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RESEARCH ARTICLE

MANDIBULAR ANGLE AS AN INDICATOR OF SEX DETERMINATION FOR A PUDUCHERRY POPULATION

[1,*]Jimsha V.K, [2]Mariappan Jonathan Daniel, [3]Mithunjith Krishnan and [4]Sruthi Selvam

[1]Assistant Professor, Department of Oral Medicine and Radiology, Mahatma Gandhi Postgraduate Institute of Dental Sciences Puducherry, Puducherry (U.T), India
[2]Associate Dean (Academics), Professor and Head, Department of Oral Medicine and Radiology, Mahatma Gandhi Postgraduate Institute of Dental Sciences Puducherry, Puducherry (U.T), India
[3]Assistant Professor Department of Conservative Dentistry and Endodontics, Indira Gandhi Postgraduate Institute of Dental Sciences, SBV University, Puducherry, India
[4]Postgraduate Resident, Department of Oral Medicine and Radiology, Mahatma Gandhi Postgraduate Institute of Dental Sciences Puducherry, Puducherry (U.T), India

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ABSTRACT

Introduction: Sex is a biological quality that distinguishes male and females.Determination of sex is the prime aspect of forensic investigations followed by age and identification of ethnic population.
Aim and objectives: The aim of this study is to evaluate the mandibular angle by direct digital orthopantamography and its significance in gender determination.
Materials & Methods: The sample consist of 100 digital orthopantamography images, mandibular angle was measured on the image for each case using inbuilt dimaxis software and statistical analysis was done by using T test.
Results: The outcome of our study showed that there was a significant difference in the mandibular angle between genders with the angle being more obtuse angle in female when compared to male. So our study infersthat mandibular angle can be used as a reliable parameter for sex identification.

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INTRODUCTION

The determination of sex of the skeleton represents an important stage in forensic investigation. Sex determination is usually the first step in personal identification followed by age estimation.Among human bones the pelvis and skull are the most reliable source for sex determination. Mandible is the strongest, and movable part of the skull, morphological features of the mandible always show some difference depends on the age, sex and race of an individual (Ahamed Tanveer, 2011). Male and female mandibles are distinguished by general size,chin shape, gonial angle and gonial flare. As mandible is the last skull bone to cease growth (Basvaraj, 2016) it is sensitive to adolescent growth spurt (Franklin, 2007).

Corresponding author: **Jimsha V.K.**
Assistant Professor, Department of Oral Medicine and Radiology, Mahatma Gandhi Postgraduate Institute of Dental Sciences Puducherry, Puducherry (U.T), India.
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A number of studies have been conducted to test the accuracy of mandible in determining sex worldwide. Humphry *et al* states that almost any sites of the mandible seems to have a potential for becoming sexually dimorphic, continues deposition and resorption of the bone is taking place during the growth phase (Humphrey, 1999). Among the craniofacial morphology the mandibular angle is the largest and hardest facial bone and retains its shape better than any other bones. Presence of a dense layer of compact bone makes it very durable and hence remains well preserved than many other bones. Mandibular ramus also be used to differentiate between sex and it also expresses strong univariate sexual dimorphism.
In the cases of mass disaster sex determination is challenging, mainly depends on available skeleton fragments. Dentomaxillofacial radiologyhas become a routine procedure in our practice mainly OPG was taken most widely, for obtaining comprehensive overview of the maxillofacial complex.The importance of imaging techniques in forensic medicine is widely recognised and it is a powerful tool in the present scenario.

The reliability of sex determination depends on the degree of sexual dimorphism inherent in the population. Various studies have been done in the past to investigate the reliability of angular measurements taken from panoramic radiograph. The values for the gonial angle are of particular interest because lateral cephalograms do not permit reliable registration of this angle and the super imposition images create difficulties in recognition and measurement of the individual angle (Scheuer, 2002). The present study is to evaluate the mandibular angle by direct digital orthopantomography and its significance in gender determination.

MATERIALS AND METHODS

We examined the images of 100 patients (50 male, 50 female) under the age group of 18-30 who underwent direct digital panoramic imaging for various diagnostic purposes. The images were acquired using Planmeca promax digital system, Finland, exposure parameters were 57-85 kvp, 12-16 mA according to patient age and size. Only images with high quality and correct positioning were included. Patient with various asymmetry affecting the craniofacial region and mandible, various local or systemic disorders affecting growth of the craniofacial region, postsurgical cases or patient with any acquired skeleton deformities were excluded from the study. The gonial angle was measured by tracing a line tangent to the lower border of the mandible and another line tangent to the distal border of the ramus on each side, the intersection of the two lines was measured by using inbuilt dimaxis software (Figure1). Data was collected for statistical analysis.

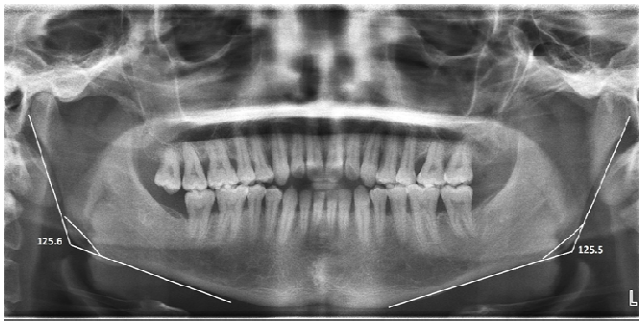

Figure 1. The gonial angle was measured by tracing a line tangent to the lower border of the mandible and another line tangent to the distal border of the ramus on each side, the intersection of the two lines were measured by using inbuilt dimaxis software

RESULTS

Statistical analysis was performed by using" T " test p value was < 0.05 significant at 1% level which states that measured value differ significantly by age, there was a good inter observer comparison (Table 1, 2).

