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ORIGINAL ARTICLE

Morphometric assessment of mental foramen for gender prediction using panoramic radiographs in the West Bengal population – A retrospective digital study

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Abstract

Background: The gender testimony is of vital importance in forensic science when only craniofacial fragments are only the remains. Mandible exhibits a high level of distinct position among the genders. Different studies have well proved that mandible shows the gender dimorphism in many morphological features such as mandible height, gonial angle, bigonial width, and bicondylar width. The anatomical position of mental foramen can also be used to differentiate between gender and such skeleton metric analysis done on radiographs is found to be of more accuracy.
Aim: This study was conducted to assess the precision of mental foramen as a landmark for gender differentiation.
Materials and Methods: Three hundred panoramic radiographs were selected for mental foramen analysis. Distance from the tangential line drawn to basal bone mandible to tangential line drawn to upper and lower borders of mental foramen on bilateral sides was measured and recorded. The data cataloged were subjected to statistical analysis.
Results: The distance between mental foramen to basal bone of mandible was more in male than that to females on the bilateral aspect, which was statistically significant.
Conclusion: Mental foramen can be considered as a radiographic landmark to determine gender in the West Bengal population of India.

Introduction

In humans, the bones of the face are considered as the landmarks of the individual distinctiveness since ages. The inherent complexity of facial bones flaunts diversity in a morphometric pattern which is the basis of individual testimony.[1] Gender estimation is an indispensable component of biological assessment in forensic science.

The mandible is the most durable bone of the craniofacial complex. It flaunts a high magnitude of dimorphism among genders. The majority of morphometric changes in mandible occur in the alveolar process. Even changes occur in the morphology of the basal bone throughout life but at a very slow rate.[2] Thus, morphological differences in the mandible are associated with age, gender, and dental status. The morphological changes in mandible can be easily evaluated on radiographs.[3]

The mental foramen is considered as a stable anatomical landmark in the human skull. The mental foramen is anatomically positioned near the apices of mandibular premolars on the buccal cortical plates of the mandible. It is anatomically stationed at 11–15 mm superior to the base of the mandible.[4,5] As the foramen wall is corticated, it becomes strenuous to identify it on radiographs when bone density increases with age.

The morphology of mental foramen is quite wavering. The mental canal opens superiorly and posteriorly in the mandible, and due to this reason, it is usually visual only 50% the time. Radiographically, mental foramen appears in various radiolucent shapes.[6,7] The radiographs have an exclusive role in forensic science for estimation of age and gender determination when compared to the histological and biochemical methods. Panoramic radiography is a preferred diagnostic modality as it allows a more accurate bilateral localization of mental foramen. This study was conducted to assess whether the anatomical position of mental foramen can be used as a landmark for gender differentiation.

Materials and Methods

The present retrospective study was performed in private radiological center. The sample size includes 300 panoramic radiographs of 150 males and 150 females of the same group of 30–40 years. Pantomographic with radiolucent-opaque, mixed lesions in the mandible, congenital anomalies, bizzare appearance, and malignancies of mandible patients are excluded. Thus, a total of 600 mental foramen were assessed. The radiographs selected for the study in which mental foramen was clearly seen and identified as a separate entity. Tangential lines were drawn to the upper and lower border of mental foramen on the left and right sides of the mandible. Tangential lines were also out-stretched from the basal bone of mandible. Then, perpendiculars were dropped between tangents to the upper and lower border of mental foramen and tangents to basal bone of mandible bilaterally. The distances were measured from upper border of the mental foramen to basal bone of mandible and from lower border of the mental foramen to the basal bone of mandible [Figure 1].

Results

The distance from tangential drawn to the upper border of mental foramen and tangential drawn to basal bone of mandible in females on the left side was 15.4 mm and 15.6 mm on the right side. On average the measurements on the right side was slightly more than that of the left side. The difference between the sides was statistically insignificant ($P > 0.5$) [Table 1].

