Radiographic correlation of Gonial Angle with Age and Gender among Pediatric Patient visiting a Tertiary Hospital: A Retrospective Study

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ABSTRACT

Introduction: The mandible is one of the largest and most rigid bone in the facial skeleton. The mandibular parameters like gonial angle, bigonial width and ramus heights can be used to determine a correlation with an individual's age and gender. This can be an important legal ramifications and its assessment has a great role in forensic and orthodontic purposes.

Objective: To assess the radiographic correlation of gonial angle with age and gender.

Methods: A total of 325 Orthopantomographs (OPG) were evaluated which included 168 male and 157 female dentate subjects. It was further categorized into three groups: Group I (3-9 years), Group II (10-15 years) and Group III (16-17 years). The gonial angle was measured bilaterally and the data were statistically analyzed.

Results: The mean age of the subjects was 12.24+3.79 yrs. The mean values (in degrees) of right (126.71+5.89) and left gonial angles (129.92+5.86) were higher on females compared to males. However, it was not statistically significant. The mean values of right and left gonial angles were higher on the age group 8-12yrs (126.70+ 6.52 and 128.56+ 5.83) and lowest on the age group 13-17yrs (125.40+ 6.84 and 126.93+7.35) which also showed statistically insignificant in all age groups.

Conclusions: The morphometric analysis of the mandible through radiographic measurements may be useful in estimating an individual's age and gender when comparing to known population. Gonial angle has been used as an adjunct parameter which has an implications on forensic identifications as well as orthodontic analysis.

Keywords: *gender, gonial angle, mandible, orthopantomograph.*

INTRODUCTION

The mandible is the largest and most rigid bone in facial skeleton.[1] It undergoes morphological alterations throughout the lifetime of an individual.[2] The changes are mainly influenced by age of individual and occlusal status.[3] Many anatomical formations such as gonial angle, bi-gonial breadth and height of mandibular ramus, antegonial angle, and antegonial depth can be used for gender and age estimation.[4,5] Gonial angle is formed by ramus line which is tangent to the posterior border of mandible, and the mandibular line which is horizontal portion of inferior border of the mandible through the gnathion.[6,7] Futhermore, the gonial angle is particularly important in orthodontic research to understand the changes in developmental period.[8,9] It is also a common parameter used to depict orthodontic extractions and surgical treatments.[10]

The influence of individual age and gender on degree of gonial angle is controversial. Some studies have shown widening of gonial angle with advancement of age whereas other have reported conflicting results.[11,12] To date there has been limited research regarding comparison of

gonial angle with age and gender in pediatric population in Nepal so this data may enable future references to monitor growth patterns as well as advances in forensic identifications.

METHODS

After obtaining ethical clearance from the Institutional review committee, (Ref:151/22) the total of 325 digital Orthopantamographs (OPG) of the children in the age group of 3-17 years which were archived in the Department of Oral medicine and radiology were used in this study. Based on convenience sampling, the OPG's archived from August 2020 till October 2022 were assessed. Children with previous orofacial trauma, surgery, temporomandibular joint and cranio-cervical disorders were excluded. The sample size was determined based on the formula of mean difference and it came to be 325.

The standardized radiographs with good contrast were only included for the study. To ensure consistency, principal investigator was responsible for the selection of radiographs based on the inclusion and exclusion criteria. The radiographs were subjected of right and left gonial angle and then they were digitally traced by using the digital imaging software Rainbow TM image viewer version 1.0.0.0. The gonion is the most inferior, posterior and lateral point on the external angle of the mandible. The gonial angle was measured as angle between the two tangents from the gonion; the first running superiorly along the posterior border of mandibular ramus and other anteriorly along the inferior border of the mandible. The method employed for this parameter was according to the study conducted by Shamout et al.[3] This was measured bilaterally and the data were recorded in pre-designed proforma, entered in excel sheet and transferred to SPSS version 20 for statistical analysis.

The obtained angles for all the subjects were separated for males and females and descriptive statistics were generated. The sexual dimorphism of the gonial angle among males and females were assessed using t-test. Gonial angle between age groups was evaluated using ANOVA. The images were taken by Dentium Rainbow CBCT machine having parameters as scan Time: 20 seconds, peak Voltage: 100 kVp, tube Current: 12 mA, Field of View: 16cm x 18cm, voxel size: 300 μm. The images were viewed on same computer screen, under ambient light with all curtains closed and measurements were made in Rainbow TM ImageViewer Version 1.0.0.0.

Figure 1: Measurement of gonial angle (Horizontal line onto the lower border of the mandible and tangential line along the posterior border of the ramus) on right and left side.

RESULTS

A total of 325 OPG's were included in the study out of which 168 (51.7%) were of males and 157 (48.3%) were of females (Table 1).

The mean value according to age was 12.24±3.79 yrs.

In case of female, gonial angles were higher compared to males. However, it was not statistically significant (p>0.001) (Table 3).

