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Original Research Article

A MORPHOLOGICAL STUDY OF MENTAL FORAMEN OF THE DRY ADULT HUMAN MANDIBLES

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ABSTRACT

Background: The principal complication of surgery of the mental foramen region is paralysis of the mental nerve. Identification of mental foramen is thus important to dental surgeons in nerve blocks and in doing surgical procedures like apicocurettage of mandibular premolars, amalgam filling, periodontal surgery etc. so as to avoid injury to neurovascular bundle. Accessory mental foramina tend to exist in the apical area of the first molar and posterior or inferior area of the mental foramen. Verification of the existence of accessory mental foramina would prevent accessory nerve injury during periapical surgery. In root canal treatment, the possibility of accessory mental foramina–related nerve paraesthesia seems low unless the mental foramen is injured. These foramina have been found to vary in position in different ethnic groups. Therefore, knowledge of morphology of mental foramen will enable effective mental block anaesthesia.

Materials and Methods: Hundred dry adult human mandibles were examined for number, shape and position of mental foramen in relation to the roots of mandibular teeth.

Results: Mental foramen was present in all hundred observed mandibles and it was bilateral. 1.5% of the mandibles showed double mental foramen which was present in the right side. None of the mandibles presented with bilateral accessory mental foramen. Taking both sides into consideration, round shaped mental foramen were observed in 106 mandibles and oval shaped in 94 mandibles. The most common position was on the longitudinal axis of the second premolar.

Conclusions: The morphologic variations of mental foramen are clinically important for dental surgeons and anaesthetists.

KEY WORDS: Mental Foramen, Morphology, Mental Anaesthesia, Apicocurettage of Mandibular Premolar, Position of Mental Foramen.

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INTRODUCTION

The mental foramen is an opening located on the external surface of the mandible in the region of the mandibular premolars. Mental nerve and vessels pass through mental foramen. Normally, mental foramen is located below the interval between the premolars. However, variations in the location of the foramen have been reported. It may lie between the apices of lower premolars or below the apex of second premolar [1].

In apicocurettage of mandibular premolars, the dentist depends on the relation of the mental foramen to the lower premolar and to the body of ramus; otherwise operation on the lower premolar may damage the mental nerve. The mental nerve injury can cause transitory or permanent sensitive, thermal and tactile changes in the areas of its innervations [2].

Knowledge of the most common position of the mental foramen of a local population is very important for oral surgeon both when administering regional anesthesia and performing periapical surgery in the mandible like implantation operations. Although it is often possible to identify the mental foramen by pulpation and radiographically, knowing the normal range of possible location is essential [2].

The presence of small foramina identified as accessory mental foramina in the surrounding area of the mental foramen has also been discovered [3, 4]. The reported frequency of occurrence of accessory mental foramina has varied between less than 5% and about 30% [5-7]. Toh et al. [8] described the distributions of accessory mental nerve emerging from the accessory mental foramina to the mucous membrane and skin of the corner of mouth to the labial region. The group indicated the possible occurrence of pain caused by injury of the nerves emerging from the accessory mental foramina by an injection via the mucous membrane. Boronat López et al. [9] mentioned the accessory mental foramina as one of the factors implicated in regional anesthesia failure.

So, the present study was undertaken to provide information on number, shape, position and variations of mental foramen. The results of this study will furnish a reference for dentists in clinical practices.

Aim: To study the morphological characteristics and variations of mental foramen in the dry adult human mandible

MATERIALS AND METHODS

The study included 100 dry human mandibles of undetermined age and gender (as they were not recorded at the time of acquisition) procured from the Department of Anatomy, Seth G.S. Medical College, Parel, Mumbai, India from October 2012 to October 2014. They were kept free from any dust, moth or insect. Each mandible was assigned a serial number. The study was approved by the Institutional Ethics Committee. The results obtained were recorded and tabulated.

