INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

GENDER IDENTIFICATION USING DENTAL PANORAMIC RADIOGRAPH

Dental Science

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ABSTRACT

Mandible is a bone which exhibits one of the best sexual dimorphism in human skeleton.. human mandibles are preferred by forensic experts and paleontologists in gender determination of unknown skeletal remnants. There had been various parameters examined to determine the gender from mandibles.. The reliability of these parameters however was found to vary from populations to populations. The study was to determine the gender from a panoramic radiograph by means of gonial angle, bigonial width, height of the ramus and the position of mental foramen. The accuracy for sex determination using all the variables was 67% for males and 65% for females, the literature review with regard to gender determination from the mandible suggests that the gender determination accuracies vary from 60% to 80%, on an average.

KEYWORDS

Mandible, Measurements, Radiograph, Gender.

INTRODUCTION

Since the evolution of human race, Gender plays a very important role in the social and cultural attributes. Gender has had its own significant role in the survival and existence of the human race. Forensic anthropology is a relatively new scientific discipline. Hence gender determination from skeletal remains is crucial in the identification of human remains.[1]

Among the entire facial skeleton, The mandible is the most often studied part of the skeleton in documenting geographic variation and racial classification. The mandible is a paired bone that develops within the mandibular arch, embedding teeth and forming an articulation of the jaw with the cranium: the temporomandibular joint (TMJ).[2]. In a forensic anthropology context, the mandible represents a reliable skeletal element as it shows increased resistance to environmental factors, being usually well preserved even in archaeological context.[3]

Measurements such as gonial angle, ramus height and bigonial width have been used to evaluate the morphology of the mandible. Ingervall and Thilander have shown that dentate subjects with strong masseter and temporalis muscles have small gonial angles.[4] Literature also suggests that males had longer ramus height than females.[2] A more recent study conducted by Haghanifer and Rokouei has classified the position of mental foramen on the basis of gender in Iranian population.[5] This suggests that the accurate information regarding the location and orientation of the mental canal and its foramen can be very important in gender determination.

Over the years, various radiological modalities from conventional to digital modalities have been utilized for imaging of the facial skeletal structures.[6] Panoramic radiograph allows a bilateral view and are adequate to inform on vertical measurements of the mandible.[2]. Several studies have reported that panoramic radiographs are reproducible and accurate for the linear and angular measurements on mandibles.[7]

Thus, the present study was undertaken to know the gender differences in gonial angle, bigonial width, height of the ramus and the position of the mental foramen using panoramic radiography in Eluru population.

LITERATURE SURVEY

Mattila K, Altonen M, Haavikko K (1977) conducted a study and proved conclusively that the panoramic radiograph is the more obvious choice for determination of the gonial angles.[8]

Steyn M, Iscan MY (1998) made an attempt to establish population specific standards for sex determination from the skull. They studied 44 male and 47 female skeletons of known sex and race. They evaluated the complete cranium, vault, face, mandible and bizygomatic breadth. Dimensions from the complete cranium provided the best accuracy. In the mandible, bigonial breadth was the most dimorphic of the measurements taken. Average accuracies ranged from 80% (bizygomatic breadth alone) to 86% (cranium).[9]

Arnay-de-la-Rosa M et al (2007) conducted a study to determine genders using osteometric measurements, visual inspection and by amplification of sex specific amelogenin alleles. They concluded that the diagnosis based on visual examination of the mandible or on its metric measurement only serves to roughly estimate sex with an accuracy of around 70% or less. [10]

Galdames ICS, Valenzuela JSP, Quezada NAS, Contreras CEC, Rivas JAH, López MC (2008) analyzed the level of agreement for determining the sex by observing the flexure of the posterior margin of the mandibular ramus, at the level of the occlusal plane. They concluded that there is a moderate level of accuracy in diagnosing the sex by observing the posterior edge of the mandibular ramus in adult Panoramic radiographs. Gender determination of females were more accurate compared to males, using this method.[13]

Ayoub F et al (2009) conducted a study to evaluate the significance of the mandibular angle in sex determination in a sample of Lebanese young individuals. Lateral cephalometric radiographs were used. No statistically significant differences were detected between both genders..[12]

Haghanifar S, Rokouei M (2009) conducted a study to determine the most common location of the mental foramen, gender differences in its position and the symmetry of its location within individuals in Iranian population. They evaluated 400 panoramic radiographs. They concluded that the most common locations of the mental foramen were between the two premolars and in line with the second premolar, the mental foramina were symmetrical on both sides, among males it was commonly seen in line with second premolar and in females it was between first and second premolars.[5]

