

Age & Gender Predilection Using Bigonial Width & Gonial Angle in Panoramic Radiograph: Retrospective Study

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ABSTRACT

Background: Age & Gender Estimation is an essential part of forensic investigation. Mandible is the strongest bone & well-preserved bone in complicated cases. Digital radiography is a tool that is very useful in forensic study. The present study was aimed to explore the impact of both age and gender on gonial angle and bigonial width in the dentulous Gujarat population using digital OPG.

Materials & Methods: Study Comprises randomly selected 50 OPG (25 male ,25 Female) dentate age range from 18 to 79 years from oral Medicine & Radiology Department. Any defect, anomaly were ruled out. Sample were Divided into 7 age groups. Bigonial angle and Gonial Angle were digitally measured. The collected data from the subjects were analysed using the SPSS version 25. Unpaired *t*-test, Paired *t*-test, one-way ANOVA and Pearson Co-relation test were used for comparison. Parameters were studied according to gender, side and different age groups.

Result: Females have higher values of the gonial angle compared to male counterparts, but lower bigonial width. (p -value=0.00) Males have low value of gonial angle, but longer bigonial width than female(p -value=0.00). It was seen that person having a larger gonial angle have a shorter bigonial width compare to those having a lower gonial angle & longer bigonial width. (p -value=0.00) There are no significance changes seen with increase age. (p -value > 0.05)

Conclusion: The study can be useful to assist in forensic study and investigation.

Keywords: Digital Panoramic radiography, Age and Gender Estimation, Mandibular Parameter.

INTRODUCTION

Age estimation along with gender determination from the bone remnants stand as an essential part of forensic science and forensic anthropology. Especially in mass disasters where injuries make the bodies unrecognizable, the skeletal remains

become the only tool for the identification of individuals. In such conditions, the skull, and more specifically, mandible is most oftenly recovered intact as it is the largest and the strongest bone of the skull.^[1] Further, such availability of mandibular bone for forensic examination encourages the fabrication of techniques of age estimation and

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gender determination. Dry skull's orthopantomography (OPG) are frequently used on scientific research or forensic investigations [2] and digital OPGs are one of the best quality examinations to study the dry skull. Jaw, sinus & TMJ usually are seen in panoramic radiographs and hence it can be comfortably used to study the parameters of mandibular bone that aid in age estimation and gender determination.

The angle between the ramus & the corpus of mandible was named by Jensen E and Palling M, the gonial angle.^[3,4] The gonial angle is formed by the ramus line (RL) and the mandibular line (ML), where RL is the tangent to the posterior border of the mandible and ML is the lower border of the mandible through the gnathion (gn). Izard G^[5] in 1927 cited the following averages of the variability in the gonial angle: 135 to 150 degrees at birth; 135 to 140 degrees when the first dentition is finished; 120 to 130 degrees up to the time of eruption of the second molars and becomes similar to the infantile angle of 120 to 150 degrees in old age.^[6]

The present study was aimed to explore the impact of both age and gender on gonial angle and bigonial width in the dentulous Gujarat population using digital orthopantomographs.

MATERIALS & METHODS

A retrospective study was conducted at Karnavati School of Dentistry. This study evaluated randomly selected 50 panoramic images of patients visiting the OPD, taken for various diagnostic purposes. The subjects with traumatic bite, bruxism, attrition, malocclusion, or any temporomandibular joint anomaly were ruled out. The present study included panoramic images of dentate and partially edentulous subjects (25 males and 25 females) with age ranging from 10 to 79 years old.

Inclusion criteria:

Good quality standard panoramic images without any grade of exposure or positioning errors.

Exclusion criteria:

Presence of any pathological lesions, fracture or deformity or developmental disturbances of the mandible and edentulous mandible.

Panoramic radiographs were collected from Digora software & measured using Radiant Software. After calibration of images (to obtain 1:1 magnification), the bigonial width (in cm) and gonial angle (in Degree) measurements were performed [Figures 1 and 2].

BIGONIAL WIDTH

The most inferior, posterior and lateral point on the external mandibular angle is known as Gonion and the distance between both Gonion [Gonial angles (Go)] is known as the bigonial width. It was measured horizontally from the right to left gonion by drawing the line digitally from one gonial angle to other gonial angle.^[7]



Fig 1: Bigonial Width Measurement.

GONIAL ANGLES:

The gonial angles were measured as follows : (Mattila *et al.*)^[8]

Two lines were sketched on the panoramic radiographs digitally. A tangential line extending from the most inferior points at the gonial angle to the lower border of the body of mandible and the another line tangential to the posterior borders of the ramus and the condyle. The gonial angle formed by the intersection of these two lines, measured on the both sides.^[7,8]



Fig 2: Gonial Angle Measurement.

Statistical Analysis

The collected data from the subjects were analysed using the SPSS version 25 (SPSS Inc., IL, USA). Paired *t*-test was used to compare between right and left gonial angle. Unpaired *t*-test was carried out to compare between gender with bigonial width

Table 1: Mean Values of all parameters & Independent *t*-test.