The different parameters recorded were:

1. The number of mental foramina (Fig. 1 and Fig. 2)

2. The shape of mental foramina whether oval (Fig. 3) or round (Fig. 4)

3. The position of mental foramen in relation to the roots of mandibular teeth (Fig. 5)

The position of the mental foramen was recorded as either in line with the longitudinal axis of the tooth or lying in between two teeth according to following scheme:

If any part of the foramen lay on a line drawn perpendicular to the occlusal plane passing along the longitudinal axis of a tooth, the foramen was assigned that position. If any part lay on a similar line passing through the contact area between the teeth, it was assigned that position. If the foramen was too small to intersect a line or too large, intersecting two lines, then it was assigned more anterior position. The position was assigned by holding a transparent, flexible plastic sheet marked with 'T' (Fig. 6) against the lateral aspect of the mandible. The horizontal bar of the 'T' was aligned with the occlusal plane; the vertical was used to locate the foramen. The position of the mental foramen was expressed in relation to the lower teeth, in accordance with Tebo and Telford [10] as:

I – between the canine and the first premolar

II – beneath the first premolar (Fig. 7)

III – between the premolars (Fig. 8)

IV – beneath the second premolar (Fig. 9)

V – between the second premolar and first molar (Fig. 10)

VI – beneath the mesial root of the first molar (Fig. 11)

E – Edentulous, hence unable to determine the position (Fig. 12)

The average position was expressed as the

mean position rank of the six positions [11]. The use of the position rank was necessary because a linear scale could not be used [12 and 13]. Some mandibles were edentulous and position of mental foramen could not be determined in them (Fig. 12).

4.Any variation if present

Inclusion Criteria: All the mandibles available during the study period

Exclusion Criteria: Damaged bones, bones of pediatric age group and bones affected by pathology.

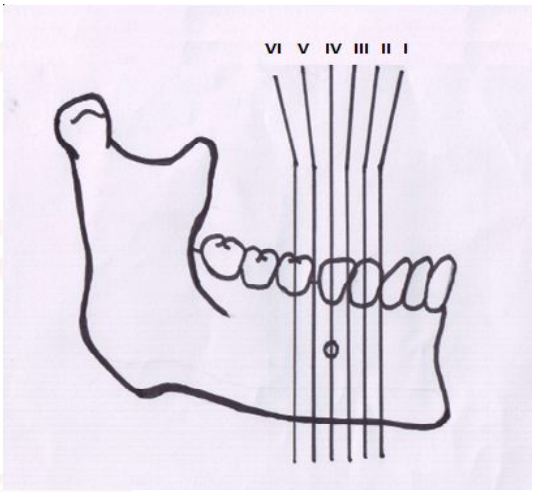
Fig. 1: Single mental foramen.

Fig. 2: Double mental foramen.

Fig. 3: Oval shape mental foramen.

Fig. 4: Round shape mental foramen

Fig. 5: Illustration showing position of mental foramen in relation to the mandibular teeth (schematic diagram)



where,

The position of the mental foramen expressed in relation to the lower teeth as follows:

I– between the canine and the first premolar

II – beneath the first premolar

III – between the premolars

IV – beneath the second premolar

V –between the second premolar and first molar

VI – beneath the mesial root of the first molar

Fig. 6: Transparent plastic sheet used to note the position of mental foramen.