Huumonen S et al (2010) conducted a study to evaluate the association of tooth loss on the shape of mandible They observed that morphology of the mandible changes as a consequence of tooth loss, which can be expressed as a widening of the gonial angle and shortening of the ramus and condylar height. These findings highlight the importance of rehabilitation of the masticatory system to maintain good functioning of the masticatory muscles for as long as possible.[13]

Ongkana N, Sudwan P (2010) conducted a study to investigate the observable features of mandibles, which can be used consequently as the standard for sex determination in the Thai population. They examined eighty-eight mandibles, 64 males and 24 females. The shape of the chin, presence of the antegonial notch, appearance of the gonial angle and presence of the posterior ramus flexure were observed. According to the results the frequency of three morphologic features the shape of the chin, the presence of an antegonial notch and the appearance of the gonial angle, showed significant differences between the sexes. The accuracy of prediction for sex determination was 75.0 % and 70.3% in females and males, respectively. They showed that human mandibles exhibited sexual dimorphism, and could be used to distinguish the sex of Thai mandibles.[14]

Kharoshah MAA, Almadani O, Ghaleb SS, Zaki MK, Fattah YAA (2010) conducted a study on Egyptian population to evaluate sex determination using osteometric mandibular measurements. Spiral CT scan with three dimension reconstruction modality was used to assess six mandibular measurements in 330 persons. The study concluded that the overall predictive accuracy of this prediction model was 83.9%. [15]

Indira AP, Markande A, David MP (2012) conducted a study to measure, compare, and evaluate the various measurements of mandibular ramus. They studied Panoramic radiographs of 50 males and 50 females of Bangalore population in the age group between 20 and 50 years. They concluded that the mandibular ramus can be considered as a valuable tool in gender determination since it posses resistance to damage and disintegration process. [16]

Shamout RA, Ammoush M, Alrbata R, Habahbah AA (2012) studied the influence of age and gender differences in dentate Jordanian subjects using digital Panoramic radiography They concluded that the morphology of the mandible changed as a consequence of age and between genders, which can be expressed as a widening of the gonial angle, increasing of the bigonial width and shortening of the ramus. [2]

Marinescu M, Panaitescu V, Rosu M (2013) conducted a study in 200 mandibles using 3 measurements (chin height, bigonial width and bicondylar breadth) for assessing sexual dimorphism. The auhors observed an overall accuracy of about 84% in correctly sexing the mandibles. [3]

Thakur KC, Choudhary AK, Jain SK, Kumar L (2013) conducted a study to evaluate two important metric traits of the mandible i.e., mandibular angle & height of the ramus and their role in sexual dimorphism. They studied 30 dry male and 30 dry female adult human mandibles.They concluded that Mandibular angle in conjunction with other anthropological parameters may be useful as good anthropological tools in assessing races and sexual dimorphism. [17]

Pokhrel R, Bhatnagar R (2013) conducted a study on Indian population using discriminant function analysis to calculate the accuracy of two parameters each from ramus and condyle. They concluded that the fragments of mandible with just ramus or condyle can be used for sexing with results as good as that of whole mandible. [18]

Vinay G, Mangala Gowri SR (2013) conducted a study to measure, compare, and evaluate the various measurements of ramus breadth and mandibular angle to assess the usefulness in gender determination. The study showed that the mandible is an important bone in the determination of gender with high accuracy. [19]

Akhlaghi M, Khalighi Z, Vasigh S (2014) Investigated mandibular anthropometric parameters for sex determination in Iranian cadavers. Study was done in 45 Iranian cadavers below the age of 20;. They concluded that, symphysial height and mandibular bigonial breadth could be used to determine the gender with high accuracy. [20]

Method of study
A total of 200 patients belonging to both genders of age group 10-60 years attending the outpatient department of Oral Medicine and Radiology, St. Joseph Dental College and Hospital, Eluru were selected for the study by simple random sampling.

Panoramic radiograph of subjects were made using the digital Panoramic radiograph machine (Sirona Orthophos XG Model 6229343 D3352, SN 05685). (Figure I)

(Figure I)

The radiographs taken were stored in sidexis next generation software with all the patient details incorporated. All radiographs were interpreted using Sidexis next generation software (version 2.5, SIRONA Germany)

Interpretation of the radiographs
The stored radiographic images were imported to the Sidexis next generation software. [Figure 5]. The measurements of gonial angle, bigonial width and height of the ramus were made using the measuring tool in the software. (Figure- II).
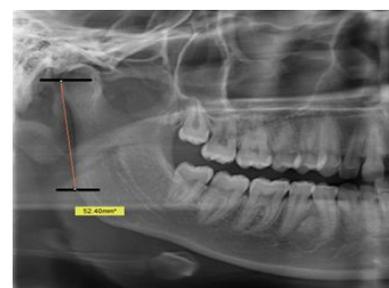

(Figure-II)

Gonial angles were measured using a method described by Mattila et al as follows: [8]

A line was digitally traced on the panoramic radiographs tangential to the most inferior points at the gonial angle and the lower border of the mandibular body and another line tangential to the posterior borders of the ramus and the condyle (Figure III). The intersection of these two lines formed the gonial angle. These measurements on the either sides of the mandible were recorded as right and left gonial angles, respectively.