The vertical distance between tangential drawn to the upper border of mental foramen and tangential line to basal bone of mandible in males was measured as on an average of 17.4 mm on the right side and 17.2 mm on the left right side. On average the measurements on the right side was slightly more than that of the left side. The difference between the sides was statistically insignificant ($P > 0.5$) [Table 1 and Graph 1].

The average distance from a tangential line drawn to the upper border of the mental foramen to a tangential line drawn to basal bone of mandible in males was measured as on an average of 17.3 mm and in females was 15.5 mm. The comparison of vertical distance from the upper border of the mental foramen to basal bone of the mandible among genders showed statistically significant differences [Table 1]. The average distance from tangential drawn to lower border of mental foramen and tangential line drawn to basal bone of mandible on the right side in males as well as females was slightly more than the left side but was statistically insignificant [Table 2 and Graph 2].

The average distance from a tangential line drawn to lower border of mental foramen and a tangential line drawn to basal bone of mandible in males was 16.7 mm and in females 14.4 mm. The comparison of distance from a tangential line drawn to the lower border of mental foramen and a tangential line drawn to basal bone of mandible between the genders showed statistically highly significant differences. *t*-test and Chi-square test were used in statistical analysis that included the mean values in both genders bilaterally.

Figure 1: Orthopantomogram showing vertical measurement from the tangential line drawn to the lower border of the mental foramen to a tangential line drawn to basal bone of mandible on the right side along with vertical measurement from a tangential line drawn to the upper border of the mental foramen to a tangential line drawn to basal bone of mandible on left side

Discussion

The strongest bone of the facial region is mandible, and it is highly recalcitrant to mechanical, chemical or physical impacts and time. Panoramic radiography is the most conventional two-dimensional imaging technique used to study mandible and maxilla at the same time in a single image. Panoramic radiograph allows exact detection of the anatomical position of the mental foramen on mandible in two dimensions, i.e., both horizontal and vertical dimension.[8]

The anatomical position of mental foramen can be well assessed by estimating the vertical distance between the mental

Table 1: Distance from the tangential line drawn to the upper border of the mental foramen to a tangential line drawn to basal bone of mandible in males and females

Gender	Male			Female		
Side	Right	Left	Total	Right	Left	Total
n	150	150	300	150	150	300
Mean	17.4	17.2	17.3	15.6	15.4	15.5
SD	1.008	0.732	0.87	0.932	0.842	0.887
SEM	0.0671	0.0659	0.0665	0.0741	0.0556	0.0648

**SD: Standard deviation, SEM: Standard error mean

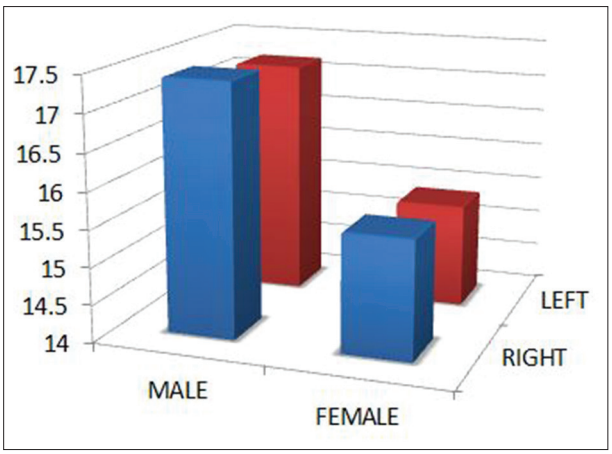
Table 2: Distances from the tangential line drawn to the lower border of the mental foramen to a tangential line drawn to basal bone of mandible in males and females

Gender	Male			Female		
Side	Right	Left	Total	Right	Left	Total
n	150	150	300	150	150	300
Mean	16.5	16.9	16.7	14.7	14.1	14.4
SD	0.908	0.841	0.874	0.759	0.919	0.839
SEM	0.0591	0.0723	0.0657	0.0693	0.0517	0.0605