The mean values of right and left gonial angles were higher on the age group 8-12years and lowest on the age group 13-17 years which was also statistically insignificant (Table 4).

Table 1: Frequency distribution of subjects based on gender and age.

Variables	N (%)
Male	168 (51.7)
Female	157(48.3)
Total	**325**
Age sub-groups	
3-7 yrs	95 (29.2)
8-12yrs	147 (45.2)
13-17yrs	83 (25.5)
Total	**325**

Table 2: Mean values of age (in years) and gonial angle (in degree).

Variables	Mean±SD
Age	12.24+3.79
Gonial angle male	126.76±5.59
Gonial angle female	127.32±5.14
Gonial Angle Right	126.06±6.36
Gonial Angle Left	128.16±23

* SD= Standard Deviation

Table 3: Comparison of Gonial Angle (in degree) between Gender.

Variables	Subgroups	Mean±SD	p value
Gonial Angle right	Male	125.45±6.72	0.075
	Female	126.71±5.89	
Gonial Angle left	Male	128.07±6.57	0.835
	Female	127.92±5.86	

SD= Standard Deviation

Table 4: Comparison of Gonial Angle (in degree) between age groups

Variables	Subgroups	Mean±SD	p value
Gonial Angle right	3-9 years	125.65±5.57	0.248
	10-15 years	126.70± 6.52	
	16-18 years	125.40±6.84	
Gonial Angle Left	3-9 years	128.07± 5.68	0.163
	10-15 years	128.56± 5.83	
	16-18 years	126.93±7.35	

DISCUSSION

The gonial angle is a representation of the form of the mandible. This angle has an important role in predicting growth and it also has specific effects initially on growth, profile changes and the condition of the anterior teeth of the lower jaw.[13] Various studies have been conducted on the gonial angle but with contradictory and variable results. There are either environmental or genetic factors controlling the mandibular angle configuration within each population.[13] In the previous studies conducted on African, including modern Egyptian populations, the gonial angle of the two sexes was found to be greater in males than females.[7]

In the present study, the average age of the study sample was 12.24±3.79 years and the average gonial angle for male was found to be 126.76±5.59 and female was 127.32±5.14. In the present study, gonial angle were noted more in females as compared to that in males which was not statistically significant (p>0.001). These findings were similar to Ohm & Silness et al[5], Upadhyay et al[7], Kanya et al[14] who stated that the gonial angle did not differ statistically according to the gender. This can be a possible explanation for the wider gonial angle in females. But the result of demonstrating the higher values in female is concurrent with the results of Al-Shamout et al[3] and Pillay et al[15] have observed downward and backward rotation of the mandible while males have forward rotation of the mandible. Besides, Gamba et al[16] and Bhuyan et al[17] found lower values in females.

In the present study there was increase in the gonial angle which was in support with the study done by Al-Shamount et al.[3] However, the increase was not definite. On the other hand Upadhyay et al[4] observed a definite decrease in the gonial angle with the increase in age and was statistically significant while others have reported a lack of recognizable change in the gonial angle with the age. It therefore appears that the age related gonial angle may not be consistent. It is believed that masticatory muscles change with the age, have reduction in their contractile activity and muscle density, with the masseter and medial pterygoid muscles undergoing greater age related decrease because of their insertion into the region of the gonial angle.[18] According to Merrot et al[19] increase in the mandibular angle in the elderly edentate may be explained by imbalance between the elevator and depressor muscles of the mandible.

When comparing bilateral measurements of the gonial angle regardless of the gender the results were statistically insignificant that supports the results compared by Jodi et al[20] but their study showed the mean value was higher on the right side. The mean gonial angle for right side was 126 ± 6.36 and for the left side was 128 ± 6.23 on this study. The gonial angle was observed to have the greatest value in the age group of 8-12 years and the lowest in the age group 13-17 years which was also statistically insignificant which analogous with the study done by Direk et al[21] that reported there was no significant difference in gonial angle according to age groups.

These results showed clearly that it is very difficult to express a precise relationship between the age and gender. The study was hospital based and limited to the population of Kavrepalanchowk district in particular. Further research should be conducted across the areas and population of Nepal. Only gonial angle is compared in the study with gender and side, evaluating it and other anatomical structures in the skull bones together in larger groups may provide more beneficial results.

CONCLUSIONS

Orthopantamographs have been proven to be valuable tool for the determination of morphometric analysis of the mandible which can aid in correlation between age and gender. From the study various conclusion can be drawn such as the gonial angle value was higher on female than in male, higher on left side than in right side but all these were not statistically significant which gives the impression that future research should be conducted across a vast area and greater sample subject should be taken that accurately reflects the age population which may ultimately yields a meaning results.