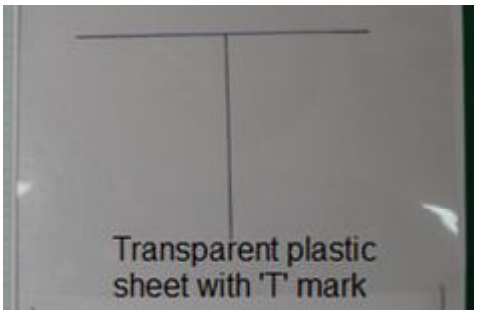


Fig. 7 - 12 Position of mental foramen in relation to the mandibular teeth

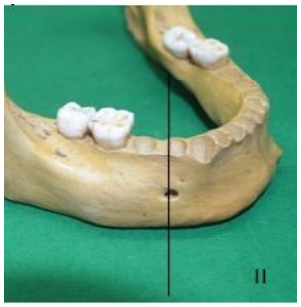


Fig. 7: Position II

Fig. 8: Position III

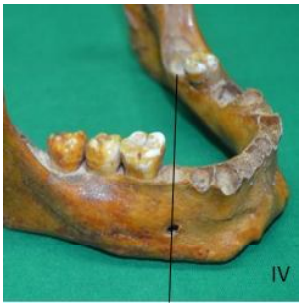


Fig. 9: Position IV

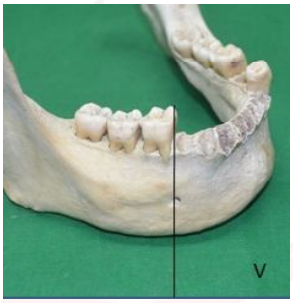


Fig. 10: Position V VVVPosition Position

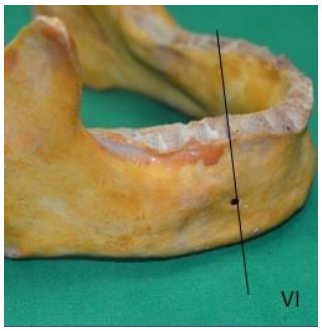


Fig. 11: Position VI

Fig. 12: Edentulous

where,

The position of the mental foramen expressed in relation to the lower teeth as follows:

II – beneath the first premolar

III – between the premolars

IV – beneath the second premolar

V–between the second premolar and first molar

VI–beneath the mesial root of the first molar

E –Edentulous

RESULTS

Incidences of Mental Foramen: Mental foramen was present in all one hundred observed mandibles and it was bilateral.

Incidences of Accessory Mental Foramen: 1.5 % of the mandibles showed double mental foramen which was present in the right side (Fig. 2). Out of these, there was a single large foramen while the others were small (satellite) foramina. There was no triple mental foramen. None of the mandibles presented with bilateral accessory mental foramen.

Round shaped mental foramen were observed in 106 sides of the mandibles and oval shaped in 94 sides of the mandibles. On both right and left sides, mental foramen was oval in 47 % of mandibles and round in 53 % of mandibles (Fig.13).

Fig. 13: Shape of mental foramen.

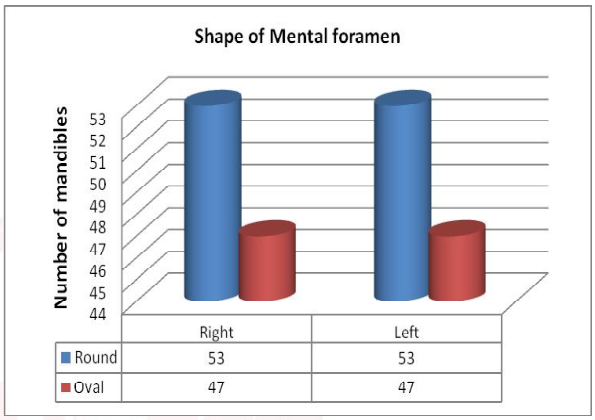
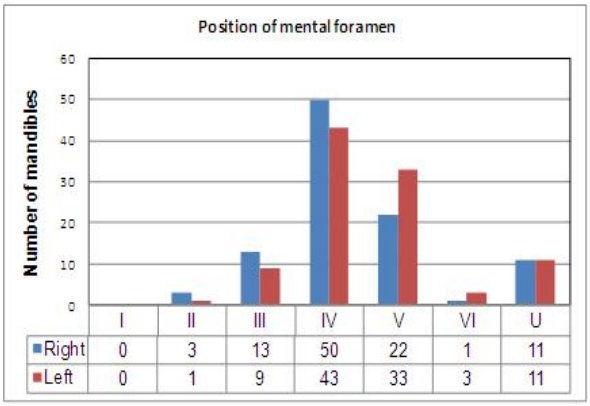


Fig. 14: Position of mental foramen.