	Male	Female	Overall	Mean	<i>p</i> value (Independent <i>t</i> -Test)
Age	46.04±18.3	45.92 ± 14.64	45.98 ±15.57		
Bigonial width	24.01±1.71	22.33±1.40	23.17 ±1.77		0.00(<0.05)
Gonial angle right	115.42±7.24	123.03±3.16	119.23 ±6.74		0.00(<0.05)
Gonial angle left	114.99±8.20	123.01±5.63	119.00 ±8.05		0.00(<0.05)

The sample was divided into seven groups Group A: 10–19 years, Group B: 20–29 years, Group C: 30–39 years, Group D: 40–49 years, Group E: 50–59 years,

Group F: 60–69 years and Group G: 70– 79 years. Mean values are shown in [Table 2]

Table 2: Mean values in males and female in all age groups & Anova test.

Bigonial width			Right Gonial angle		Left Gonial angle	
Age Group	Male	Female	Male	Female	Male	Female
A (10–19)	24.37±1.42	-	113.15±11.24	-	113.15±17.56	-
B (20–29)	23.12±2.43	24.59	113.86±6.68	120.50	114.14±8.37	114.60
C (30–39)	25.84	21.79±1.07	108.5	122.51±2.70	107.20	123.86±6.8
D (40–49)	24.69±0.75	21.86±1.53	116.30±3.67	125.50±2.23	110.5±7.21	124.90±6.9
E (50–59)	23.54±1.06	22.505±1.63	121.142±6.14	121.950±4.75	117.75±7.05	122.11±4.37
F (60–69)	24.94±1.87	23.29±1.10	111.40±3.67	123.82	113.35±4.31	122.80±3.82
G	23.07±1.80	21.75	116.25±15.76	125.90	122.60±16.97	121.30

& gonial angle. One-Way ANOVA was used to compare the difference in the studied parameters according to different age groups. Turkey's *post hoc* test was not applied as there was no statistically significant difference observed by ANOVA. Pearson correlation was applied for comparing the correlation of different variables.

RESULT

The mean age of male was 46.04±18.3. Mean age of female was 45.92 ± 14.64. Mean bigonial width was 22.33±1.40 in female. Mean bigonial width was 24.01±1.71 in males. Right & left gonial angle in male is 115.42±7.24 & 114.99±8.20. Right & left gonial angle in female was 123.03±3.167 & 123.01±5.63 respectively. [Table 1]

(70-79)					
ANOVA <i>F</i> Value	1.462	1.859	0.978		
<i>p</i> Value	0.214	0.110	0.452		

Table 3: Pearson Correlation test of all variable.

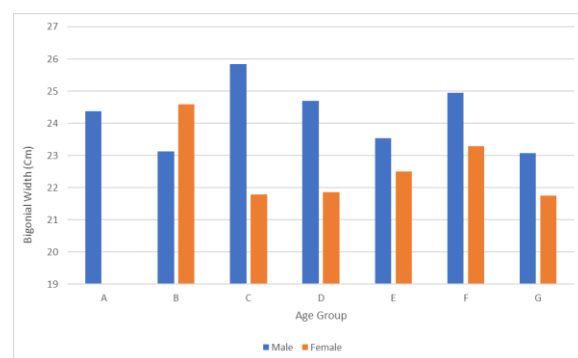
Correlations					
		BIGONIAL WIDTH	RIGHT GONIAL ANGLE	LEFT GONIAL ANGLE	
BIGONIAL WIDTH	Pearson Correlation	1	-.520**	-.486**	
	Sig. (2-tailed)	-	.000	.000	
	N	50	50	50	
RIGHT GONIAL ANGLE	Pearson Correlation	-.520**	1	.778**	
	Sig. (2-tailed)	.000	-	.000	
	N	50	50	50	
LEFT GONIAL ANGLE	Pearson Correlation	-.486**	.778**	1	
	Sig. (2-tailed)	.000	.000	-	
	N	50	50	50	

One-way ANOVA was used to compare the difference in the studied parameters according to different age groups. Turkey's *post hoc* test was not applied as there was no statistically significant difference observed by ANOVA. Pearson correlation test was carried out between bigonial width, right gonial angle & left gonial angle. There is moderate negative correlation of bigonial width with right and left gonial angle. Both gonial angle have a strong positive relation. All results are statistically significant. [Table 3] Paired t-test was used to compare between right & left gonial angle. There was no significant difference between right & left gonial angle as p-value is greater than 0.05.

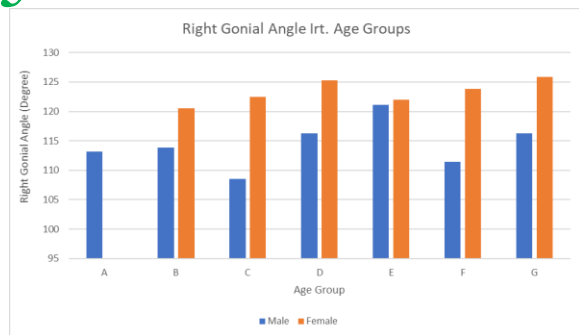
The subjects were then divided based on gender into males and females and compared using the Unpaired T-test to check any overall gender difference.

