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Research Article

Assessment of Gonial Angle as a Determinant of Age, Gender and Nationality

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Abstract

Background: The mandible is the most significant, strongest, and most resilient bone in the facial skeleton, exhibiting sexual dimorphism. It experiences morphological changes as a result of losing teeth, which are manifested as an enlargement of the mandibular angle, frequently referred to as the gonial angle. The gonial angle is formed by the junction of the lower and posterior margins of the individual's lower jaw. Another name for it is the mandibular angle. This observational cross-sectional study aims to determine if the gonial angle is a reliable determinant for patient's age, gender and nationality.
Methods: The panoramic radiographs were collected from the database of the dental teaching hospital at Umm Al-Qura University (UQU) in Makkah. Inclusion criteria were patients with permanent dentition stage, panoramic radiographs with high quality and clarity, and all panoramic radiographs needed to be taken with the same machine setting. All panoramic radiographs with documented history of facial trauma, prior facial or mandibular surgery, congenital diseases affecting the face or jaw, and facial asymmetry were excluded.
Results: Out of 1503 panoramic radiographs, 426 (28%) are included in the study's analysis. The mean age of the included population was 32.27. The majority of the sample was male (n=216, 50.7%). Most of the panoramic radiograph was related to Saudi population (n=273, 55.6%) and the non-Saudi population (n=153, 44.4%). The mean of the right GA measure was 122.77, compared to 123.68 on the left side. Statistical analyses showed that there was significant association between GA readings and age, but not with the gender and nationality.
Conclusion: Based on results of the present study, there is an association between the GA measures and age, while no association is found between GA measures and gender and nationality.

INTRODUCTION

The mandible is the most significant, strongest, and most resilient bone in the facial skeleton, exhibiting sexual dimorphism (Vodanović et al., 2006). It experiences morphological changes as a result of losing teeth, which are manifested as an enlargement of the mandibular angle, frequently referred to as the gonial angle(Casey et al., 1988). The gonial angle is formed by the junction of the lower and posterior margins of the individual's lower jaw. Another name for it is the mandibular angle (Upadhyay et al., 2012).

When assessing a person's mandibular rotation and determining their developmental pattern, the gonial angle is a critical factor (Graber, 1967). and the extraction pattern in class II patients (Chole et al., 2013), decid-

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ing whether they should perform surgery on individuals with class III skeletal bases (Fischer-Brandies et al., 1984), as well as the estimation of age in forensic medicine (Larheim & Svanaes , 1986; Upadhyay et al., 2012). There is a correlation between a prominent chin and a high gonial angle, and between a retreated chin and a short gonial angle. Gonial angle asymmetry may be a sign of hemifacial microsomia and Treacher-Collins syndrome, several craniomaxill ofacial disorders (Larheim & Svanaes , 1986).

Additionally, facial aging is a dynamic process that includes soft tissue aging as well as bone structure (Shaw et al., 2010). Examined mandibular changes in 120 individuals who were split into three age groups: or = 65 years old, 41-64 years old, and 20-40 years old. The investigation used three-dimensional radiography, Three-dimensional radiography was employed in the investigation, and edentulous individuals were eliminated. These measurements resulted in a significant decrease in the mandibular height, mandibular body length, and ramus height. In both sexes, the mandibular angle increased significantly with age (Sitanggang et al., 2018).

Previous research on the current topic has produced mixed results, with some studies (Abu Alhaija et al., 2011; Bhardwaj, 2014; Huumonen et al., 2010; Leversha et al., 2016). Claiming that GA values can be used to predict age and gender, while others (Hassan, 2011; Ohm & Silness , 1999; Rösing et al., 2007). Claim that there is no statistically significant relationship between gonial values, age, and gender.

The most popular extraoral radiographs are panoramic radiographs, which can be readily saved and stored in the database for years. They provide the most detail regarding the hard tissue of the maxilla and mandible. The large number of panoramic radiography offers an excellent chance to investigate sexual dimorphism and age estimation in specific populations. (Behl et al., 2020). This study aims to determine if the gonial angle is a reliable determinant for patient's age, gender and nationality.

MATERIALS AND METHODS

This was an observational cross-sectional study in nature. The study was conducted with ethical approval from the Umm Al-Qura University institutional review board. Between 2020 and 2022, panoramic radiograph scans were obtained from the dental teaching hospital's database. The included patients should be in the permanent dentition stage, and at least 21 years old. Furthermore, panoramic radiographs should have superior image quality and clarity, and all panoramic radiographs need to be taken with the same machine setting. On the other hand, any patient under 21 years, edentulous or partially edentulous patients who lost their upper and lower posterior teeth that results in loss of the posterior occlusion either unilaterally or bilaterally, any patient with a documented history of facial trauma, prior facial or mandibular surgery, congenital diseases affecting the face or jaw, and facial asymmetry were excluded.

All radiographs were taken using a GENDEX® Orthopantomogram (OPG) scanner (GXDP-700TM, Hatfield, USA) by an experienced radiograph technician. Imaging was carried out with the following settings: 70 kV, 16 s, and 71 mGy.cm2. Each Patient was instructed to stand as straight and tall as possible in the unit then the patient was asked to take a grip of the hand grips and place their chin on the chin cup so the Frankfort's horizontal line is parallel to the floor after that gently adjust the patient's head to the position of the midsagittal laser.

To assess the location of the GA, a software program MircoDicom viewer 2023.2 X 86 was used for OPG radiographic analysis. The GA was measured by identifying the posterior border of the ramus which extends from the condylar process to the angle of the mandible drawing a tangent to that border, and drawing another tangent to the lower border of the mandible the GA is the angle between the two tangent lines as shown in (Figure 1).

