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Original Research Article

Morphometric Evaluation of Mental Foramen of Dry Adult Human Mandibles of South Indian Population and Their Clinical Correlation

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ABSTRACT

Introduction: Morphometric assessment of mental foramina (MF) of the mandible for its variable position is considered to be helpful for the surgeons and dentists for the localized surgical procedures and for the anesthetists to execute nerve block practices. Hence the objective of the present study is to establish the morphometric variability in the position of MF in terms of gender in the mandibles of Southern Indian origin with possible clinical implications.

Methods: The shape, size, and location of MF were measured on both sides of the mandible (n=92). Location of MF was established by measuring the distance from MF to the [1] mental symphysis [2] alveolar crest, [3] the base of the mandible, and [4] posterior border of the ramus of the mandible. All the morphometric data were analyzed statistically with a significance level of $p<0.05$.

Results: The higher incidence (58.7%) of rounded MF was recorded. There were no cases of MF anterior to the first pre-molar and below the 1st molar. Most of them (45.7%) were below the 2nd premolar. There was a significant association between gender and the position of the MF (p=0.011). But, no association between gender and side as well as the shape was noted. Significant associations were found between gender and the distance from mental foramen to the posterior border of the ramus and also to the alveolar crest. A significant association between the gender and the positions of the MF was noted.

Conclusion: The variations observed from previous studies might be related to the feeding habits of different regions which may ultimately, affect the development of mandibles. Prior knowledge regarding the common positions of MF in local populations is helpful in effective nerve blocks and maxillofacial surgeries.

KEY WORDS: Mental foramen, mental nerve block, distal implant, mandible.

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INTRODUCTION

The mental foramina are situated on the body of the mandible through which the mental nerve with the accompanying vessels passes. The morphological evaluation of the mental foramina (MF) is often done to look for shape and positional variations and the presence of accessory foramen if any [1]. The shape and position of the MF have frequently encountered variations that often get unnoticed or undiagnosed [2]. The precise knowledge regarding the various position of the MF and its diameter, together with the incidental presence of accessory MF are essential for the dentists while performing curettage, root canal treatments, and effective anaesthetic procedures that requires nerve block in periapical and orthognathic surgeries [3]. Care should be taken to avoid the damage of neurovascular structures which are passing through the MF because the injury of the mental nerve might lead to paraesthesia in its distribution territory [4].

Morphometric evaluation of the MF in terms of its diameter and all possible variant positions with respect to gender is essential during the administration of local anesthesia in dental procedures. It has been widely accepted that minimal distance between MF and implant site is required to be up to 6mm [5]. Precise localization of the position of the MF is important to place the distal implants. Hence, Morphometric assessment of the mental foramina of the mandible for its variable position is considered to be helpful for the surgeons and dentists for the localized surgical procedures and for the anesthetists to execute nerve block practices. Apart from these, it is also helpful in both diagnostic and clinical procedures of the mandible.

Several studies across the globe have documented different morphometric findings for the size, shape, and position of the MF. The position of the MF from the long axis of the mandibular teeth is reported to be highly variable than mostly accepted documentation and therefore it is obsolete now [6]. Hence the objective of the present study is to establish the morphometric variability in the position of MF in terms of gender in the mandibles of Southern Indian origin with possible clinical implications.

METHODOLOGY

Forty-six dried adult human mandibles with intact alveolar margins of male (n=30) and female (n=16) origin were obtained and used in this study. The shape (Figure-1), size, and location (in relation to lower premolar teeth) of MF were measured on both sides of the mandible (n=92) using Vernier calliper. The shape of MF observed was either oval or rounded. Mean horizontal and vertical diameters were measured. The position of MF was noted in relation to mandibular teeth. Location of MF was identified by using the following parameters (Figure-2): (1) Distance from mental foramen to mental symphysis (MS); (2) Distance from mental foramen to alveolar crest (AC) and (3) Distance from mental foramen to the base of the mandible (BM). and (4) the distance from the MF to the posterior border of the ramus of the mandible (PBR). Comparison between the mean values of two variables i.e. gender and position/size of the MF was performed statistically using the independent t-test and Anova. p-value<0.05 was considered statistically significant.

Fig. 1: Shape of the mental foramen. A- round, B- oval shape.

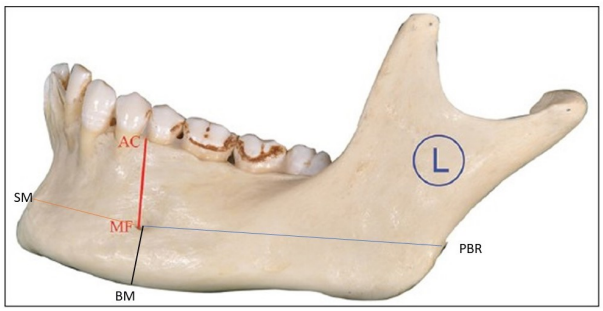

Fig. 2: Schematic representation of distances measured from mental foramina (MF) to the adjacent bony landmarks of the mandible. SM- Symphysis menti, PBR- Posterior border of Ramus of the mandible, AC- Alveolar crest, BM- Base of the mandible.

