

Mental foramen: An Indicator for Gender Determination - A Radiographic Study

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Abstract

Background: The identification of sex from human remains is of fundamental importance in forensic science. Among the skeletal components pelvis and skull, with mandible being the practical element are used for gender determination. Location of mental foramen can be used to differentiate between sexes and such skeleton metric analysis done on radiographs are found to be of more accuracy.

Aim: To assess the usefulness of mental foramen as an aid in gender determination.

Materials and Methods: One hundred panoramic radiographs (50 males and 50 females) were selected for mental foramen analysis. Distance from superior and inferior borders of mental foramen to the lower border of mandible (SL and IL) of both sides were recorded by drawing tangents to the superior and inferior border of mental foramen and perpendiculars to the lower border of mandible from tangents. The data obtained were subjected to statistical analysis.

Results: The obtained average values of SL and IL were found significantly higher in males than in females. But the distances for the right and left sides of a study sample were almost similar in both males and females and the results were non-significant.

Conclusion: Analyzing mental foramen location can be considered as an additional radiographic method to determine gender.

Keywords: Mental foramen, Forensic science, Panoramic radiograph, Gender determination

Introduction

The mandible is a paired bone that develops within the mandibular arch with embedded teeth and forming an articulation of the jaw with the cranium called as temporomandibular joint. The mental foramen is located bilaterally on the buccal cortical plates of mandible and commonly lies near the apices of mandibular premolars. The mental foramen is a funnel like opening which is located 11- 15 mm superior to the inferior border of mandible transmitting mental nerves and vessels which supplies sensory innervations to lower lip, buccal vestibule and gingival mesial to first mandibular molar. As wall of foramen is made up of cortical bone, so when bone density increases mental foramen becomes difficult to identify on radiographs. Mental foramen aids in interpreting anatomical landmarks in oral pathology and forensics as among many anatomical landmarks in human skull, mental foramen is a stable landmark on mandible.^{1,2,3,4}

The radiographs are indispensable tools that are used in forensic anthropology. The radiographic method is simplest and cheapest method for age estimation and gender determination when compared to the histological and biochemical methods. Among radiographic methods Panoramic radiography is the most preferred diagnostic modality as it allows a more accurate localization of mental foramen. The present study was conducted with the aim to analyses and signify the average measurements of distance from superior and inferior borders of mental foramen to the lower border of mandible (SL and IL) of both sides in gender determination.^{1,2,3,4}

Materials and Methods

The present retrospective study was performed in department of Oral Medicine, Radiology and Diagnosis on the panoramic radiographs of outpatients aged between 18-65 years, which visited the department for routine dental check-up. All the subjects were briefed about the study and an informed consent was taken. The study was conducted after getting approval from the ethical committee.

The sample size includes 100 panoramic radiographs of 50 males and 50 females. Thus a total 200 mental foramen were studied for analysis. The patients were subjected to the digitalized panoramic radiograph with the use of appropriate radiation protection measures. All the radiographs were captured using digital Panoremic machine - Vatech Pax-400C. The inclusion criteria for radiographs were: patients above 18 years of age with no oral-maxillofacial surgical intervention and high quality radiographs with correct positioning. The exclusion criteria for the radiographs were: presence of artifacts, distortion of images, presence of any pathology, surgical interventions, non-visualization of mental foramen and patients below 18 years of age.

Out of 160 screened panoramic radiographs, a total of 100 radiographs (50 males and 50 females) were selected for the study in which mental foramen was clearly seen and was identified as a separate entity. Tangents were drawn to the superior and inferior border of mental foramen on le and right sides and then perpendiculars were drawn from tangents to the lower border of mandible on both sides. The distances were

measured from superior border of mental foramen to inferior border of mandible as S-L and from inferior border of mental foramen to inferior border of mandible as I-L (Fig. 1).

Statistical analysis was carried out using *t*-test and Chi-square test that included the mean values in males and females of both the right and left side. Statistical analysis was carried out using *t*-test and Chi-square test that included the mean values in males and females of both the right and left sides.

Results

In the present, the mean distance in centimeter with standard deviation from the superior border of the mental foramen to the lower border of the mandible (S-L) on the right side in males was 1.73 ± 0.04 , whereas it was 1.53 ± 0.05 in females. On the left side, it was 1.69 ± 0.07 in males and 1.52 ± 0.04 in females [Tables 1 and 2]. Also the mean distance from the inferior border of the mental foramen to the lower border of the mandible (I-L) on the right side in males was 1.42 ± 0.06 , whereas it was 1.24 ± 0.05 in females. On the left side, it was 1.41 ± 0.04 in males and 1.22 ± 0.04 cm in females [Tables 1 and 2].

The comparison of S-L and I-L between the right and left sides in males described a non-significant difference ($P = 0.60$ and $P = 0.139$). In the same way, the comparison of S-L and I-L between the right and left sides in females showed a non-significant difference ($P = 0.154$ and $P = 0.063$) [Tables 3 and 4].

