

To Assess the Values of Gonial & Antegonial Angle on Panoramic Radiograph and their Role in the Gender Determination

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Balwinder Singh^{1*}, Sukhdeep Singh Kahlon², Ramandeep S. Narang³, Shilpa Gupta², Khushbinder⁴, Kirandeep Kaur⁵, Shiny Singh⁴ and Pavleen Kaur⁴

¹Department of Oral Medicine and Radiology, SGRD Institute of Dental Sciences & Research, Amritsar, Punjab, India

²Department of Orthodontics & Maxillofacial Orthopedics, SGRD Institute of Dental Sciences & Research, Amritsar, Punjab, India

³Department of Oral Pathology, SGRD Institute of Dental Sciences & Research, Amritsar, Punjab, India

⁴SGRD Institute of Dental Sciences & Research, Amritsar, Punjab, India

⁵Consultant Oral and Maxillofacial Surgeon at Bibi Kaulan Ji Charitable hospital, Sri Amritsar, Punjab, India

Abstract

Objective: To assess the values of gonial & antegonial angle on panoramic radiographs and assess their role in the gender determination.

Materials & Method: A study was carried out on 400 selected panoramic radiographs (200 males and 200 females). Gonial angle and antegonial angle were recorded and their predictability for the gender assessment was done. Statistical analysis of Student's *t*-test, Man-Whitney test and ROC curve were used.

Results: There was significant difference in mean values of antegonial angle between males and females. The ROC curve suggested that both the right and left antegonial angle have 73% and 69% predictability respectively in gender determination. No statistically significant difference ($p > 0.05$) was found in gonial angle between males and females.

Conclusion: The antegonial region values are influenced by gender and have potential to be the used as forensic tool in gender determination.

Introduction

Dental measurements are important in forensic for the study of sexual dimorphism and for prediction of growth pattern and for evaluating changes with age and gender [1,2]. Since Late Pleistocene/Early Holocene humans there is trend toward tooth and jaw size reduction [2].

Panoramic radiographs (OPGs) are most commonly advised radiograph in dental practices to assess mandibular and maxillary vital structures. They are a most comprehensive approach to visualise the most aspects of dental conditions using a single film. The high rate of prescription of panoramic radiographs means it is a useful tool to study the morphological changes that occur with age as well as any differences or correlations between genders. There is acceptable reproducibility for the vertical and angular variables for group comparisons, provided head positioning is standardized and kept constant [3,4]. It is stated that despite the unreliability of horizontal measurements, angular measurements might be performed with high reliability in OPG.

With the advancing age, the majority of the mandibular changes occur not only in the alveolar process; but also the changes are seen in the basal bone [5]. The remodelling in the gonial angle, antegonial angle, mental foramen, mandibular foramen and mandibular canal of the mandible occurs throughout the life with age, gender and dental status [6].

Among the various skeletal parts, pelvis and skull are traditional indicators of gender. But recently with the advances and depth of researches made in the field of forensic odontology, the role of facial structures has gained importance. The mandible is a common approach used by anthropologists. In a study, Hu KS, et al. examined the morphological characteristics of the mandibles of 102 Koreans of either sex of 13 non-metric items of the mandible and he concluded that non-metric method used to analyze the mandible in this study can be used for gender discrimination [7].

Various studies have utilized panoramic radiographs to measure gonial angle and antegonial angle. The results were variable and inconsistent [8-10]. The role of individual age and gender on the degree of gonial angle is controversial. There has also been differences in the gonial angle measurements in comparison to genders in some

*Corresponding author: Balwinder Singh, Senior Lecturer, Department of Oral Medicine and Radiology, SGRD Institute of Dental Sciences & Research, Amritsar, Punjab, India, Tel: +91-9988220039, Email: dr.balwindersingh@rediffmail.com

studies [11,12]. Ohm and Silness [9] and Dutra, et al. [13] found no significant difference in gonial angle between sexes.

Morphological alterations in the antegonial region have been researched thoroughly in young individuals but little research has been done for gender determination. To date there has been limited research into gender differences in antegonial angle and gonial angle together noticing any change in parameters in regards to gender.

Internationally, studies have been conducted in an attempt to correlate gender with mandibular parameters but at present, there are no known studies conducted on the North Indian Population. The present study was conducted to better understand the alteration in the gonial region and antegonial region and to correlate with gender determination

Materials & Methods

This study evaluated 400 digital panoramic radiographs of patients visiting SGRD Institute of Research & Dental Sciences, Sri Amritsar, India. The participants were aged between 18 and 69 years were grouped into two groups. One group consisted of 200 males and other group consisted of 200 females.

