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Original Research Article

Age Estimation and Sex Determination using Antegonial Depth in Indian Population - A Retrospective Study

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Antegonial Depth, Orthopantomograph, Panoramic Radiographs, Antegonial Notch, Antegonial Depth.

Abstract

Introduction: Identification of an individual is crucial from womb to tomb. It has always been a challenging task. Estimation of age after death from the adult skeleton is one of the most important objectives in medico-legal cases. Among the various parameters available, skeletal age determination is considered the best. This study attempts to assess the Reliability of antegonial depth or notch as an indicator of chronological age. **Material & Methods:** A total of 400 patients (200 males and 200 females), panoramic radiograph taken for various purposes were included in the study. The patients were categorized according to age, gender. Panoramic radiographs were traced and antegonial depths were measured. **Results:** A trend of same antegonial depth with age was observed in both males and females. Furthermore, there were differences between males and females uniformly in antegonial depth. **Conclusions:** The antegonial depth remained almost same with the advancing age and in between sexes.

1. Introduction

Various authors described several changes which Occurs in the shape of the human lower jaw as age progresses. One of the notable changes is change in the gonial (mandibular) angle. The angle between the mandible body and the ramus is called the gonial angle. Surface resorption field present at the lower edge of the mandible in the ramus body junction, forming an antegonial notch or antegonial depth. Any Changes in the gonial angle is largely formed by ramus remodelling and is determined by the remodelling direction of the ramus with its condyle.

Very few studies have been carried till date in India antegonial depth and relation with determination of sex and age.[1–5] Other than age and loss of teeth, other factors may influence gonial angle changes. Panoramic radiograph is the most basic choice for Determination of ante gonial depth.[4] Thus, the aim of this study was to evaluate antegonial depth from panoramic radiographs of to

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determine their sex and age.

2. Materials and Methods

The present study titled "Age Estimation and Sex Determination using Antegonial Depth - A Retrospective Study" was conducted in the Department of Forensic Odontology, JSS Dental College and Hospital, Sri Jagadguru Sri Shivarathreeshwara Academy of Higher Education and Research (JSSAHER), Mysuru, Karnataka.

This study was undertaken with an aim of establishing certain mandibular parameters as criteria, thereby setting a population specific standard for age and sex determination. Digital orthopantomograms (OPG) archived in the Department of Oral Medicine and Radiology, JSS Dental College and Hospital, Mysuru was used for this study with Inclusion criteria of radiograph with proper contrast and density were only selected in which all the structures were clearly visible and in exclusion criteria radiograph with improper density were excluded from the study.

The study followed Stratified random sampling technique which consisted of 400 OPG (200 male and 200 female subjects) that were divided into five groups on the basis of chronological age by decades (40 in each group for male and female subjects), in the age range of 20-70 years **(Table 1)**.

Table 1: Sample size distribution

Study Groups	Age group	Male	Female
Group 1	20-30 years	40	40
Group 2	31-40 years	40	40
Group 3	41-50 years	40	40
Group 4	51-60 years	40	40
Group 5	61-70 years	40	40
	Total	200	200

Mandibular parameter antegonial depth was studied and assessed whether this will aid in estimating the age and determining the sex. Digital orthopantomograms were obtained from Planmeca Promax Scara 3 Digital OPG Machine, (70 kVp, 8 mA for 16 seconds), Manufactured by PLANMECA OY, Helsinki, Finland, with a 1:1 ratio. The digital orthopantomograms were imported into Planmeca Romexis Viewer Software 2.9.2.R., and the measurements were done. Microsoft Office Excel (2016) sheet was used for compiling the data.

