

## Importance of Success Criteria in the Validity of Panoramic Radiograph for Measurement of Gonial Angle

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### ABSTRACT

**Introduction:** The size of the gonial angle depends on the method of measurement being used. It can be measured on both panoramic and cephalometric radiographs. The study aims to find the effect of the success criteria of a panoramic radiograph on its validity to evaluate the gonial angle.

**Materials and methods:** Lateral cephalometric and dental panoramic radiographs of 76 individuals of both genders with age range from 12 to 25 years were included in this study. The samples divided into two groups: The first group included 36 samples with non-evaluated panoramic radiographs having good quality and sharpness. The second group included 40 samples of evaluated panoramic radiographs, which were selected according to the specific criteria of success. A paired t-test was used for evaluating the difference between the gonial angle in the lateral cephalometric and panoramic radiographs of both sides. A p-value  $\geq 0.05$  was considered to be statistically insignificant.

**Results:** The findings of the study showed a significant difference in the values of the gonial angle between the non-evaluated panoramic radiographs of right and left sides ( $p=0.00, 0.001$ ) respectively as compared to the cephalometric radiograph. No significant differences observed in the value of gonial angle measurements. They were obtained from cephalometric and evaluated panoramic radiographs of both sides ( $p=0.888, 0.938$ ) respectively.

**Conclusion:** The success criteria could serve as an easy and simple method to assess the quality of panoramic radiographs for accurately measuring the gonial angle on both sides and without superimposition as compared to cephalometric radiographs.

**Key words:** Gonial angle, Panoramic radiograph, Cephalometry

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### INTRODUCTION

The lateral cephalometric radiography is considered as an essential diagnostic tool for orthodontics, it is used to evaluate the stage of development and craniofacial relationships [1,2]. The value of the gonial angle usually is used to determine the stage of growth and besides the determination of sex and gender [3,4]. The gonial angle is defined as an angle formed by the intersection of the ramus border tangential line and the mandibular lower border tangential line [5,6]. Measurement of the gonial angle is essential in orthodontic treatment and orthodontic surgery. It is important to assess the symmetry of the facial skeleton. Therefore, accurate determination

of the gonial angle is essential for assessing the orthodontic cases. Ordinarily, the cephalometric radiograph is used to evaluate the gonial angle, as an intermediate value of the right and left sides angles due to the superimposed of both sides of the mandible [2,7].

The panoramic technique was first described by Paatero in 1952 and since then it has been used in a variety of dental specialties. The main advantages of the panoramic radiography include less radiation dose, fast technique, good patient co-operation, and covering the broad anatomic structures. The ability of dental panoramic radiographs to view both maxilla and mandible in a single image makes it a respected radiological technique [8-10]. Although it can provide a single image of the entire stomatognathic system-teeth, jaws, temporomandibular joints, sinuses. It suffers from the limitation of methodological errors. Many authors considered

the panoramic radiograph as the choice to assess the right and left gonial angles accurately without superimposition in a single radiograph [2,11]. Other authors compared the angular measurements on both panoramic and lateral cephalometric radiographs; they found that the panoramic radiography can provide an acceptable measurement of the gonial angle, but that it is not as reliable as a lateral cephalometric radiograph. This study is conducted to find the effect of the success criteria of a panoramic radiograph on its validity to assess the gonial angle [12,13].

#### MATERIALS AND METHODS

Lateral cephalometric and dental panoramic radiographs of 76 subjects of both genders with skeletal CL-I classification obtained from the database archiving of the digital Dimax Pro system (Helsinki, Finland) in the Dental Radiology Class of Oral and Maxillofacial Surgery Department, College of Dentistry, University of Mosul. The age of patients ranged from 12 to 25 years. The samples of the patients were divided into two groups: the first group included 36 samples (18 female and 18 male) where the panoramic radiographs were of good quality and sharpness (non-evaluated panoramic radiographs). The second group included 40 samples (20 female and 20 male), where the panoramic radiographs were selected according to the specific criteria of success [14] (evaluated panoramic radiographs) as follows Figure 1.

1a: The connection line between the two points is drawn through the deepest point of the articular eminence, perpendicular to the median sagittal plane, providing information in normal cases on whether improper positioning has occurred.

1b: The line connecting the deepest part of the innominate line of the facies temporalis of the zygomatic bone and the maxilla perpendicular

to the median sagittal plane provide information about the horizontal positioning of the head.

1c: Median sagittal plane in normal cases is perpendicular to 1a and 1b. It demonstrates the vertical positioning of the head.

2a: Bilateral comparison of the width of the ascending mandibular ramus exhibits an asymmetric positioning of the head or nearly lateral displacement of the mandible.

2b: A comparison of the distance between the midline of the mandible to the dorsal border of the ascending ramus provides information about any asymmetric positioning of the skull or the mandible, as evident from the apparent lateral displacement of the mandibular midline.

