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Mental Foramen: An Adjuvant Tool for Gender Determination in Adults

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Abstract

Background: Mental foramen which is the stable landmark in mandible can be used as a reliable tool for identification as it varies its position among different racial and ethnic groups. In this view the present study was conducted to evaluate the position of mental foramen in horizontal and vertical planes and also the differences in measurements of superior and inferior borders of mental foramen to the lower border of mandible with respect to gender in people of Kerala ethnicity.

Methodology: Demographic details were evaluated and patients hailing from Kerala by birth and domicile were selected for the study. 100 panoramic radiographs were categorized into two groups, 50 males and 50 females. Position of mental foramen in horizontal and vertical plane and its relation to lower border of mandible were made using Gimp2.8 software. **Statistical Analysis:** Mean values were calculated, chi square test and unpaired t-test were applied to see the significant difference; with p value <0.05 considered as statistically significant.

Results: The most common position of mental foramen in horizontal plane in males and females was in a line with second premolar on both right and left quadrants. In vertical plane the most common position of mental foramen in males was inferior to apex of second premolar, while in females it was at or in line with the apex of second premolar on both right and left sides. Study also highlighted significant variations in length of superior and inferior border of the foramen in relation to lower border of the mandible with respect to gender.

Conclusion: Panoramic radiographs can be used for making the proposed measurements. Mental foramen shows sexual dimorphism in its position and this variation can also be observed in different racial and ethnic groups and so can be used as an adjuvant tool for gender determination.

Keywords: mental foramen, gender, mandible, forensic, panoramic radiographs, horizontal plane, vertical plane.

Introduction

Forensic studies on living people play an important role for gender identification in case of the deceased in mass

fatalities. Forensic dentists and anthropologists consider radiographic analysis and morphological characteristics of the bone as important tools in determination of sex.In human bone, skull and pelvis are the most reliable sources for distinguishing gender. The mandible is considered as the hardest and most durable bone in the human skull and persists in a well conserved state compared to any other bone. It also exhibits high degree of sexual dimorphism. Therefore the use of morphological features of the mandible is a common approach used by anthropologists and forensic dentists in the determination of sex.Studies have shown that skeletal and anatomical features vary by population; therefore, there is a demand for population-fixed standards. Among many anatomical landmarks in human skull, mental foramen is the most stable landmark. Mental foramen is located in the body of the mandible halfway between the lower border of the mandible and alveolar margins. The funnel like opening is directed outward, upward and posteriorly in the anterolateral aspect of the mandible. Panoramic radiographs provides a well delineated picture of the entire body of mandible and allows more precise location of the mental foramen in both horizontal as well as vertical dimensions. Literature studies revealed that there exhibits a differences in position of mental foramen with varying population. In India with the diverse population and differences in racial and ethnic background, there might be variations in the position of the mental foramen among various population groups. With this view the present study was conducted to evaluate the position of mental foramen in horizontal and vertical planes and also to study the differences in measurements of superior and inferior borders of mental foramen to the lower border of mandible with respect to gender in people of Kerala ethnicity.

Materials and Methods

Demographic details were evaluated and patients hailing from Kerala by birth and domicile were selected for the study. Ethical clearance was obtained from the ethical committee of the institute.100 panoramic radiographs were categorized into two groups, Group A consisted of panoramic radiographs of 50 male subjects, and Group B consisted of 50 female subjects. Only radiographs with clearly visible mental foramen and dentate subjects within the age range of 18-50 years were included in the study. The exclusion criteria were distortion of images, presence of artefacts, surgical interventions and presence of any pathology.

Classification of mental foramen in horizontal and vertical planes was carried out according to Parnami et al. [1]

The location of mental foramen in horizontal plane was recorded as follows:(figure:1)

Position 1: Located anterior to first premolar

Position 2: Situated in line with the first premolar

Position 3: Between the first and second premolar

Position 4: In line with second premolar

Position 5: Between the second premolar and first molar

Position 6: In line with the first molar

The position of mental foramen in vertical planes was recorded as follows: (figure: 2)

Position a: Located anterior to the apex of first premolar

Position b: At or in line with the apex of first premolar

Position c: In between the apex of first and second premolar

Position d: At or in line with the apex of second premolar

Position e: Inferior to the apex of second premolar

Figure 1: Position of mental foramen in horizontal plane (Parnami P et al)