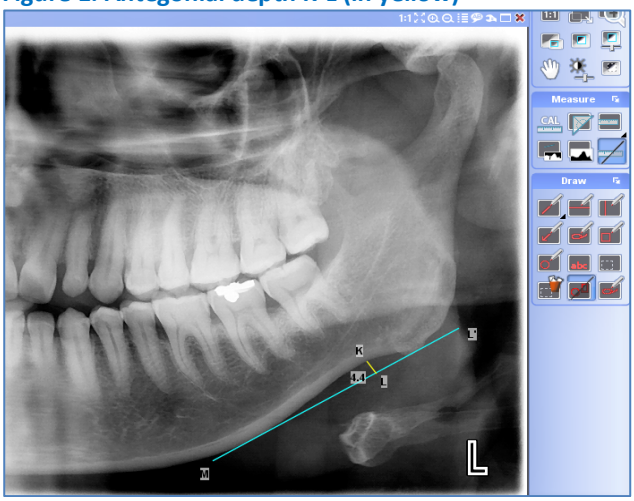
The statistical analysis was carried out using SPSS Software Package version 20 with Descriptive statistics, ANOVA test, post- hoc test, independent t-test were applied.

Methodology:

Ethical clearance ((No: JSS/DCH/IEC/2017-18 /02) was obtained from JSS Dental College & Hospital's Institutional Ethical Committee prior to conducting the study. The digital orthopantomograms were selected based on the inclusion and exclusion criteria mentioned above. The selected radiographs were imported to Planmeca Romexis Viewer 2.9.2.R software, where the antegonial depths were digitally traced and the measured values noted. Literature states that a very high degree of symmetry exists between the left and the right sides, therefore all the measurements were made on the left side of the radiograph for uniformity [6, 7]. The measurements were calibrated in millimeters (mm) and the measured values were entered in Microsoft Office Excel sheet.

Antegonial Depth (K-L): The antegonial depth was measured as the distance along a perpendicular line from the deepest point of the notch concavity to a tangent through the inferior border of the mandible (ML). This method of measurement is taken from Revant H. Chole et al., 2013 [8] and represented in the **figure 1**.

Figure 1: Antegonial depth K-L (in yellow)



3. Results and Observations

The mean values of antegonial depth for females and males in relation to different age groups depicted in table 2.

Group 1: 20-30 years

For antegonial depth females had a mean value of 0.93 mm +/- 0.96 with SEM 0.15 while males had a mean value of 1.80 mm +/- 1.57 with SEM 0.24. For antegonial depth, the mean difference between females and males was 0.875 mm.

Group 2: 31-40 years

In this age group antegonial depth showed a mean value of 0.91 mm +/- 1.02, SEM = 0.16 for females.

Males had a mean value of 1.32 mm +/- 1.71, SEM = 0.27. The mean difference between females and males was 0.4125 mm. P value obtained was 0.195 (P > 0.05), implying that males and females showed no significant differences.

Group 3: 41-50 years

In this age group mean value obtained was 0.59 mm +/- 0.97 with SEM of 0.15. For males mean value was 1.38 mm +/- 1.35, SEM = 0.21. The mean difference between females and males was 0.795 mm. The P value was 0.004, which was statistically significant (P < 0.05). In other words, significant differences are present between females and males.

Group 4: 51-60 years

The mean value in females for antegonial depth was 1.01 mm +/- 0.96, SEM = 0.15, while in males mean value was calculated to be 1.79 mm +/- 0.96, SEM = 0.15. The mean difference between females and males was 0.7825 mm. The calculated P value was 0.006 (P < 0.05). In other words, significant differences are present between females and males by 0.7825 mm.

Group 5: 61-70 years

Antegonial depth for females was 0.90 mm +/- 1.04, SEM = 0.16, for males it was 1.34 mm +/- 1.47, SEM = 0.23. The mean difference between females and males was 0.661 mm. P value calculated was found to be 0.128 (P > 0.05), thus implying that females and males do not show significant difference.