Table 1. Inter-observer comparison

INTER-OBSERVER COMPARISON

LOCATION (SIDE)	OBSERVER	MEAN	±	SD	MD	SDD	T-VALUE	P-VALUE
Right	1	122.36	±	5.69	-0.31	2.83	-0.78^{NS}	0.4365
	2	122.68	±	5.37				
Left	1	121.94	±	5.77	0.02	2.89	0.04^{NS}	0.9689
	2	121.92	±	5.62				

NS – Not Significant
Hence there is no difference in the observation between two observers.

Table 2. Comparison by gender

COMPARISON BY GENDER

LOCATION (SIDE)	GENDER	MEAN	±	SD	T-VALUE	P-VALUE
Right	Male	119.11	±	4.26	-4.90*	0.0000
	Female	125.62	±	5.09		
Left	Male	118.41	±	4.57	-5.44*	0.0000
	Female	125.46	±	4.61		

*Significant at 1% level
Differ significantly by Gender.

DISCUSSION

Application of radiology in forensic was introduced in 1896, one year after the discovery of X rays by Sir Wilhem Conrad Roentgen, to identify the lead bullet inside the head of a victim.Radiological methods are widely used in identification, age estimation and establishing causes of death. Many studies now support the uses of forensic radiology to compliment and in specific cases to replace conventional biopsy. In Dento maxillofacial radiography, panoramic radiography is a part of routine radiographic examination in most of the cases. There have been many studies in the past decade that have proven the usefulness of orthopantomograms for the determination of morphological dimension of the mandible (Nohadani, 1986 and Kitai, 2013). Panoramic radiograph was selected in our study as it proved to be a better choice for estimating gonial angle than the lateral cephalogram as stated by Mattila *et al* (Matilla, 1977). Most of the studies were conducted using manual methods of matric analysis on a dry skull bone, which is time consuming and technique is prone to error and other cases conventional panoramic radiograph had been used but in our study we have chosen direct digital OPG. It has various advantages like immediate observation of radiographic images, ability to enhance images, data storage, less radiation, superior image quality, adding the benefit that the analysis can be repeated to eliminate errors. One of the drawbacks in the conventional OPG is that of observer bias due to manual method of measuring the angle that is overcome by direct digital OPG where the measurements are done by inbuilt dimaxis software. Disadvantages of OPG technique is uneven magnification and distortion, vertical dimension as compared to the horizontal dimension is little altered , mainly because of the horizontal movements of the X ray tube and film. When considering the mandible condyle, ramus dimorphism is noted regarding the mandibular ramus compared with mandibular body according to the study done by Humphry *et al* (Scheuer, 2002). From the present study gonial angle measurement is high in female gender compared to male, we state that gonial angle can also be usedas a valuable tool for sex identification. The structure of the gonial region will be maintained by the insertion of the medial pterygoid and masseter muscles and the muscle function tends to preserve bone at its point of insertion.Results obtained in our study was similar to that of Mbajjorgu Fe *et al*. (1996**)** who by examining cadaveric section has stated that mandibular angle and length can be used as an indicator for sex determination .Result of our study gives a valuable evidence that gonial angle can be effectively and

precisely measured using Direct digital OPG and also can be used as an indicator for sex determination in forensic radiology. Ayoub *et al*. (2009) evaluated the significance of the mandibular angle in sex determination in a sample of Lebanese young individuals. But this study demonstrated no significant difference of the mandibular angle in sex determination in young Lebanese population. In our study we achieved a statistically significant difference between the mandibular angle in male and female, female showed more obtuse angle when compare to male but there was no difference noted in the right or left side gonial angle. The reason behind this may be females have a downward and back ward rotation in mandible, while males have a forward orientation in mandible .There was a good inter observer comparison. Limitation of our study was small sample size, studies on large sample size should be done to get more accurate results. As regards to the gonial angle, measurement varies from each researcher, there are some studies which state that the value is higher in female[12,13]where asothers reported statistically significant increase in the male gender (Kumar, 2013). There are some studies where there are no differences in this parameter (Karoshaha, 2010; Upadhyay, 2012 and Pecora, 2018). However, level of sexual dimorphism are population specific due to combination of genetic and environmental factors.Generally overall size and bone thickness of the male skeleton is greater than that of the female, it has been established that socio environmental factors such as food, climate, nutrition and pathologies influences, the growth and development of bone. In our study statistically significant differences between male and female gonial angle was reported, hence this parameter can be used for sex determination in forensic purpose.

Conclusion

This preliminary study on images of mandibles from the Pondicherry population clearly indicates that mandibular angle has satisfactory potential for determination of sex. It can especially be used for forensic cases where damaged and partially preserved mandibles are frequently found. We suggest that larger samples and populations from more diverse geographic regions may enhance the effectiveness of this parameter.

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