

Morphology and morphometry of the mental foramen in dry adult human mandibles from central India and their clinical correlation

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SUMMARY

The mental foramen (MF) is a small foramen situated on the antero-lateral aspect of the body of the mandible. It is an important anatomical landmark to facilitate surgical, local anesthetic and other invasive procedures. Studying the position and its morphological variations help to localize the mental nerve and thus prevent complications during surgical procedures. The present study was carried out on 87 dry adult human mandibles obtained from Department of Anatomy and Forensic Medicine of L.N. Medical College, Bhopal, India. In 51.7 % cases the foramen was round in shape while in 48.3% cases it was oval. The most common position observed was on the longitudinal axis of the 2nd premolar tooth (52.8 % on right side and 54% on left side). The mean distance from symphysis menti to the medial margin of mandibular foramen was 26.08 mm (SD±0.66) and 26.15 mm (SD±0.64) on the right and left side respectively. The mean distance from the posterior margin of the mental foramen to the posterior border of the ramus of the mandible was 66.18 mm (SD±0.79) and 66.27 mm (SD±0.80) on the right and left side respectively. The mean distance from the alveolar crest to the upper margin of the mental foramen was 10.67 mm (SD±0.21) and 10.71 mm

(SD±0.18) on the right and left side respectively, and the mean distance from the lower border of the mandible to the lower margin of the mental foramen was 14.59 mm (SD±0.23) and 14.64 mm (SD±0.20) on the right and left side respectively.

Key words: Anatomical variations – Morphology – Morphometry – Mental Foramen

INTRODUCTION

The mental foramen is situated on the antero-lateral aspect of the body of the mandible. It provides a route for the mental nerve and vessels (Igbigbi and Lebona, 2005; Agthong et al., 2005; Phillips et al., 1992). Variations of the mental foramen are often encountered, ranging from differences in positions (Zivanovic, 1970; Santini and Land, 1990) and shape (Agarwal and Gupta, 2011) to the presence of an accessory foramen (Sawyer et al., 1998) or even a complete absence in some cases (Defreitas et al., 1979; Hasan et al., 2010). The mental foramen is an important landmark during osteotomy procedures, anesthetic nerve blocks and in the prevention of neurovascular complications after invasive procedures on the lower jaw. In the present study we observed its variable posi-

tions and shapes, and measured its dimension with reference to surrounding landmarks.

MATERIAL AND METHODS

Eighty-seven dry adult human (sex unknown) mandibles with intact teeth obtained from the Department of Anatomy and Forensic Medicine of L.N. Medical College constituted the material for study. We observed the variable position and shape of the mental foramina. We measured the distance of the mental foramen (in mm) from different landmarks, including the symphysis menti, the alveolar crest, the posterior border of the ramus of the mandible and the lower border of the mandible with a digital vernier caliper and calculated the size of the mental foramen (Igbigbi and Lebona, 2005) (Fig. 1):

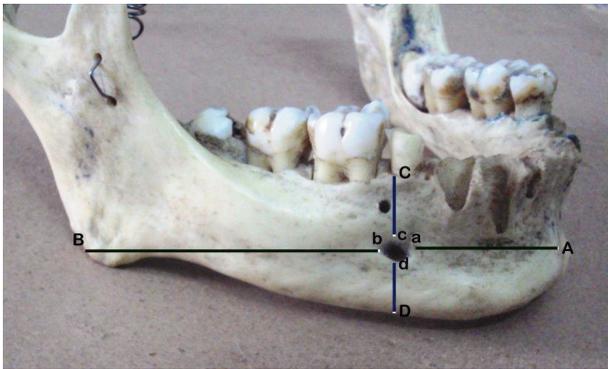


Fig. 1. Relation of the mental foramen to the body of the mandible. C: point at the alveolar crest lying on a longitudinal axis with the mental foramen; D: point at the lower border of the mandible lying on a longitudinal axis with the mental foramen; c: point at the upper margin of the mental foramen; d: point at the lower margin of the mental foramen; A: point at the symphysis menti lying on a transverse axis with the mental foramen; B: point at posterior border of ramus lying on a transverse axis with mental foramen; a: point at the medial margin of the mental foramen; b: point at the lateral margin of the mental foramen.