Overall Age Group: 20-70 years

Females had a mean value of 0.87 mm +/- 0.99, SEM 0.07 for antegonial depth and males had a mean value of 1.53 mm+/- 1.52, SEM = 0.10 for antegonial depth. The mean difference between females and males was 0.661 mm. The P value was statistically significant, 0.000. This shows that females and males have significant difference by 0.66 mm.

Table 2: Mean values of antegonial depth for females and males in relation to different age groups

Age group (years)	Female		Male		Statistically significant
	No.	Mean (mm)	No.	Mean (mm)	
Group 1: 20-30	40	0.93 ± 0.96	40	1.80 ±1.57	Yes (P = 0.00)
Group 2: 31-40	40	0.91± 1.02	40	1.32 ±1.71	No (P = 0.19)
Group 3: 41-50	40	0.59 ± 0.97	40	1.38 ±1.35	Yes (P = 0.00)
Group 4: 51-60	40	1.01 ±0.96	40	1.97 ± 1.45	Yes (P = 0.00)
Group 5: 61-70	40	0.90 ± 1.04	40	1.34 ± 1.47	No (P =0.12)
Overall: 20-70	200	0.87 ± 0.99	200	1.53 ± 1.52	Yes (P = 0.00)

Logistic Regression Analysis for sex determination.

The logit equation obtained using logistic regression analysis to determine the sex with the mandibular parameter bigonial width was:

Antegonial depth: Log [P/(1-P)] = - 0.482 + (0.412 x Antegonial Depth) with a standard error of 0.085mm. Where, Log is the log odd or logit value, P is the probability.

The standard error obtained was 0.085 mm. It is important to note that if P > 0.5 classifies it as male otherwise female. The overall prediction accuracy obtained was 58.8% (**Table 3**).

Table 3: Prediction Accuracy for sex determination using Antegonial Depth

	Predicted		Percentage Correct
	Male	Female	
Male	120	80	60.0%
Female	85	115	57.5%
Overall	205	195	58.8%

4. Discussion

1. Antegonial depth

According to this study mean antegonial depth was 0.87 +/- 0.99 (females) and 1.53 +/- 1.52 (males). This parameter also shows greater values for males than females. Antegonial depth is statistically significant, P value = 0.000, thus implying that females and males show significant differences for antegonial depth. In female subjects the antegonial depth remains constant in the 2nd and 3rd decade, decreases in the 4th, increases in the 5th and decreases in the 6th decade of life. Among males, it decreases in the 3rd and 4th decades, increases in the 5th decade and decreases in the 6th decade of life (**Table 2**).

Sex

The present study is in concordance with the results of the previous studies as is noted from the above table (**Table 4**) where the mean antegonial depth is larger in males than in females. It can be seen that the present study has slightly smaller values (females 0.87 mm and males 1.53 mm) than the previous studies (**Table 4**). This could be due to differences in sample size, age groups and population Chole H et al., 2013 [8], and the magnification factor, standardisation, and machine used. In a study

conducted by Chole et al., 2013 [8], correlation of age and antegonial depth was not significant ($P > 0.05$). Males had significantly greater antegonial depth than females (2.251 mm ± 1.405 and 1.14 mm ± 0.5763, resp.), irrespective of the dental status.[8] These results are similar to that obtained in the current study where males have a greater antegonial depth (1.53 mm) than females (0.87 mm). The morphological change in the antegonial region has received little attention in the literature[8]. In a study by Ghosh et al., 2010[9], the mean value of antegonial depth did not change significantly with age. Females had smaller values as compared to males.[9] According to Dutra et al.[5], the antegonial depth was significantly greater for males than females (2.12mm ± 0.09 versus 1.46mm ± 0.07, $P < 0.0001$). Edentulous individuals (1.87mm ± 0.1) had significantly greater antegonial depth than dentate and partially dentate individuals (1.60mm ± 0.1 and 1.65mm ± 0.1, respectively).[10] The results of the present study support these findings. Edentulous individuals showed a greater antegonial depth than the dentate or the partially dentate. This observation however, was made on only a few radiographs (the present study consisted of only a few edentulous OPG) and hence in order to substantiate this finding a study with a greater sample size should be conducted. Males had a larger antegonial depth than females in the current study. In a study conducted by B Rai et al., 2006 [11] the antegonial depth was significantly greater for males (2.57 ± 0.33 mm) than females (1.59 ± 0.49 mm), p < 0.01, irrespective to age.[11] Antegonial depth was measured as the distance along a perpendicular line from the deepest point of the notch concavity to a tangent through the inferior border of the mandible (8, 11, 9, 5). Similar results were obtained in the present study where the antegonial depth was significantly greater for males than females irrespective to age. It may due to hormonal differences affecting bone metabolism.[11] In the present study antegonial depth had a predictive accuracy of 58.8% (**Table 3**).