4: A bilateral comparison of the apparent teeth sizes in the maxilla with asymmetric positioning of the skull and the mandible is also an indication of improper patient positioning.

The quality of radiographs was assessed by an expert oral radiologist to compensate for the requirement of each group before inclusion in the study. The radiographs were acquired with the Ceph-Pan Dimax Pro X-ray unit (Helsinki, Finland). The gonial angle formed by the intersection between the tangential lines of the posterior border of the ramus and the lower border of the mandible [2] in cephalometric and panoramic radiographs was used as the standard (Figures 2 and 3). Digital Imaging Software from Dimax Pro (Helsinki, Finland) was used to digitally trace and measure the gonial angle on the lateral cephalometric and on the right and left sides of panoramic radiographs. Measurements were implemented to the nearest 0.5 degrees.

#### Statistical analysis

Descriptive statistics were carried out to calculate means and standard deviations for

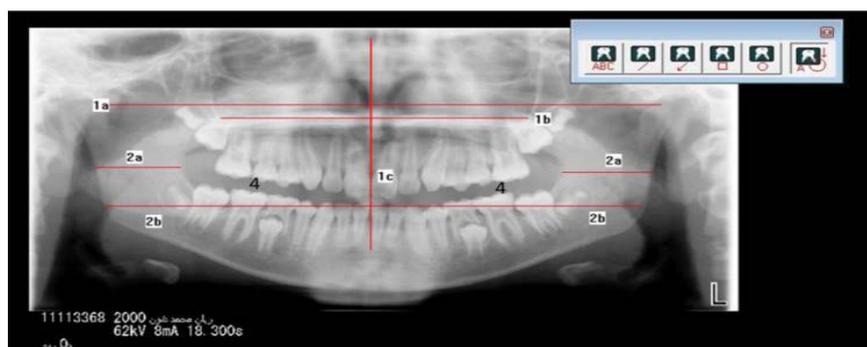


Figure 1: An evaluation criterion of the panoramic radiograph.

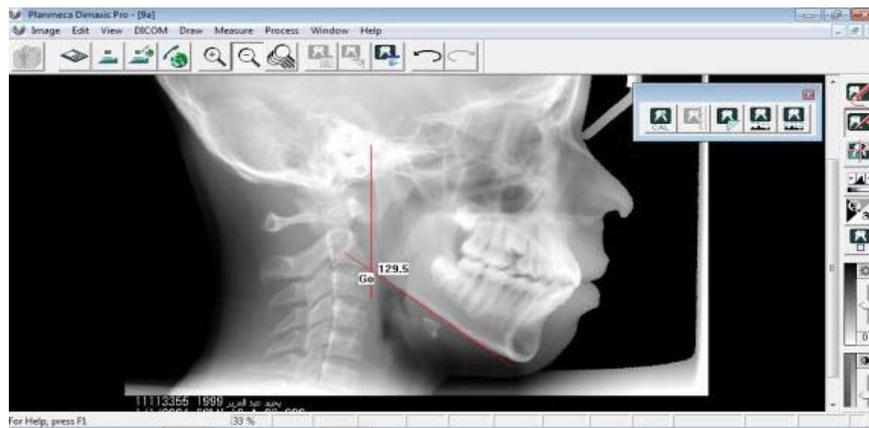


Figure 2: Digital measurement of the gonial angle in the cephalometric radiograph.



Figure 3: Digital measurements of the right and left gonial angles in the panoramic radiograph.

Table 1: Descriptive statistics of the all variable in both genders.

Group	Samples	Gender	No.	Side	Min.	Max.	Mean	SD
Non-evaluated	Cephalometric	F	18	-	121.43	135	129.99	4.6889
		M	18	-	121.44	136	126.94	4.6801
	panoramic	F	18	R	117.55	132.2	126.54	6.2442
		L	18	117.6	131.75	126.91	6.2031	
Evaluated	Cephalometric	F	20	-	121.43	134.96	128.98	4.448
		M	20	-	122.55	135.86	129.53	4.076
	panoramic	F	20	R	122.6	134.56	129.82	3.3861
		L	20	122.33	135.78	128.18	4.3658	
	panoramic	R	20	122.75	134.76	129.76	4.4432	
		L	20	122.7	134.56	129.36	4.0307	

Min: Minimum; Max: Maximum; SD: Standard Deviation

all variables (Table 1). The paired t-test was used for evaluating the difference between the measurements of the gonial angle in the lateral cephalometric and panoramic radiographs of both sides. The analyses were performed using the SPSS version 13.0, a p-value of  $\geq 0.05$  was considered to indicate statistical not significance.

**RESULTS**

The results showed a significant difference in the values of the gonial angle in the non-evaluated panoramic radiographs of both right and left sides

( $p=0.00, 0.001$ ) respectively as compared to its value gained from the cephalometric radiograph. While, no significant differences were seen in the value of gonial angle measurements gained from cephalometric and evaluated panoramic radiographs in both sides ( $p=0.888, 0.938$ ) respectively (Table 2). Also, no significant differences are seen as comparing the right and left side measurements of the panoramic radiographs either evaluated ( $p=0.809$ ) or non-evaluated ( $p=0.888$ ) (Table 3).