Aa: Distance from the symphysis menti to the medial margin of the mental foramen.

Bb: Distance from the posterior border of the ramus of the mandible to the lateral margin of the mental foramen.

AB: Distance from the symphysis menti to the posterior border of the ramus of the mandible.

HD: Horizontal diameter of the foramen = $AB - (Aa + Bb)$.

Cc: Distance from the alveolar crest to the upper margin of the mental foramen.

Dd: Distance from the lower border of the mandible to the lower margin of the mental foramen.

CD: Distance from the alveolar crest to the lower border of the mandible.

VD: Vertical diameter of the foramen = $CD - (Cc + Dd)$.

The statistical results were expressed as means and standard deviations.

RESULTS

The position of the mental foramen was classified in relation to the teeth of the lower jaw, in accordance with Tebo and Telford (1950).

- I) Foramen lying on a longitudinal axis passing between the canine and first premolar.
- II) Foramen lying on the longitudinal axis of the first premolar.
- III) Foramen lying on a longitudinal axis passing between the first and second premolars.
- IV) Foramen lying on the longitudinal axis of the second premolar.
- V) Foramen lying on a longitudinal axis passing between the second premolar and the first molar.
- VI) Foramen lying on the longitudinal axis of the first molar.

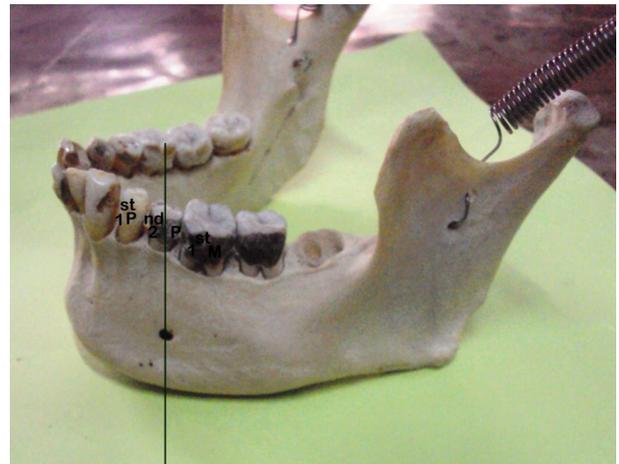


Fig. 2. Mandible showing the mental foramen lying in position IV. 1st P: first premolar; 2nd P: second premolar; 1st M: first molar.

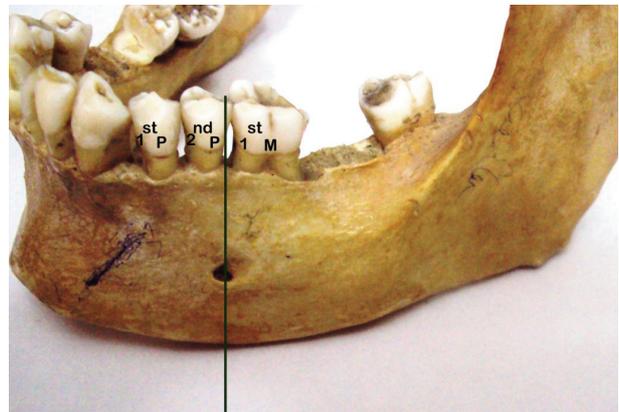


Fig. 3. Mandible showing the mental foramen lying in position V. 1st P: first premolar; 2nd P: second premolar; 1st M: first molar.

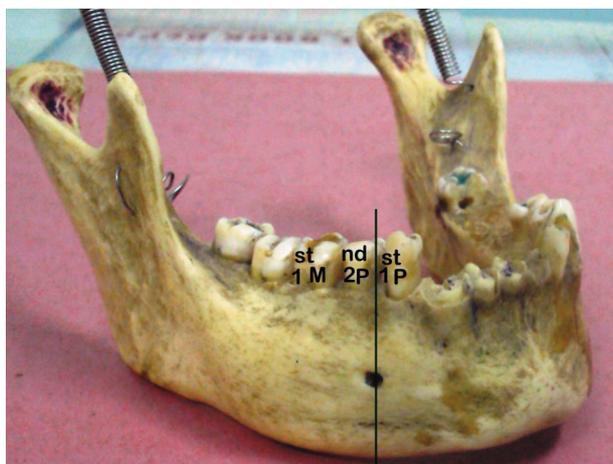


Fig. 4. Mandible showing the mental foramen lying in position III. 1st P: first premolar; 2nd P: second premolar; 1st M: first molar.