Age

In the current study, antegonial depth shows an overall decrease with age in both females and males, by 0.3 mm in females and in males by 0.46 mm except in the 5th decade where an increase is seen with increase in age (Table 2). This decline in antegonial angle with age was not consistently significant across all age groups. Ghosh et al.,2010 [9], in their study revealed that no statistically significant relation was observed between the mean antegonial depths with respect to the age, though an increase in antegonial depth with age was observed in both males and females.[9] The study was concluded by stating that the antegonial regions undergo remodelling with advancing age. The increase in antegonial depth with advancing age is influenced by tooth loss.[9]

Thus, antegonial angle is not a reliable parameter for the estimation of age. In the present study, except in group 2 (P = 0.019) and group 5 (0.12) all other groups had statistically significant P values (0.00) thus implying that significant differences exist between females and males. With respect to age, the mean value of antegonial depth did not change significantly with age. Also, antegonial depth was not selected by regression analysis for age estimation thereby showing that it is not suitable for the estimation of age. Thus, the results of the present study show that antegonial depth can be used in sex determination but is not a reliable parameter for age estimation.

Table 4: Comparison of Mean Value of Antegonial Depth in Different Studies in Indian Population

S. No	Study (mm)	Sample Population	Male	Female
1.	Chole H et al 2013 [8]	India	2.25 ± 1.40	1.14 ± 0.57
2.	Ghosh S et al 2010 [9]	India	2.25 ± 1.40	1.14 ± 0.57
3.	Rai B et al 2006 [11]	India	2.57 ± 0.33	1.59± 0.49
4.	Aruleena et al 2019 [16]	India	2.95 ± 0.53	2.81 ⍰ 0.23
5.	Present study 2021	India	1.53 ± 1.52	0.87 ± 0.99

A Study was done by estimating age from hyoid bone, this study showed that as the age advances, the incidence of degree of fusion of greater cornea with the body of hyoid bone increases.[12] Another study was done on age estimation from radiographic evaluation of various developmental stages of Maxillary Third Molars and found reliable results.[13] A Study on Estimation of Stature from Bigonial Breadth in Population of Western Maharashtra was done and found mean height, bigonial diameter were higher in males than in females.[14] Correct knowledge about recognizing a dental sample as substantial evidence by police personnel is certainly important to prevent the loss and tampering of evidence. Also dental

records prove to be the best defence for the dentist in case of a malpractice suit. To maximize dental application in forensic cases, it is necessary to train dentists in the practical aspects of this subject. Also there is a necessity in exposing dentists to the basic principles and techniques of the subject. The availability and accuracy of dental records determine the success of identification. All such measures would help to identify, recover, and interpret the dental evidence correctly, thus providing timely justice to all.[15]

5. Conclusion

This study showed that the antegonial Notch or Depth are influenced by Sex but not by age. Thus, changes taking place in antegonial depth can be used as a forensic tool for sex determination but not is not a reliable parameter for the estimation of age.

Ethical Clearance: IEC approval was taken from the Institutional Ethical committee.

Contributor ship of Author: All authors equally contributed.

Conflict of interest: None to declare.

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