**Table 2: A comparison between cephalometric and panoramic measurements of gonial angle.**

Pairs	Side	Mean	SD	SE mean	t-value	df	p-value
Cephalometric-Non-evaluated panoramic measurements	R	3.889	5.467	0.911	4.268	35	0
	L	3.514	5.656	0.942	3.728	35	0.001
Cephalometric-Evaluated panoramic measurements	R	0.155	6.928	1.095	0.141	39	0.888
	L	-0.091	7.371	1.165	-0.079	39	0.938

DF: Degree of Freedom; SD: Standard Deviation. SE: Standard of Error. p-value  $\geq 0.05$  is not significant

**Table 3: A comparison of gonial angle measurements between the right and left sides of the panoramic radiograph.**

Pairs	Mean	SD	SE mean	t-value	df	p-value
Right-Left non-evaluated panoramic measurements	-0.375	2.25	0.375	-1	35	0.888
Right-Left evaluated panoramic measurements	-0.246	6.425	1.015	-0.243	39	0.809

DF: Degree of Freedom; SD: Standard Deviation. SE: Standard of Error. p-value  $\geq 0.05$  is not significant

## DISCUSSION

Lateral cephalometric radiographs are usually used for evaluation of skeletal and dentofacial development through the assessment of different angular and linear measurements [15-17]. Recently, the dental panoramic radiograph has been used to evaluate different angular and linear measurements to assess the skeletal and dentofacial developments [9,18]. There is a great controversy between authors with respect to the use of two types of radiographs; several authors support the validity of a panoramic radiograph in the measurement of the gonial angle.

The results of this study show a significant difference between the cephalometric radiograph and both sides of non-evaluated panoramic radiographs in measuring the gonial angle, with a mean difference of about 3.5 degrees between the two radiographic techniques. These findings related to that the quality of a panoramic radiograph is greatly affected by the patient head position in vertical and horizontal plains which resulted in angular distortion even this position being standardized using the light-beam positioning marker. In addition to that, the size of the focal trough is very limited, which is very sensitive to the change in the patient head position [19,20]. Therefore, any minor change in the patient's head position resulted in a low diagnostic quality of the panoramic radiograph. Thus, leading to great changes in the shape and size of the object which affect the linear and angular measurements [14,20]. These results come in agreement with those of other studies; Arkai et al. [21] and Park et al. [22] preferred the use of cephalometric radiograph on the panoramic radiograph in the measurements of gonial angle. They found that the value of the gonial angle from a panoramic radiograph is smaller in 2 to 3.6 degrees than that obtained from a cephalometric

radiograph. Similarly, Kundi, et al. [23] concluded that the gonial angle cannot be measured on the panoramic radiograph as accurately as a lateral cephalometric radiograph.

No significant difference is found in the value of the gonial angle between the cephalometric and evaluated panoramic radiographs because the success criteria were considered to select the panoramic radiographs for this group. Which makes the quality of these radiographs in the optimum and free from the effect of patient head positioning errors. Thus, the validity of panoramic radiographs in measuring the gonial angle greatly depends on their quality which should be carefully evaluated to obtain adequate angular and linear measurements by considering the success criteria to display the quality of panoramic radiography [24,25].

A cephalometric radiograph can be used accurately to measure the gonial angle as an intermediate measure between both sides of the mandible, but it is impossible to determine each side separately [3]. The panoramic radiograph could be used to measure the gonial angle on both sides of the mandible in a single radiograph with minimum radiation dose to the patient and minimum cost effect [25,26]. Concerning the amount of radiation exposure for a cephalometric radiograph is equivalent to less than one day of average background radiation. While the panoramic radiographs have a radiation dose equivalent to 1 - 3 days of background radiation [27]. Many authors support the use of cephalometric and panoramic radiographs to measure the gonial angle; Majeed, et al. [9], Park, et al. [22], Trivedi, et al. [28], Katti, et al. [29], Ganeiber, et al. [30], Kundi [31] and Ozkan, et al. [32] they prove that the panoramic radiography can be used to determine the gonial angle as accurately and easily as lateral cephalogram

without superimposition of anatomic landmarks, which commonly occurs in a lateral cephalogram.

Also, there is no significant difference in the measurement of the gonial angle between the right and left sides of panoramic radiographs in two groups of samples. This compensates the results of other studies, [3,4,29,33] establish that the panoramic radiograph provides equally reliable information about both left and right side gonial angles.

### CONCLUSION

The panoramic radiograph could be used to assess the gonial angle as accurately as that of a cephalometric radiograph and represents both the right and left gonial angles without superimposition in an easy and simple method with a single radiograph. Respect should be given to the success criteria in observing the quality of panoramic radiographs.

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