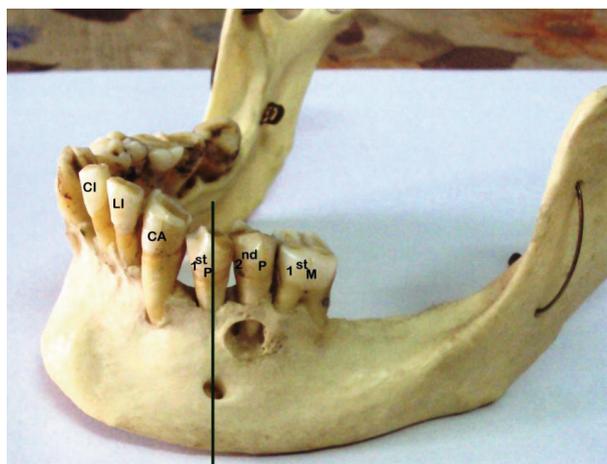


Fig. 5. Mandible showing the mental foramen lying in position II. CI: Central incisor; LI: Lateral incisor; CA: Canine; 1st P: first premolar; 2nd P: second premolar; 1st M: first molar.

The most common position was on the longitudinal axis of the second premolar i.e. position IV (Fig. 2) followed by V (Fig. 3), III (Fig.

4) and II (Fig. 5). The mental foramen was not observed in position I and VI in any mandible. The results are presented in Table 1.

Table 1. Relationship of the mental foramen with the lower teeth; N=87

Position	I	II	III	IV	V	VI
Right	0	3(3.4%)	17(19.5%)	46(52.8%)	21(24.1%)	0
Left	0	3(3.4%)	16(18.3%)	47(54.0%)	21(24.1%)	0

To locate the mental foramen and to measure its size, several parameters were considered; the results are presented in Tables 2 and 3

Table 2. Parameters to locate the right and left mental foramina in relation to the symphysis menti and the posterior border of the ramus of the mandible, and horizontal foramen diameter.

Parameters (*)	Aa		Bb		AB		HD	
	Rt	Lt	Rt	Lt	Rt	Lt	Rt	Lt
Mean (mm)	26.08	26.15	66.18	66.27	96.83	97.04	4.57	4.61
SD (mm)	0.66	0.64	0.79	0.80	1.04	1.02	0.19	0.17

(*) Aa: symphysis menti to the medial margin of the foramen; Bb: posterior border of the ramus of mandible to the lateral margin of the foramen; AB: symphysis menti to the posterior border of the ramus of the mandible; HD: horizontal diameter of the foramen.

Table 3. Parameters to locate the right and left mental foramina in relation to the lower border of the mandible and alveolar crest, and vertical foramen diameter.

Parameters (*)	Cc		Dd		CD		VD	
	Rt	Lt	Rt	Lt	Rt	Lt	Rt	Lt
Mean (mm)	10.67	10.71	14.59	14.64	28.87	28.90	3.58	3.55
SD (mm)	0.21	0.18	0.23	0.20	0.37	0.32	0.17	0.18

(*) Cc: alveolar crest to the upper margin of the foramen; Dd: Lower border of the mandible to the lower margin of the foramen; CD: alveolar crest to the lower border of the mandible; VD: vertical diameter of the foramen.

In 51.7% of the cases, the mental foramen was round in shape and in 48.3% cases the mental foramen was oval on the right as well as on the left side.