Mental foramen was situated below the apex of second premolar tooth in 46.5 % mandibles (position IV) whereas in 27.5 % it was found between second premolar and first molar (position V). In 11 % of mandibles it was observed between first and second premolars (position III). It was seen below the apex of first premolar (position II) and below first molar (position VI) equally (2 % each). The mental foramen was not observed in between canine and first premolar (position I) in any mandible. In 22 sides, position could not be determined as they were edentulous. Position of accessory mental foramen (in 1 mandible out of 100) was found to be situated 13 mm lateral from the mental foramen below apex of first molar tooth

(position VI). It was observed to be located 11 mm above and medial to the mental foramen between first and second premolar (position III) in 1 mandible out of the same 100 (Fig.14).

where,

The position of the mental foramen expressed in relation to the lower teeth as follows:

I – between the canine and the first premolar

II – beneath the first premolar

III – between the premolars

IV – beneath the second premolar

V\ –between the second premolar and first molar

VI – beneath the mesial root of the first molar

U – position not determined

Lingual fenestrations: A fenestration is a defect in the bony plate overlying the roots of the teeth. According to Azaz & Lustmann, in the living, fenestrations are usually detected during surgical procedures when a buccal flap is raised [14]. Lingual fenestration was found on one side only of a single mandible, close to mental foramen. It was located on the lingual aspect of the junction of right first and second molars and the buccal aspect of the right first molar (Fig. 15).

Table 1: Comparison of the numbers of the mental foramen with other studies.

Study	No. of mandibles	Absent (%)	Accessory mental foramen Number (%)
Riesenfeld [3]	3987	-	197 (4.9)
DeFreitas [35]	1435	3 (0.2)	-
Gershenson [5]	525	-	28 (5.1)
Serman	408	-	11 (2.7)
Toh et al. [8]	-	-	6.7 - 12.5
Mwaniki & Hassanali [25]	79	-	4.5
Shankland [36]	138	-	6.62
Sawyer et al. [6]	705	-	42 (5.9)
Kokten et al. [37]	45	-	2.22
Stithipom	110	-	2 (1.8)
Al-Khateeb et al. [20]	860*	-	10
Katakami [38]	150	-	16 (10.6)
Naitoh [39]	157**	-	13 (8.2)
Present study	100	-	3 (1.5)

* Radiologic study ** Cone-beam computed tomography study

Fig. 15: Illustration showing lingual fenestration (probe).

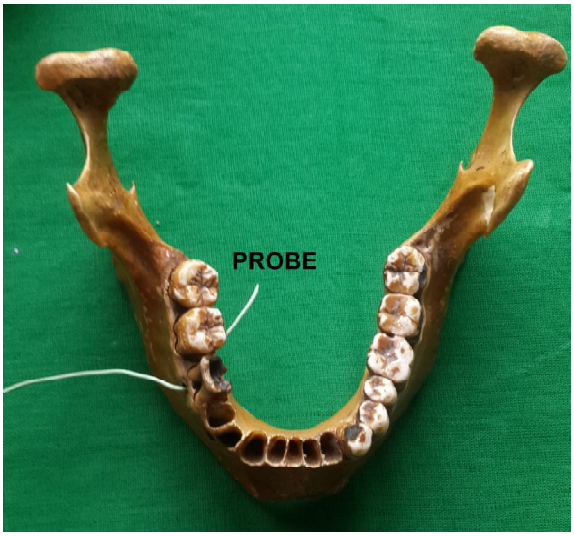


Table 2: Comparison of the shapes of the mental foramen with other studies.

Study	Year	Country	Materials for study	Shape of the mental foramen (%)	
				Oval	Round
Gershenson et al. [5]	1986	Switzerland	Dry bones (n = 525) Cadaver dissections (n=50)	65.5	34.5
Mbajiorgu et al. [21]	1998	Zimbabwe	Dry bones (n = 32)	56.3	43.8
Igbigbi, Lebona [40]	2005	Malawi	Dry bones (n = 70)	Majority	-
Prabodra, Nanayakkara [41]	2006	Sri Lanka	24 Hemi mandibles (15 Male and 9 Female- age ranged from 47 to 103 years)	66.7	33.3
Fabian [42]	2007	Tanzania	Dry bones (n = 100)	54	46
Singh, Srivastav [18]	2010	India	Dry bones (n = 100)	6.0 (right) 13.0 (left)	94.0 (right) 87.0 (left)
Agarwal, Gupta [30]	2011	India (South Gujarat)	Dry bones (n = 100)	92	8
Rastogi et al. [17]	2012	India (Central)	Dry bones (n = 87)	48.3	51.7
Gupta, Soni [19]	2012	India	Dry bones (n = 120)	11	89
Pirov, Pirov [43]	2012	Rome	Dry bones (n = 37) Radiographs (n = 30)	60.2	39.9
Udhaya [44]	2013	India (South)	Dry bones (n = 90)	83.3	16.7
Present study		India	Dry bones (n = 100)	47	53

Table 3: Comparison of the position of the mental foramen with other studies.