RESULTS

Of the 92 MF, 60 were male and 32 were of female origin. The higher incidence of rounded MF was recorded among the mandibles examined with a prevalence of 58.7%. About the position of the MF, there were no mandibles found with MF anterior to the first pre-molar (Type-1) and below the 1st molar (Type-6). Most of them were of Type-4, i.e., below the 2nd premolar with an incidence of 45.7% (Table-1).

Table 1: Description of the position of MF (n=92).

Type	Position with respect to the mandibular teeth	N (%)
Type-1	Anterior to first pre-molar	0
Type-2	Below the first premolar	8 (8.7%)
Type-3	Below the first and second premolar	19 (20.7%)
Type-4	Below 2nd premolar	42 (45.7%)
Type-5	Behind 2nd premolar	23 (25%)
Type-6	Below 1st molar	0

Table 2: Horizontal diameters (HD) and vertical diameters (VD) of mental foramen in mandibles grouped according to gender.

Characteristic	Mean (mm)	Std. Deviation
Male – HD	2.347	0.55275
Female - HD	2.4575	0.75171
Male – VD	1.8511	0.38177
Female – VD	1.9888	0.37156

HD- horizontal diameter, VD- vertical diameter

The horizontal (HD) and vertical diameters (VD) of the mental foramen were determined by measuring their diameters (Table-2). The average HD for males was 2.35±0.55 mm and for females, it was 2.46±0.75 mm. The average VD for males was 1.85±0.38 mm and for females, it was 1.99±0.37. It was observed that there was a significant association between gender and the position of the MF (p=0.011) (Table-3, figure 2). However, no association between gender and the shape of the MF was noted (Figure 3). An independent t-test was used to assess for an association between the gender and morphometric parameters (distances) related to the MF (Table 4).

Significant associations were found between gender and the distance from mental foramen to the posterior border of the ramus (p=0.006), and gender and the distance from mental foramen to the alveolar crest (p=0.049). However, there was no significant association between gender and the distance from mental foramen to mental symphysis (p=0.34) and the distance from mental foramen to the inferior border of the mandible (p=0.46).

Table 4: Independent t-test for an association between gender and parameters related to the mental foramina:

Gender	Distance between MF and posterior border of the ramus of mandible (PBR)		p-value
	Mean (mm)	Standard Deviation	
Male	65.8003	4.3396	**0.006***
Female	63.0641	4.68559	
	Distance between mental foramen to the alveolar crest (AC) of the mandible		
Male	12.0287	3.15408	**0.049***
Female	13.2973	2.36209	

MF- Mental foramen, *p<0.05

Table 5: One-way ANOVA for an association between gender and various positions of the mental foramina.

Gender	Positions of the mental foramen		p-value
	Mean	Standard Deviation	
Male	3.72	0.904	**0.024***
Female	4.16	0.81	

*p<0.05

Table 3: Association between gender and position of the mental foramen.

MF- mental foramen
*p<0.05

		Position of MF				p-value
		Below the first premolar	Below the first and second premolar	Below 2nd premolar	Behind 2nd premolar	
Gender	Male	8	11	31	10	**0.011***
		13.30%	18.30%	51.70%	16.70%	
	Female	0	8	11	13	
		0.00%	25.00%	34.40%	40.60%	
Total		8	19	42	23	
		8.70%	20.70%	45.70%	25.00%	

Independent t-test to assess for an association between the location of the MF and the parameters related to the MF did not show any significant associations. Location of the MF with SM showed p=0.243, with PBR showed p=0.58, with AC showed p=0.96, with BM showed p=0.76. One-way Anova was performed to assess for an association between the gender and the various positions of the MF and this was found to be significantly associated at p=0.024 (Table 5).

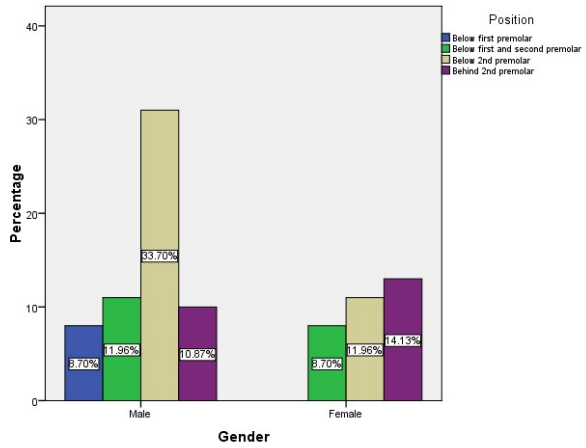

Fig. 2: Gender and position of the mental foramina.