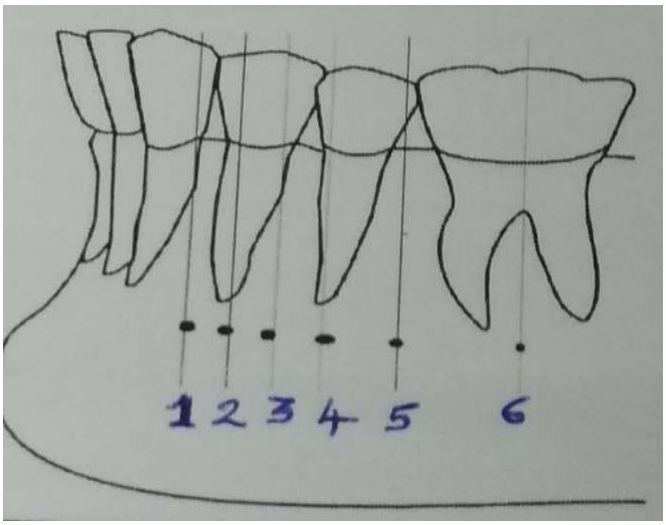
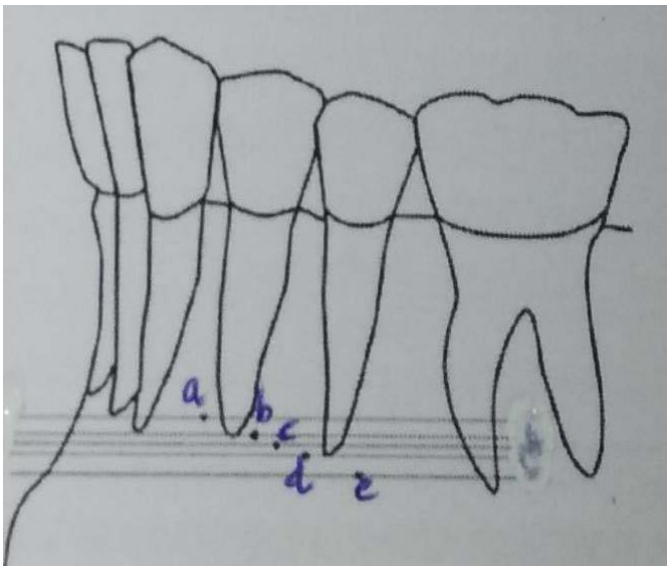


Figure 2: Position of mental foramen in vertical plane (Parnami P et al)



Measurements for evaluating distance of superior and inferior borders of the mental foramen in relation to the lower border of the mandible were made using the Gimp software 2.8.

Statistical Analysis

The data obtained were evaluated using Statistical Package for the Social Sciences (SPSS) version 16. Mean values were calculated, chi square test and unpaired t-test was applied to see the significant difference; with p value <0.05 considered as statistically significant

Results: A total of 100 panoramic radiographs were studied;50 males (group A) and 50 female patients (group B).Of the total 50 right mental foramen analyzed in male subjects (horizontal plane: fig 4)the most common position of mental foramen was position 4: in line with the second premolar (46%), thereafter comes position 3:between first and second premolar (28%). The same result was obtained in female subjects. Left side analysis also showed that (fig5) the common position of mental foramen in horizontal plane was same as that of right side in males & females. But vertical plane analysis gave a different position of mental foramen in males and females. In males the most frequent position found on right and left side (fig:6 & fig:7) was position E: Inferior to the apex of second premolar (56%-right & 54%-left) while in females, the most common position found was position D: at or in line with the apex of second premolar (42%-right & 44%). Statistically significant results between males and females were obtained while evaluating the distance from superior and inferior borders of the mental foramen in relation to the lower border of the mandible on both right and left sides(Table-1). p value was 0.00 on both right and left sides.