(Figure III)

Ramus heights were measured using a method described by Huumonen S et al as follows: [13]A line represented the ramus extended from the most superior lateral point to the most inferior lateral point on the ramus tangent (FigureIV). Ramus height was measured on both sides on each panoramic radiograph as the right and left ramus heights respectively.
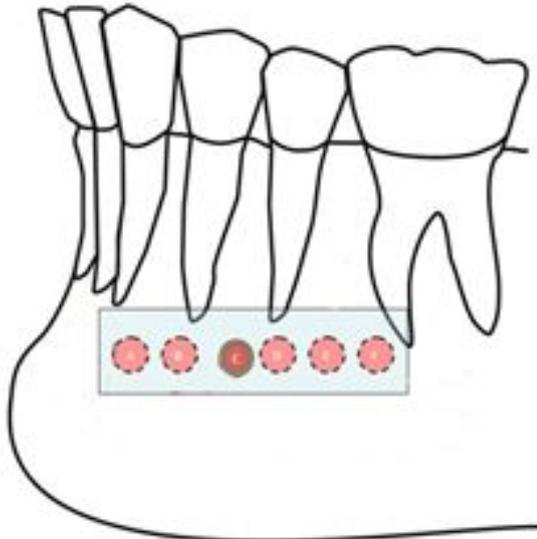

(FigureIV)

Bigonial width is the distance between both Gonia (Go). [17] Gonian is the most inferior, posterior and lateral point on the external angle of the mandible. It was measured horizontally from the right to left gonia. (Figure V)
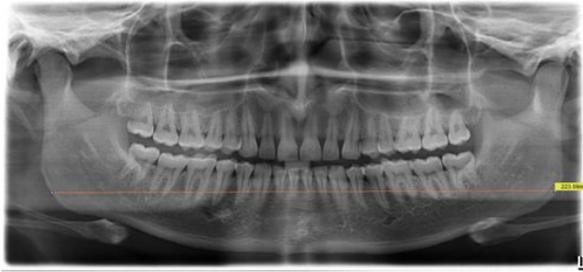
(Figure V)

Position of mental foramen was evaluated and was classified based on the system described by Haghanifer and Rokouei.[5] (Figure VI)

(Figure VI)

RESULTS
The study group consisted of 200 normal individuals in the age group 11-60 yrs, including both genders with normal vertical and transverse proportions. The radiographs obtained was recorded and interpreted for selected parameters. The data obtained were tabulated and subjected to statistical analysis. The following statistical methods were adopted using Statistical package for social sciences (SPSS) software. Normal descriptive statistics (frequency tables, means, standard deviation) were performed.

Comparison of gonial angles
Gonial angle in males and females using the mean of right and left side were compared. Significant differences were observed only in the age groups 31-40 and 51-60 with p values 0.001 and 0.002 respectively.

Comparison of ramus heights
Comparison of ramus height in males and females using the means of right and left side was done. Significant difference was observed in all the age groups except the 51-60 yrs age group where p value was 0.282.

Bigonial width comparison between males and females
Bigonial width in males and females when compared showed significant difference in the age groups 11-20, 41-50 & 51-60 with p values 0.006, 0.001 and 0.030 respectively.

Mental foramen comparison between males and females
Comparison of position of mental foramen in males and females using the means of right and left side was done. There was no significant difference in the position of mental foramen between males and females and the p values were above 0.05. Most common location of mental foramen for both males and females was between the first and second premolars.

CONCLUSION
The present study was carried out to determine the gender from

panoramic radiographs applying the measurements of gonial angles, bigonial widths, ramus heights and assessing the position of mental foramen. It showed us an encouraging results and accuracies when compared to the previous studies. This study used panoramic radiograph, a commonly advised screening radiograph, which is readily available, easy to perform and would reduce the need for additional exposure and cost for the patients.

We conclude that panoramic radiographs can be a valuable tool in determining gender from the mandibles with accuracies comparable to that of dried mandibles and mandibles are reliable skeletal fragment in gender determination. Future studies with a larger sample can be done to improve the assessment of sexual dimorphism.

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