dental surgeons that will facilitate effective localization of the neurovascular bundle passing through mental foramen thus avoiding complications from local anesthetic, surgical and other invasive procedures. The major limitation of this study was the non-availability of records pertaining to the sex of the bone being examined. It is suggested that pre-operative radiographs and additional radiographs from different angles if necessary should be taken to locate the MF prior to surgery. This would help immensely in ascertaining the accurate location of the MF because of its great variability and thus avoid any unforeseen injury.

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