Figure 3 : Mental foramen in horizontal plane (right)

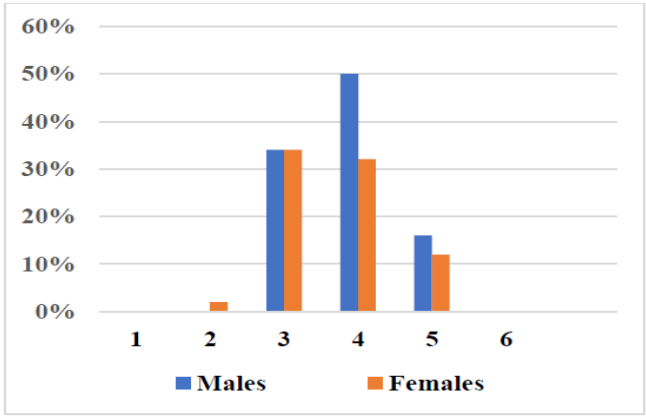


Figure 4: Mental foramen in horizontal plane (left)

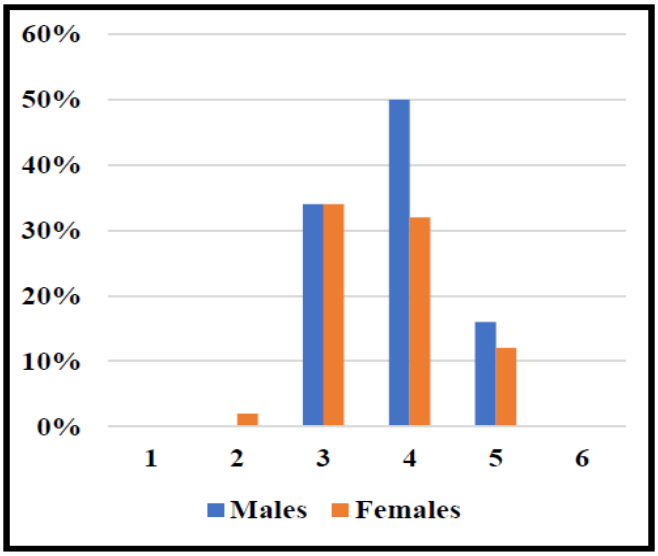


Figure 5: Mental foramen in vertical plane (right)

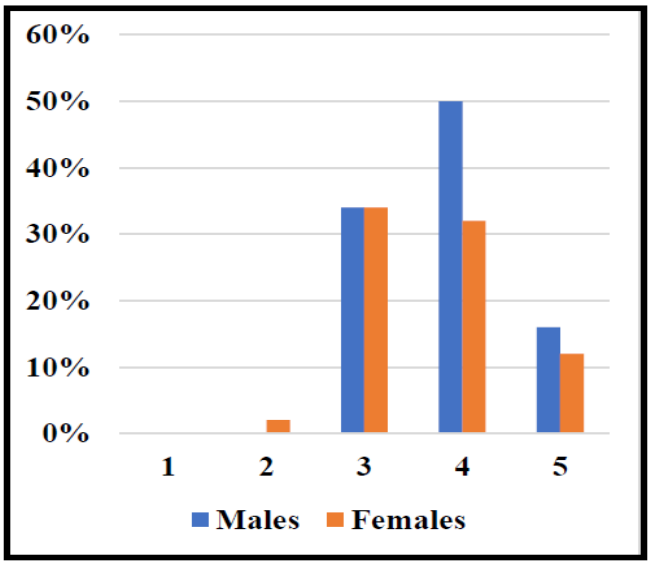


Figure 6: Mental foramen in vertical plane (left)

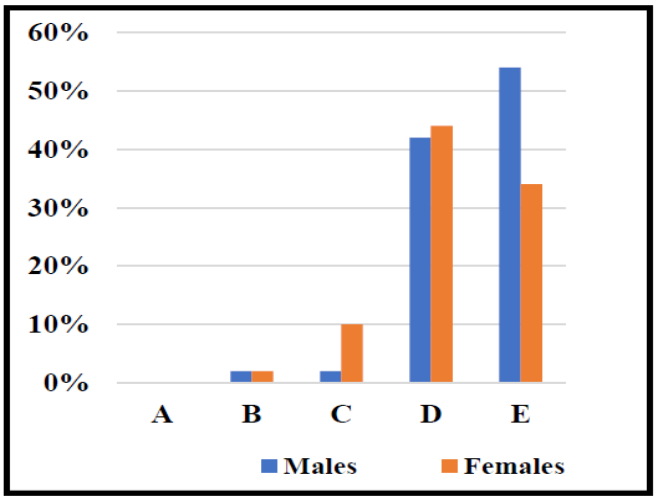


Table 1: The measurements between superior and inferior borders of mental foramen to the lower border of the mandible.