Gender difference in gonial angle and bigonial width were statistically significant with $p \leq 0.05$.

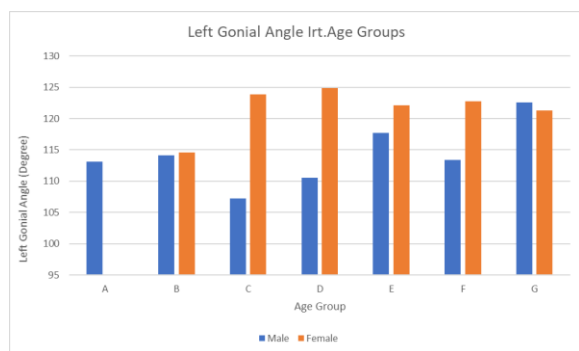
Graph 1: Comparison of bigonial width with various age groups.



Graph 2: Comparison of right gonial angle with various age groups



Graph 3: Comparison of left gonial angle with various age groups.



DISCUSSION

Age estimation and sex determination using the skeletal remains is generally accomplished using the pelvis and the skull. Mandible, being the largest, strongest and movable bone of the skull, is often found intact for forensic examination. The present study was done to measure the bigonial width and gonial angle on digital panoramic radiographs and to compare these parameters between both the genders and different age groups in adult dentate patients. It is very well documented in the literature that the gonial angles are recorded to be around 130 to 150 degrees at birth and gradually reduce to around 120 to 130 degrees by the end of mixed dentition period. Therefore, our study comprised of a wide age range of 10 to 80 years to study the effect of aging in permanent dentition period on the selected parameters.

Several studies have reported that panoramic radiographs are reproducible and accurate for both linear and angular measurements of mandible. Larheim and Svanaes^[9] have found that the gonial

angles assessed on a panoramic radiograph was almost identical that measured on a dried mandible.

Investigations were carried out to determine if there was a correlation between three mandibular parameters, age and gender using measurements of both right and left gonial angles and bigonial width in orthopantomographs.

In the present study, there was no significant change with regard to bigonial width across the age groups. Although, there was an increasing trend of gonial angle with age; it was not statistically significant in our study. This was in agreement with Chole *et al.* ^[4], Dutra *et al.* ^[10], Oksayan *et al.* ^[11] and Raustia and Salonen ^[12] who did not find any significant differences in the gonial angle with respect to age of their subjects. On the other hand, this contradicts some researchers ^[2,7] who found that the gonial angle increased with age and other researches ^[13] where the gonial angle decreased with age. The difference between the results of these studies may be attributed to the different populations, age ranges and different dental status selected for the studies. Thus, gonial angle, which is regularly used to determine the rotation of the mandible and to aid in diagnosing growth patterns to plan orthodontic extractions or surgical treatments, should further be evaluated among a larger population for better evaluation.

Our investigations revealed a correlation between mandibular morphology and gender, but not with age. It may be due to the age-related morphological changes in mandible. It was found that males have longer bigonial width than females but a smaller gonial angle and vice versa. Females were found to have a significantly higher value of gonial angle than their male counterpart; which was similar to the results obtained by Ghosh *et al.* ^[14], Joo *et al.* ^[15] and Leversha J *et al.* ^[16] However our results were not in agreement with Dutra *et al.* ^[10] & Radhakrishnan *et al.* ^[17], where no significant difference was found between genders.

The study found no significant difference when comparing left and right gonial angles. This was in agreement with Leversha J *et al.* ^[16] & Shahabi *et al.* ^[18] On the contrary, some researchers ^[2] found that

the gonial angle on the right side was significantly smaller than on the left possibly because of more use of the right side. Investigations revealed correlation between bigonial width and gonial angle. Bigonial width is inversely proportional to gonial angle (right & left both). As gonial angle increases, value of bigonial width decreases and vice-versa. Right and Left gonial angle correlate positively with each other.

$$(BW \propto \frac{1}{GA}, BW = \text{Bigonial width}, GA = \text{Gonial angle})$$

Moreover, this was a hospital-based study and was limited to Gujarat population and in particular Ahmedabad-Gandhinagar population. Further research should be conducted across other areas and hospitals in Gujarat for more significant results.

CONCLUSION

There is no significance difference between right & left gonial angle. Mean value is almost equal in both the sides. Females have higher values of the gonial angle compared to male counterparts, but lower bigonial width. Males have low value of gonial angle, but longer bigonial width than female. It was seen that person having a larger gonial angle have a shorter bigonial width compare to those having a lower gonial angle & longer bigonial width. There are no significant changes seen with the increasing age. Excluding some limitations, digital imaging can be used to assist in sex determination for forensic studies.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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