Study	Year	Country	Materials for study	Most common position of the mental foramen
Phillips et al. [23]	1990	US	Dry bones (n = 75)	position IV
Wang et al. [12]	1986	China	Dry bones (n = 100)	position IV (58.98%)
Santini [33]	1990	UK	Dry bones (n = 44 British) (n = 68 Chinese)	position III position IV
Mwaniki, Hassanali [25]	1992	Kenya	Dry bones (n = 79)	position IV (56.1%) position V (31.1%)
Oguz & Bozkir [27]	2002	Turkey	Dry bones (n = 34)	position IV R: 61.76% L: 50.0%
Cutright et al. [28]	2003	US	Cadavers (n = 80)	position IV
Olasoji et al. [32]	2004	Nigeria	Dry bones (n = 32)	position IV (35.9%)
			Radiographs (n = 157)	position III (34.0%)
Kokten et al. [37]	2004	Turkey	Dry bones (n = 45)	position IV (42.1%)
			Radiographs (n =114)	position IV (49.0%)
Ari et al. [26]	2005	Turkey	Dry bones (n = 36)	position IV R : 50% L : 47%
Apinhasmit et al. [24]	2006	Thailand	Dry bones (n = 106)	position IV
Amorim et al. [45]	2008	Brazil	Dry bones (n = 170)	position IV R : 71.4% L : 68.1%
Singh, Srivastav [18]	2010	India	Dry bones (n = 100)	position IV (68.8%)
Agarwal, Gupta [30]	2011	India (South Gujarat)	Dry bones (n = 100)	position IV R : 81.6% L : 81.5%
Gupta, Soni [19]	2012	India	Dry bones (n = 120)	position IV (75.8%)
Loyal et al. [31]	2014	Kenya	Cadavers (n = 32)	position IV (57.8%) position V (25.0%)
Present Study		India	Dry bones (n = 100)	position IV (46.5%) R : 50.0% L : 43.0%

DISCUSSION

The knowledge of the various parameters of mental foramen is important as it helps to avoid damage to the mental nerve in surgical procedures, aids in interpreting anatomical landmarks in oral pathology and important for implant techniques. Understanding the position of these foramina will also assist the clinician in performing local anaesthetic blocks. This information may play an even more important role in recently developed minimally invasive surgery techniques. Hence, the present study measured various dimensions of mental foramen.

Number of mental foramina: Table 1 shows that the number of mental foramen found in the present study resembled with the findings of Stithipom. Azaz & Lustmann (1973) reported multiple mental foramina in 8.6 % of the sides [14]. Jaffar et al. reported multiple mental foramina in 30 % of the mandibles on either side. Only 4 % of the mandibles showed bilateral multiple mental foramina [13]. Gershenson et al. (1986) reported multiple foramina in 5.1 % of the mandibles [5]. Multiple foramina are presumed to be the result of branching of the mental nerve prior to its exit from the mental foramen. It is not due to double or split mandibular canals (Gershenson et al., 1986). Concepcion et al. encountered an accessory branch of mental nerve adjacent to the mental foramina during flap reflection in a periapical surgery [15]. Çag¢irankaya et al. presented a case of accessory mental foramina below the apex of the first molar demonstrated with intraoral radiographies for periodontal treatment. The clinical significance of accessory mental foramina remains a presumption [16]. The knowledge of the additional foramina may be important for the radiotherapists while planning radiation therapy.