The comparison of S-L between males and females showed a highly significant difference ($P = 0.001$) on the right side and a highly significant difference ($P = 0.001$) on the left side [Table 5]. The comparison of I-L between males and females showed a highly significant difference ($P = 0.001$) on the right side and a highly significant difference ($P = 0.001$) on the left side [Table 6].



Fig. 1: Distance from superior and inferior border of mental foramen (S-L and I-L)

Table 1: SL and IL in Males

	RT	Left
SL	1.73 ± 0.04	1.69 ± 0.07
IL	1.42 ± 0.06	1.41 ± 0.04

Table 2: SL and IL in Females

	RT	Left
SL	1.53 ± 0.05	1.52 ± 0.04
IL	1.24 ± 0.05	1.22 ± 0.04

Table 3: Comparison between Right and Left Side in Males

	RT	Left	P value	
SL	1.73 ± 0.04	1.69 ± 0.07	0.060	NS
IL	1.42 ± 0.06	1.41 ± 0.04	0.139	NS

Table 4: Comparison between Right and Left Side in Females

	RT	Left		
SL	1.53 ± 0.05	1.52 ± 0.04	0.154	NS
IL	1.24 ± 0.05	1.22 ± 0.04	0.063	NS

Table 5: Comparison between Males and Females – Right Side

	Males	Females	P value	Significance
SL	1.73 ± 0.04	1.53 ± 0.05	0.001	Significant
IL	1.42 ± 0.06	1.24 ± 0.05	0.001	Significant

Table 6: Comparison between Males and Females – Left Side

	Males	Females	P value	Significance
SL	1.69 ± 0.07	1.52 ± 0.04	0.001	Significant
IL	1.41 ± 0.04	1.22 ± 0.04	0.001	Significant

Discussion

The mental foramen is a funnel-like opening in the lateral surface of the mandible at the terminus of the mental canal. The mental foramen has been reported to vary in position in different ethnic groups and gender. Panoramic radiographs are well known to show greater part of maxilla-facial skeleton as a continuous image, thus allowing for a more accurate localization of both mental foramina in both vertical and horizontal dimensions. Whereas periapical radiographs may not reveal the position of the mental foramen if it is below the edge of the film. Comparative analysis between right and left foramen is also difficult on other conventional radiographs. It is because of this reason we selected panoramic radiographs to study mental foramen.^{4,5,6,7}

Wical and Swoope in 1974 stated that despite the alveolar bone resorption above the mental foramen, the distance from the foramen to the inferior border of the mandible remains relatively constant throughout life.⁸

Lindh et al. in 1995 and Guler et al. in 2005 also suggested that the stability of this region does not

depend on resorption of alveolar process above the foramen. And thus the vertical measurements in panoramic radiography are clinically applicable, because of the stability of the basal bone and mental foramen, these landmarks were selected as a point of reference for our study.^{9,10}

Four types of radiographic appearance of the mental foramen were classified by Yosue and Brooks in 1989. First being the **continuous type** in which the mental canal is in continuation with the mandibular canal, **the separate type** in which the foramen is distinctly separated from the mandibular canal and appears as a well-defined radiolucency with a distinct border of condensing bone. In the **diffuse type**, the foramen has an indistinct border. In **Un-identified type**, the foramen cannot be seen. As the separate type is common and easy to identify on panoramic radiograph, we selected this type for the present study. Akgul and Toygar in 2002 reported that in comparative analyses between genders, the morphometric study by means of panoramic radiography reveals differences and inherent alterations in the evaluated groups.^{4,7,11,12}

In our study, the mean values of S-L and I-L were significantly high in males as compared with females, and the results were found similar with those of Thomas et al., Mahima et al, Catovie et al, Nidhin et al and Akhilesh et al.^{4,7,13,14,15}

Vodanovic et al in 2006 found that the mean value of I-L does not exhibit sexual dimorphism. The difference may be due to racial diversity of the study population. In our study, this value was also significantly high in males, which also corresponds to the studies of Enlow et al, Amorim et al and Akhilesh et al.¹⁶

The distances (S-L and I-L) for the right and left sides of an individual showed that the values were almost similar, with a non-significant difference, and this is applicable for both the male and the female groups. This is similar to the study of Thomas et al, Nidhin et al and Akhilesh et al. Therefore, the distances from any of the sides can be used as a representative for gender discrimination.^{4,7}

Conclusion

Panoramic radiography can be considered as an additional radiographic method to determine gender from the skeletal remains because it is efficient for making the proposed measurements which is particularly important in mass disaster events, in which the jaws are available in fragments. Based on the results of this study there is a significant difference in the distance from the mental foramen to the lower border of the mandible in males and females, thus it is possible to conclude that the distances from the mental foramen to the lower border of the mandible exhibit sexual dimorphism and can be used in gender determination.

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