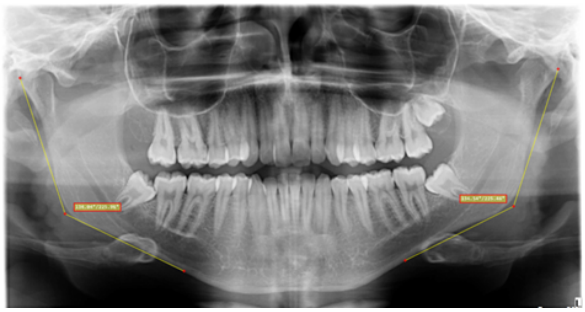

Figure 1: OPG radiograph illustrating the method used to measure GA

Statistical Analysis

Simple descriptive statistics using percentages and frequencies were used. Means and standard deviations were used to describe averages of the continuous data (i.e. age and GA measures). Chi-squared tests and t-tests were used to assess significant differences between subgroups for the categorical and non-categorical variables, respectively. The statistical significance was assumed at a 5% level, and all the analyses were carried out using IBM SPSS® version 25.0.

RESULTS

Sample characteristics and GA readings

Out of 1503 panoramic radiographs, 426 (28%), are included in the study's analysis. The mean age of the included population was 32.27 (SD=10.35). The majority of the sample was male (n=216, 50.7%). Most of the panoramic radiographs were related to the Saudi population (n=273, 55.6%) and the non-Saudi population (n=153, 44.4%). The mean of the right GA measure

was 122.77 (SD=6.73) compared to 123.68 (SD=6.72) on the left side.

Association of GA readings and age

Statistical analyses using t-test showed that there was significant association between GA readings and age. For example, low readings of right GA were associated with younger age (t=-4.77, p-value0.001, 95% of CI =-0.21 to -0.09). Similarly, low readings of left GA were associated with younger age (t=-4.20, p-value0.001, 95% of CI=-0.19 to -0.07).

Association of GA readings and gender

Chi -square test showed that there is no significant association between GA readings and gender. The mean value of the right GA in males was 122.36 (SD= 6.96) compared to females 123.20 (SD=6.47), with a p-value of 0.367. Furthermore, the mean value of the left GA in males was 123.09 (SD=6.86) compared to females 124.29 (SD=6.53) with a p-value of 0.141.

Association of GA readings and nationality

Chi-square test showed that there is no significant association between GA readings and nationality. Mean value of the right GA on the Saudi population was 122.98 (SD=6.71) in comparison with the non-Saudi population 122.52 (SD=6.76) with a p-value of 0.294. Moreover, mean value of the left GA on the Saudi population was 123.74 (SD=6.81) in comparison with the non-Saudi population 123.61 (SD=6.62) with a p-value of 0.573.

DISCUSSION

This study aimed to determine whether the GA can be used as a reliable determinant of age, gender and nationality. The data was collected from the database of Umm Al-Qura dental teaching hospital between 2020 and 2022. Out of 1503 panoramic radiographs, 426 (28%) are included in the study's analysis. Inferential statistics were used to analyze the data of this study. Our study found that there was association between GA measures and age using t-tests, but not with the gender and nationality using Chi-squared tests.

A recent study conducted in Saudi Arabia aimed to assess the possibility of using gonial angle as a determinant of gender through a retrospective panoramic study. The results revealed a significant difference associated between GA and gender; the reading of the right GA in females was 127.68±6.69○ while in males it was 125.64±5.91; the p-value was 0.003. Further, the reading of the left GA in females was 127.23±6.86○ while in males it was 125.35±6.02○; the p-value was 0.007 (Alfawzan , 2020). Another study conducted in 2018, tested the relationship between GA and gender with different age groups. The results showed a significant difference between gonial angle and age between 16-30 years old; the p-value was 0.01, while there was a non-significant difference between age group 11-15 years old and the p-value was 0.93 (Larrazabal-Moron & Sanchis-Gimeno, 2018).

According to Alonso et al., the study aimed to evaluate the measurement of gonial angle in different age groups, also comparing results for male and female patients. Statistical analysis showed no significant differences in age groups or gender when comparing the male groups 17–20 and 21–35; the p-value was 0.05. On the other hand, female age groups between 17-69 were statistically significant; the p-value was 0.05(Alonso et al., 2011). Another study in India by (Upadhyay et al., 2012) aimed to assess the relationship between the gonial angle, age and gender, and showed no statistically significant relation between the gonial angle and males or females in any age group (Upadhyay et al., 2012).

Strengths and limitations

Our study had several strengths, including the sample size being relatively high and representative. Our results were assessed and reviewed by two evaluators to ensure the reliability and consistency of the results. Panoramic radiographs included had high resolution and quality. We used electronic software to measure GA readings. However, our study results cannot be generalized because the data were retrieved from the local dental teaching hospital. Furthermore, our findings are based only on panoramic radiographs. Eventually, we did not specify a different nationality for non-Saudi participants.

CONCLUSION AND RECOMMENDATION

Based on the results of the present study, a statistically significant difference was only observed between the gonial angle readings and age using panoramic radiographs, while no significant difference was found between the gonial angle readings and other variables.

For future research, we recommend further investigation and studies to evaluate the relationship between GA readings and nationality. An additional radiographic approach should be used to measure gonial angle, such as lateral cephalometry for a more precise measurement. Moreover, samples can be collected from different centers and hospitals to make the results more applicable to the whole population.

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None

DECLARATIONS

Conflict of interest: The authors have no relevant financial or non-financial interests to disclose. The authors declare no conflict of interest.

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