Shape of mental foramen: In present study, shape of mental foramen was round in most of the mandibles similar to findings of Rastogi et al.[17], Singh and Srivastav [18] and Gupta and Soni [19]. Al-khateeb et al. (2007) from Jordan studied 860 radiographs, also found that majority of mental foramen were round in shape [20]. According to Mbajiorgu et al. (1998) [21], in 32 mandibles of black adults from Zimbabwe, mental foramen was round in 14 mandibles (43.8%) and oval in 18 mandibles (56.3%). Oliveira Junior et al. (2009) reported that the shape was oval in 59 mandibles (73.8%) on right side and 57 mandibles (71.3%) on left side [22]. The size of mental foramen and accessory mental foramen was not evaluated in the present study. (Table 2)

Position of mental foramen: The present study shows, the location of mental foramen in line with the long axes of the second premolar as the most common position (46.5%). This result is in consistence with that of Wang et al. [12], Jaffar et al. [13], Azaz & Lustmann [14], Phillips et al. [23], Apinhasmit et al. [24], Mwaniki & Hassanali [25], Ari et al. [26], Oguz & Bozkir [27], Cutright et al. [28] and Green [29]. This shows that this is the most common finding in the majority of the ethnic groups. However, the second common position found is the position between the second premolar and first molar (position V) similar to finding of Mwaniki & Hassanali [25], Agarwal & Gupta [30], and Loyal et al. [31]. Olasoji et al. found position III (between the premolars) as the most common position for the mental foramen [32]. This suggests that traits such as the localization of mental foramen may not only differ between populations of different geographic environment but also within the inhabitants of the same geography.

The position of mental foramen below the apex of second premolar was 49% by Tebo & Telford [1950; 10], 58.98 % by Wang et al. [1986; 12], 52.9 % Santini & Land [1990; 33] and 68.8 % by Singh & Srivastav [2010; 18].

The position of tooth is a quick landmark for locating the mental nerve. Surgeons should be aware that the most common position for the mental nerve is at the second premolar. However, this should not be the sole guidance, since the mental nerve may have an aberrant tooth position. This also helps in explaining cases of failed anaesthesia, when it is targeted at the second premolar region. In such cases the junction of the second premolar and first molar should be considered as a potential alternative site for the mental nerve (Table 3).

A difference in the position of the mental foramen between the right and the left sides was observed in 31% of the mandibles studied. This was not necessarily accompanied by multiple mental foramina on either side.

During the early prenatal life mental foramen is located in the alveolar bone between the primary canine and first molar (Kjaer, 1989). Therefore, it is speculated that positions other than the most common ones are due to a lag in prenatal development [34].

Knowledge of position of the mental foramen is critical to a variety of surgical and diagnostic procedures. This data is thus clearly of direct relevance in dental teaching and practice.

4. Lingual fenestrations

The occurrence of lingual fenestrations of the lower molar tooth has been reported long back (Sicher, 1965). In present study, the incidence of lingual fenestration was 1% of the sides of mandibles (Fig. 15). This was similar to finding of Jaffar et al. [13]. However, in the present it was found in the right side. In studies by Azaz & Lustmann [1973; 14] and Jaffar et al. [2002; 13], the tendency to the left side was in concordance. Subluxation of root fragments into the submandibular space may occur if there is a fenestration in the third molar region. As these fenestrations cannot be recognized by normal radiological procedures, care should be taken to avoid subluxation. This can be done by refraining to apply pressure either along the long axis of the tooth or in a lingual direction [13].

CONCLUSION

In conclusion, the present analysis revealed variations in number, shape and position of mental foramen and accessory mental foramen. The present study suggests that local differences in mental foramen position may occur in a population. These may be related to feeding habits of different regions which may ultimately affect the development of mandibles. This variability should alert the dental surgeons while performing periodontal or endodontic surgery.

The mental foramen is difficult to localize as there are no absolute anatomical landmarks for reference. The mental foramen cannot be visualized or palpated clinically; hence it is localized in relation to the lower teeth. Further, when the existence of the accessory mental foramen is confirmed, it could avoid nerve injury during periapical surgery. The possibility of accessory mental foramen related sensory disturbance is low during root canal treatment unless the mental foramen and mandibular canal are injured.

If the studies related to variations in the

position, size, incidence and shape of mental foramen and accessory mental foramen are carried out in large numbers; it will be of immense use to the anthropologists in identifying the deceased. Moreover, the data will be reliable for dental surgeons.

Conflicts of Interests: None

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