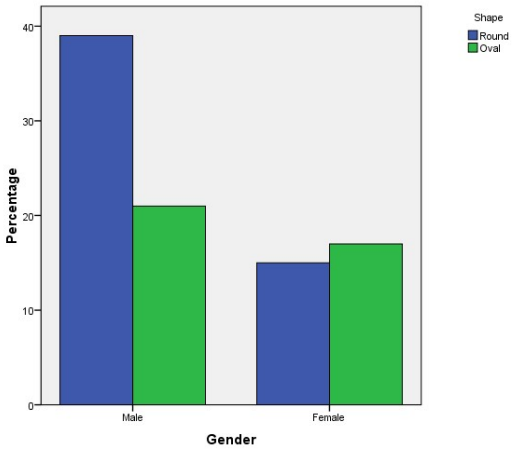

Fig. 3: Gender and shape of the mental foramen.

DISCUSSION

The present study focused on assessing the position of MF in the dried mandibles of the South Indian population. The precise identification of MF is considered to be an important factor while administering mental nerve blocks and performing surgical procedures in the specified area. During the periapical surgery or while obtaining a biopsy at the mental region of the mandible and suturing soft tissue lacerations of the mouth, the mental nerve anesthetization is performed at the vicinity of the mental foramen.

Variations exist in the position of MF among different ethnic groups. According to some studies MF is most commonly located between 1st and 2nd premolars [2,7]. In our study, the MF was present in all the studied mandibles and it was bilateral but no accessory MFs were encountered. We found the most common shape of the MF to be round (58.7%) which is in accordance with previous studies done on the Indian population of different topography [8, 9, 10]. It has been reported that the position of the MF has a close relationship with the ethnic basis of the individuals [11].

There are significant differences reported in the location of MF among different ethnic groups. Igbigbi and Lebona [12] in Malawians and Mbajiorgu et al. [13] in Zimbabweans mandibles reported position IV as the commonest followed by position V; however, Santini and Land [14] in British and Green [11] in Chinese mandibles observed position III being the commonest followed by position IV. In other studies, on Kenyan mandibles [15], position III was found most common followed by position II and in Malay populations [16] the most common position was IV followed by III. In our study on the South Indian population, we found that position IV (type 4) was the most common type followed by position V (type 5). This is in accordance with a previous study of Virendra et al., in mandibles from North India [17].

In the present study, we compared gender, side of the mandible, and shape of the mental foramen separately. It was observed that there was a significant association between gender and the position of the MF. However, no association between gender and side on which the MF was present as well as the shape was noted. Variability in MF position may be related to different feeding habits subsequently affecting mandibular development [13]. Prior knowledge of common positions in local populations may be helpful in effective nerve blocks and surgeries in those regions. The position of MF is usually difficult to locate as there are no accurate anatomical landmarks for the MF to be identified neither clinically nor can it be palpated externally. Therefore, knowledge regarding the exact

position and various distances of MF are necessary for its anaesthetic and surgical intervention.

We also measured the size of mental foramen and compared it to gender. The mean VD of mental foramen in male mandible was 1.85 mm and in female mandible it was 1.98 mm. Mean HD of mental foramen was 2.34 mm for males and 2.45 mm for the female mandible, respectively. Previous studies have measured the HD and VD of MF and the values were almost the same as the present study [8, 17]. But in our study, we have grouped the diameters based on gender which has not been done in those previous studies in the mandibles of the Indian population. However, in radiological studies, the mean HD and VD were found to be higher than in the present study [19]. It seems, consequently, that not only the size but the shape of the mental foramen is also heterogeneous among different populations.

Therefore, it can be opined that there is no single and universal pattern of MF location and it differs in different populations. A precise assessment of the MF location characteristic for every population is very helpful in clinical dental practice. The results of the present study add to the information regarding the shape, size, and position of the MF in the South Indian population and have implications for dental practitioners and maxillo-facial surgeons.

CONCLUSION

To summarize, the present study made it possible to determine the shape and location of mental foramen in relation to the adjacent anatomical landmarks of the mandible. The variations observed from previous studies might be related to the feeding habits of different regions which may ultimately, affect the development of mandibles. These results obtained may contribute to the existing literature and provide guidelines for dental procedures including anaesthesia of the mental nerve, endodontic procedures, implantology, and dental surgery.

Conflicts of Interests: **None**

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Author Contributions

RB and AS designed the study & data collection,
NK & AAP equally contributing to interpret the data, as well as drafting of the manuscript for this study,
NK supervised the study and provided critical revisions for the important intellectual content in the manuscript.
VC: Contributed in statistical analysis All authors read and approved the final manuscript.

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