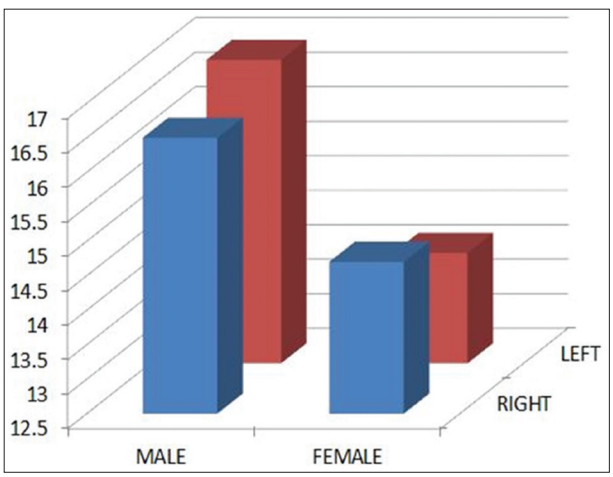
**SD: Standard deviation, SEM: Standard error mean

foramen to basal bone of mandible. It is a reliable and stable landmark. Numerous studies have been conducted using mental foramen position and dynamic results had been reported. The vertical distance from the mental foramen to the basal bone of mandible remains relatively invariable throughout life.[9] The stability of this region can be due to high resistance against resorption of the alveolar process above the foramen.[10,11] Due to the stability of the basal bone of mandible morphology and mental foramen anatomical position throughout life, this parameter was being selected as a reference point in our study.

In our study, the mean values of distance between mental foramen (upper and lower border) to basal bone of mandible were statistically significant in males as compared to females. Our results are comparable to the results of the studies done in North Indian population[8] and South Indian population.[12] Besides this, the results of our study were also comparable and



Graph 1: Difference in the distance drawn from tangential line to the upper border of the mental foramen to tangential line drawn to basal bone of mandible in males and females (mm)



Graph 2: Difference in the distance drawn from tangential line to lower border of the mental foramen to a tangential line drawn to basal bone of mandible in males and females (mm)

similar to results of some other studies[13-16] conducted worldwide. The differences in mental foramen position can be explained on the fact that sexual hormones and local factors such as masticatory muscles and mastication force are responsible for the growth and development of craniofacial skeletons. These factors are responsible for differences in the morphometric pattern in the genders.

The bone growth and development rate are lower in women as compared to males.[17] As compared to men; women have weaker muscles and weaker mastication force, so the amount of bone deposition is less along the basal bone of the mandible.[18-20] Our results were in accordance with the results of the several studies,[12-14,21] i.e., the mean values of the distance between the upper and lower border of mental foramen and basal bone of mandible in males and females were significantly higher in males as compared to than that of females.

On the contrary, study results from another study found no differences in the mean value of distances from the upper and lower border of the mental foramen to basal bone of mandible among genders.[15] In some studies, there was no statistically significant difference between the genders in relation to the lower border of the mental foramen to basal bone of the mandible.[16,17,22]

In our study, the vertical distances from the upper and lower border of the mental foramen to basal bone of mandible did not show any statistically significant difference on the right and left sides of an individual. The results were in accordance with studies[13,21] where they found that distances from the upper and lower border of mental foramen basal bone of mandible were the same on both sides.

Our study results conclude that the vertical distances from the upper and lower border of the mental foramen to basal bone of mandible from any of the sides can be used as a representative for sexual dimorphism.

Conclusion

Panoramic radiography can be considered as an adjuvant radiographic method to differentiate gender from the skeletal remains because it provides a ground for measurements of various landmarks which is a decisive key for individualization in mass disasters, in which the jaws are obtainable in fragments. The results of the present study explicit gender differentiation with the help of the anatomical position of the mental foramen from the base of the mandible.

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