Intraoral examination of the subjects was done to rule out attrition, traumatic bite, malocclusion, bruxism, or any temporomandibular joint anomaly. The exclusion criteria were individuals giving history of any surgical procedure of mandible, micrognathia, any skeletal or dental malocclusion and TMJ disorders, mandibular arch associated with any pathologies, mixed dentition, systemic diseases, evident radiographic error and presence of bifid mandibular canal. Inclusion criteria include clear visibility of all parameters on digital panoramic

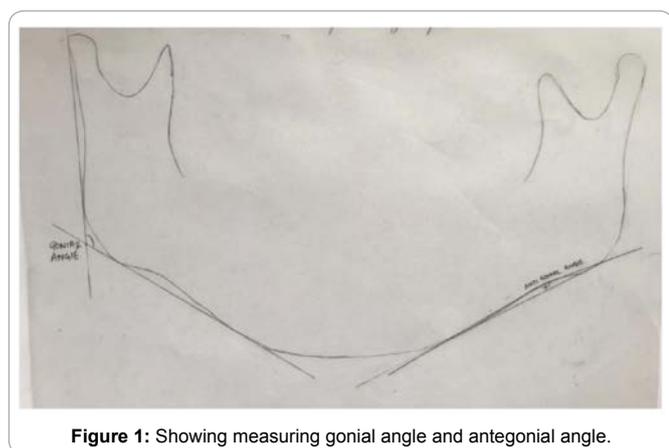


Figure 1: Showing measuring gonial angle and antegonial angle.

radiographic image and tracings can be made clearly of the gonial angle, antegonial angle on cellophane paper. Gonial angle and antegonial angle were measured on cellophane paper panoramic radiographs by a single dentomaxillofacial radiologist.

Gonial angle measurements were undertaken as described by Upadhyay, et al. [14] measuring between 2 tangents from the gonion; the first running superiorly along the posterior border of the mandibular ramus and the other anteriorly along the inferior border of the body of the mandible (Figure 1). This was measured bilaterally on the left and right hand side of each radiograph in order to produce an average value. The antegonial angle was measured by tracing two lines parallel to the antegonial region that will intersect at the deepest point of the antegonial notch.

One hundred OPGs were retraced after an interval of 1 month for calculating intra-observer variability. Various antegonial angles and depths were again measured by the same examiner. The results were compared with the older values. The data obtained was subjected to statistical analysis using SSPS version 14 for windows 7.

Results

400 radiographs were evaluated for analysis. In the present study the mean age for male group was 60.4 years and for the female group was 57.9 years with no statistical significant difference between the two ($p > 0.05$).

The Table 1 shows the gender difference in the mean values of the right and left gonial angles and antegonial angles. The mean value of gonial angle in male was 123.2 and 125.4 in right and left respectively while in female was 124.5 and 123.7 in right and left respectively. There was no statistically difference between males and females (Table 1).

The mean of the value of the antegonial angle was more in females as compared to male. The mean value of antegonial angle in male was 161.9 and 163.1 in right and left angle respectively while in female were 166.3 and 166.9 in right and left angle respectively. Statistically significant difference was observed between males and females with p value less than $<.001^{**}$ (Table 2).

Further to assess the predictive value of statistically significant antegonial angle for assessing the gender of the patient, Relative operating curve (ROC) was drawn for both right and left antegonial angles. The area under the curve represents the reliability of the antegonial angle to predict the gender. The area under the right antegonial angle was 0.723 and area under the left antegonial angle was 0.659 (Table 3). The predictive value for gender assessment was statistically significant in both right and left antegonial angle (Figure 2). Although, the right antegonial

Gender		N	Mean	Std. Deviation	Minimum	Maximum
Male	RIGHT GONIAL ANGLE	200	123.28	6.963	103	141
	RIGHT ANTIGONIAL ANGLE	200	161.96	5.378	149	172
	LEFT GONIAL ANGLE	200	125.44	6.908	101	140
	LEFT ANTI-GONIAL ANGLE	200	163.10	8.370	135	178
Female	RIGHT GONIAL ANGLE	200	124.55	6.959	109	140
	RIGHT ANTIGONIAL ANGLE	200	166.34	6.010	145	180
	LEFT GONIAL ANGLE	200	123.17	13.644	11	139
	LEFT ANTI-GONIAL ANGLE	200	166.99	5.194	151	178

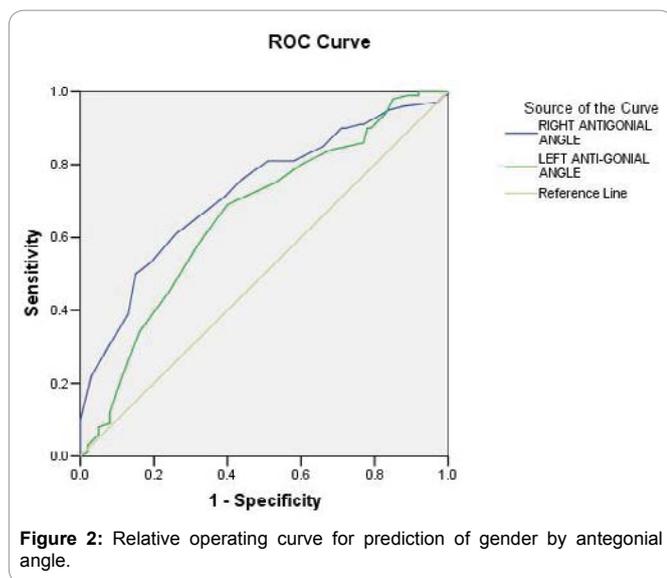
Table 1: Mean values of left & right gonial angle and antegonial angle.