Conflict of Interest: None

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REFERENCES

1. Kazim NF, Fattah AA. Radiographic study of mandibular angular cortical thickness in relation to the presence and eruption status of mandibular third molar. J Bagh College University. 2012Jan;24(1):57-60. [FullText]

2. Bathla S, Srivastava SK, Sharma RK, Chhabra S. Influence of age on the radiomorphometric indices of the gonial region of mandible in North-Indian population. Int J Med and Dent Sci. 2014 July;3(2):411-20. [Full Text | DOI]

3. Al-Shamout R, Ammoush M, Alrbata R, Al-Habahbah A. Age and gender differences in gonial angle, ramus height and bigonial width in dentate subjects. Pakistan Oral & Dental Journal. 2012 April;1(32):81-87. [FullText]

4. Ingervall B, Thilander B. Relation between facial morphology and activity of the masticatory muscles. J Oral Rehabil. 1974 Apr;1(2):131-47. [PubMed | DOI]

5. Ohm E, Silness J. Size of the mandibular jaw angle related to age, tooth retention and gender. J Oral Rehabil. 1999 Nov;26(11):883-91. [PubMed | DOI]

6. Oettlé AC, Becker PJ, de Villiers E, Steyn M. The influence of age, sex, population group, and dentition on the mandibular angle as measured on a South African sample. Am J Phys Anthropol. 2009 Aug;139(4):505-11. [PubMed | DOI]

7. Upadhyay RB, Upadhyay J, Agrawal P, Rao NN. Analysis of gonial angle in relation to age, gender, and dentition status by radiological and anthropometric methods. J Forensic Dent Sci. 2012 Jan;4(1):29-33. [PubMed | DOI]

8. Gungor K, Sagir M, Ozer I. Evaluation of the gonial angle in the Anatolian populations: from past to present. Coll Antropol. 2007 Jun;31(2):375-8. [PubMed]

9. Xiao D, Gao H, Ren Y. Craniofacial morphological characteristics of Chinese adults with normal occlusion and different skeletal divergence. Eur J Orthod. 2011 Apr;33(2):198-204. [PubMed | DOI]

10. Tahmina K, Tanaka E, Tanne K. Craniofacial morphology in orthodontically treated patients of class III malocclusion with stable and unstable treatment outcomes. Am J Orthod Dentofacial Orthop. 2000 Jun;117(6):681-90. [PubMed]

11. Zangouei-Booshehri M, Aghili HA, Abasi M, Ezoddini-Ardakani F. Agreement between panoramic and lateral cephalometric radiographs for measuring the gonial angle. Iran J Radiol. 2012 Nov;9(4):178-82. [PubMed | DOI]

12. Sağlam AA. The vertical heights of maxillary and mandibular bones in panoramic radiographs of dentate and edentulous subjects. Quintessence Int. 2002 Jun;33(6):433-8. [PubMed]

13. Franklin D, Higgins P, Oxnard C. Sexual dimorphism in the mandible of indigenous South Africans: A geometric morphometric approach. S Afr J Sci. 2008;104:101–6. [FullText]

14. Kanya AP, Kiswanjaya B, Makes BN, Iskandar HHB. Estimating sex in an Indonesian population using the mean value of eight mandibular parameters in panoramic images. J Int Dent Med Res 2017; 10(Special Issue): pp. 417-22. [FullText]

15. Pillay S, Ishwarkumar S, De Gama BZ, Pillay P. The Morphometry of the Angle of Mandible and its Correlation with Age and Sex in the eThekwini Metropolitan Region: A Panoramic Study. Int J Morphol. 2017;35(2):661-66. [FullText | DOI]

16. Gamba Tde O, Alves MC, Haiter-Neto F. Mandibular sexual dimorphism analysis in CBCT scans. J Forensic Leg Med. 2016 Feb;38:106-10. [PubMed | DOI]

17. Bhuyan R, Mohanty S, Bhuyan SK, Pati A, Priyadarshini S, Das P. Panoramic radiograph as a forensic aid in age and gender estimation: Preliminary retrospective study. J Oral Maxillofac Pathol. 2018 May-Aug;22(2):266-270. [PubMed | DOI]

18. Hannam AG, Wood WW. Relationships between the size and spatial morphology of human masseter and medial pterygoid muscles, the craniofacial skeleton, and jaw biomechanics. Am J Phys Anthropol. 1989 Dec;80(4):429-45. [PubMed | DOI]

19. Acharya AB. A digital method of measuring gonialangle on radiographs for forensic age estimation. J Forensic Radiol Imaging 2017;11:18–23. [FullText | DOI]

20. Leversha J, McKeough G, Myrteza A, Skjellrup-Wakefiled H, Welsh J, Sholapurkar A. Age and gender correlation of gonial angle, ramus height and bigonial width in dentate subjects in a dental school in Far North Queensland. J Clin Exp Dent. 2016 Feb 1;8(1):e49-54. [PubMed | DOI]

21. Direk F, Uysal II, Kivrak AS, Unver Dogan N, Fazliogullari Z, Karabulut AK. Reevaluation of Mandibular Morphometry According to Age, Gender, and Side. J Craniofac Surg. 2018 Jun;29(4):1054-59. [PubMed | DOI]