DISCUSSION

The location of the mental foramen is an important factor when considering the anaes-

thetic block of the mental incisors and surgery in the outer premolar mandibular region. Significant differences have been reported in the location of the mental foramen among different ethnic groups, position IV being the commonest, followed by position V in the studies on Malawian and Zimbabwean mandibles (Igbigbi and Lebona, 2005; Mbajiorgu et al., 1988). However, studies on British and Chinese mandibles have reported

position III as the most common, followed by position IV (Santini et al., 1990; Green, 1987). In other studies on Kenyan mandibles, position III was found to be most common, followed by position II (Mwaniki and Hassanali, 1992), and in Malay and Srilankan populations the most common position was IV, followed by III (Ngeow and Yuzawati, 2003; Ilayperuma et al., 2009). However, in the above mentioned studies right and left sides were not considered separate from each other. In the present study we considered the right and left side separately and found that the most common position of the mental foramen was position IV followed by V, on the right as well as on the left side. Our results are similar to those of Agarwal and Gupta (2011), Amorim et al. (2008) and Yesilyurt et al. (2008) in different population groups.

Occasionally, an anterior loop of the mental nerve may be present medial to the mental foramen and may cause mental nerve injury during dental implantation (Arzouman et al., 1993). Guidelines to verify the position of the mental foramen and to validate the presence of an anterior loop of the mental nerve while establishing a zone of safety for implant placement can avoid such nerve injury. Furthermore, prior knowledge of common positions in local populations may be helpful in effective nerve blocks and surgical procedures in those regions. We also measured the size of the mental foramen. The mean vertical diameters of the mental foramen in our study was 3.58 mm ± 0.17 mm on the right side and 3.55 mm ± 0.18 mm on the left side, respectively, and the mean horizontal diameter was 4.57 ± 0.19 on the right side and 4.61 ± 0.17 on the left side, respectively. Igbigbi and Lebona (2005) measured the dimensions of the mental foramen and found mean vertical diameters of 2.43 mm and 2.71 mm on the right and left side respectively and mean horizontal diameters of 5.05 mm and 5.00 mm on the

right and left side respectively. There was a large difference between the vertical and horizontal diameters in their study and this was due to a higher number of oval-shaped foramina. However, Oguz and Bozkir (2002) performed measurements on 34 dry mandibles of cadavers from Turkey and found a mean horizontal diameter of 2.93 mm on the right side and 3.14 mm on the left side, and a mean vertical diameter of 2.38 mm and 2.64 mm on the right and left side respectively. There was a small gap between the horizontal and vertical dimensions and this was attributed to a greater number of round-shaped foramen. The present results differ since they lie between the above mentioned studies due to a very slight difference in percentages between round- and oval-shaped foramina.

According to Hauser and De Stefano (1989), the different variants would be due to epigenetic traits since they may be seen as the products of genetically determined growth process of other tissues affecting bone formations. Consequently, they may undergo modification during ontogeny in the presence of modifying genes or relevant environmental conditions and such genes generally show variable degree of expression. Thus, variations in the position, shape, number and size of the mental foramen depends on the modification of genes.

In the present study we observed round-shaped mental foramina in 51.7% of the cases and oval-shaped in 48.3% of the mandibles on the right as well as on the left side. A comparison between the results of the present study and previous ones is given in Table 4 (Gershenson et al., 1986; Mbajjorgu et al., 1988; Prabodra and Nanayakkara, 2006; Singh and Srivastava, 2010; Agarwal and Gupta, 2011).

Our results are close to those of Mbajjorgu et al. (1998) but differ from those of studies carried out in other parts of India (Singh and

AUTHORS	Shape of mental foramen in percentage	
	Oval	Round
Gerhenson et al. (1986)	65.5	34.5
Mbajjorgu et al. (1998)	56.3	43.8
Prabodha and Nanayakkara (2006)	66.7	33.3
Singh and Srivastava	6.0	94.0
Agarwal and Gupta (2011)	92.0	8.0
Present Study	48.3	51.7

Srivastava, 2010; Agarwal and Gupta, 2011). The probable reason for such a difference is that the present study was confined to the Central Zone of India and that of Singh and Srivastava to East Zone and Agarwal and Gupta to West Zone, all with different environmental conditions, as mentioned by Hauser and De Stefano (1989).

CONCLUSION

The recent trend of the replacement of missing teeth by dental implants and the increasing frequency of orthognatic surgeries have highlighted the clinical significance of the mental foramen. Mental foramen variations often remain unnoticed and undiagnosed. Despite this, in order to obtain effective nerve block and to avoid post-surgical neurovascular complications in the mental regions, particular attention should be paid to the morphology and morphometry of the mental foramen. A prior CT scan can elucidate jaw structures and prevent patient morbidity.

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