	RIGHT GONIAL ANGLE	RIGHT ANTIGONIAL ANGLE	LEFT GONIAL ANGLE	LEFT ANTI-GONIAL ANGLE
Mann-Whitney U	4613.500	2768.500	4605.000	3408.000
Wilcoxon W	9663.500	7818.500	9655.000	8458.000
Z	-.946	-5.464	-.967	-3.899
Asymp. Sig. (2-tailed)	.344	<.001**	.333	<.001**

Table 2: Showing p-value of gender comparison with parameters.

Test Result Variable(s)	Area	Std. Error(a)	Asymptotic Sig.(b)
RIGHT ANTIGONIAL ANGLE	.723	.036	.000
LEFT ANTI-GONIAL ANGLE	.659	.039	.000

Table 3: Showing area under the ROC curve.



angle had more specificity and sensitivity values as compared to left antegonial angle.

Discussion

Researches has been carried out to assess the difference in values of the gonial angle and antegonial angle in males and female but very few researches has been done to assess whether gender assessment can be done with values of gonial and antegonial angle. This will allow the morphology of the mandible to be observed and differences noted between sexes. The research in this arena has been concern for while from the forensic point of view.

The study was carried out on 400 OPGs comprising 200 males and 200 females. The OPGs have been chosen for the study ahead of lateral cephalograms because OPGs have proved to be the reliable for the measuring the angular parameters as they are not influenced with the magnification error of OPG and overlapping drawback of lateral cephalograms. Also with slight misalignment of the head do not significantly affect the vertical measurements with a variation of less than 2%. Moreover the comparison can be made easy for left and right side of the parameters.

The values of the intra-class coefficients (for reliability analysis) for the left and right gonial angles and antegonial angle parameters were very high, proving the reliability of the method used in the study very high.

The study found no significant difference when comparing left and right gonial angles, regardless of gender in both gonial and antegonial angle. No gender difference was observed between the gonial angles. Females were found to have a similar value of gonial angle when compared with their male counterpart. Similar results were obtained by Dutra et al. [13] while the results were not analogous to the results obtained by Ghosh, et al. [15], Bhardwaj D, et al. [16], Huuomonen, et al. [17], Xie QF, et al. [18] who resulted out that females have larger gonial angle. This could be attributed to the reason that the masticatory forces might be almost similar in males and females in this region as non vegetarian diet is on rise. Bhardwaj D, et al. in her study found that female have larger gonial angle which might be due to impact of masticatory forces. It has been suggested that person with more masticatory forces might have a small gonial angle and on average men have greater masticatory force than do women [17]. In this study the mean age for male was 60. 4 years and in female was 57.9 years which might be another reason for similar values in males when compared with females as there is tendency for gonial angle to increase with the age as suggested by Ghosh, et al. [15]. However the mean value of gonial angle was in concordance with majority of studies.

Females had higher values of antegonial angles as compared to males. Gender differences were statistically significant in the antegonial region where males having a lower value than females. The results of this study were consistent with the results of a study of Dutra, et al. [13], Ghosh S, et al. [15], Bhardwaj D, et al. [16] and Enlow DH, et al. [19]. The value of antegonial angle in present study was in line with the studies of Dutra et al. and lower then the values found in the study of Ghosh S, et al. [15]. The difference in the values could be attributed to the resorptive nature of antegonial region with age. Moreover the female larger values of antegonial angle also might be due to gender hormonal differences affecting bone metabolism and the variation of the action of muscular masses attached in this region [13,18]. Some osteotomies for orthognathic surgery are performed in the antegonial region, and a resorptive pattern in this region has implications when performing this surgery.

Moreover the differences in the antegonial region between males and females can be useful as a forensic tool for gender determination. To further verify this ROC Relative operating curve (ROC) was drawn for antegonial angle parameter. The curve suggested that both the right and left antegonial angle have 73 % and 69% predictability in gender determination. This value is considered very high when remains of the body are the only source of determination. The observations of the present study further enrich the field of Anthropometry and will help in easy identification.

There was a no statistical difference between the left and right antegonial angle which was not in concordance with study done by Dutra, et al. [13] and Preston B, et al. [20] who proposed

that differences could be due to increased function on a preferred chewing side or random asymmetry of the facial skeleton.

The results of the study have some important implications. The study highlighted that antegonial angle have high potential to be used as tool for gender determination further enhancing the armour of forensic tools. Also the study clears out the that gonial angle not vary between male and female, so this angle can be regularly used to determine the rotation without any of the mandible and to aid in diagnosing growth patterns in order to depict orthodontic extractions or surgical treatments.

This study has limitations like effect of age groups on parameters; affect of edentulous ridge were not studied. However, this study is important in the fact that antegonial angle can be used as forensic tool. The study also shows the effects on various parameters in gender comparison.

Conclusion

This study showed that the antegonial region are influenced by gender and has potential to be the forensic tool. The gonial angle did not show any change with gender. Further studies are necessary to establish the pattern of remodelling in the mandible in different pathological conditions and the effect that this may have on dental treatment and also age related remodelling of the mandible.

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