	Gender	Mean (mm)	Standard Deviation
Superior border of mental foramen to the lower border of mandible (Right)	Males Females	15.15 12.04	0.61 0.87
Superior border of mental foramen to the lower border of mandible (Left)	Males Females	15.06 12.28	0.63 0.81
Inferior border of mental foramen to lower border of mandible (Right)	Males Females	11.55 8.89	0.83 0.59
Inferior border of mental foramen to lower border of mandible (Left)	Males Females	11.37 8.80	0.76 0.58

Discussion

Radiographs are one of the inevitable tools in the field of forensic research. Panoramic radiographs were utilized in this study as it provides more wide and reliable field to view anatomy of the mandible. Anatomically, mental foramen is the opening of the mental canal. Though the standard Anatomy textbook states that the mental foramen is most commonly found between the apices of the first and second lower premolar there is always a debate about the position of mental foramen as it is varies among different populations. Factors which can alter the location of mental foramen includes genetic constitution, muscle forces, diet or eating habits, facial biotype, environment and socioeconomic factors. [2]

In the present study the most common position of mental foramen in horizontal plane in males and females was in a line with second premolar on both right and left quadrants. In vertical plane the most common position of mental foramen in males was

inferior to apex of second premolar, while in females it is at or in line with the apex of second premolar on both right and left sides. In Malaysians [3], Srilankans[4], Kenyan africans[5] & Saudi populations[6], and the studies done by Philips et al[7], discloses that the mental foramen is most commonly positioned with second premolar tooth in contrast to the North American white population [8], North Nigerian population[9], and Asian population[10] where the mental foramen is commonly located between the two premolars. Studies conducted in different states of India also shows variation in results. Mental foramen below the apices of the second premolar as most frequent location was reported by Patel R et al[11] in Gujarati population, Singh and Srivastav[12] in Lucknow population and Shankland WE [13] in Asian Indians.

The present study also highlighted significant variations in length of superior and inferior border of the foramen in relation to lower border of the mandible with respect to gender. Distance from superior and inferior borders of mental foramen to lower border of mandible was greater in males compared to females. The length from lower border of the mandible to the mental foramen exhibited sexual dimorphism and panoramic radiography aided as a excellent radiographic tool to establish gender from mandible . The studies conducted by Wical and Swoope[14] , Lindh et al[15] , and Guler et al[16]reported that even though resorption of the alveolar bone above the mental foramen occurs as part of aging process, the distance from the foramen to the inferior border of the mandible remains relatively constant throughout life. On the contrary, Vodanovic et al[17] has found that the mean value of inferior border of the mandible to lower border of mandible does not exhibit sexual dimorphism.

Panoramic radiographs are considered to be of particular importance in mass disaster events when the jaws are available for identification in fragments. Our study points to the fact that positioning of mental foramen in vertical plane and its relation to lower border of mandible varies among ethnic & racial groups population, this will serve as a paradigm for future studies in Kerala. Large sample size and the studies from the various ethnic and racial groups of Kerala are inevitable to arrive at a definite conclusion.

Conclusion

Based on the results in Keralites, the most common position of mental foramen in horizontal plane in both male and female patients was in line with second premolar whereas in vertical plane most common position was inferior to the apex of second premolar in males, while in females at or in line with the second premolar. There were differences in position of mental foramen in vertical plane based on gender. The distance from the mental foramen to the lower border of the mandible also exhibited sexual dimorphism. Lower part of the mental foramen which is not affected by the resorption process, and significant difference in length of superior and inferior border of the foramen in relation to lower border of the mandible with respect to gender offers its application in forensic identification of gender. Significant results shows that probable values among different ethnic and racial groups could be a valuable source for gender determination in the field of forensic odontology.

Panoramic radiography is efficient in making the proposed measurements and data base of mental foramen values from various racial & ethnic groups could serve as a positive indicator for sex determination in future studies.

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