Panoramic radiographs: determination of mandibular steepness

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The aim of this study was to evaluate the potential of panoramic radiographs to measure mandibular inclination and steepness. Standardized panoramic and lateral cephalometric radiographs were taken for 95 subjects (46 females, mean age 12.4 ± 1.2 years; 49 males, mean age 12.1 ± 1.3 years). Mandibular inclination from panoramic radiograph was measured using gonial angle formed by the tangents of the lower border of the mandible and the distal border of the ascending ramus and the condyle.

A correlation test was performed to check for similarity between the measurements. The mean values for the gonial angle were 127.3 ± 6.2 and 125.7 ± 6.5 degrees measured from the panoramic and cephalometric radiographs respectively. A high correlation between the measurements taken from both radiographs was found (r=0.83, P<0.001). Panoramic radiographs are a useful tool for the measurement of gonial angle, which is an indicator of manibular steepness and subsequently mandibular growth direction. The ability to determine growth direction from the orthopantomogram will be useful because majority of dentists request an OPG for patients during routine dental examination. This will enable the dental professional to spot vertical growth problems using a readily available tool.
J Clin Pediatr Dent 29(2): 165-166, 2005

INTRODUCTION

Panoramic radiography is a widely used procedure in orthodontic diagnosis. It provides information about teeth and skeletal structures.[1] Gonial angle[2] condylar asymmetries and TMJ abnormalities[3] are among the skeletal structures investigated.

Gonial angle is one of the measurements that is usually evaluated during orthodontic treatment. It gives an idea about the mandibular plane inclination. An increased gonial angle indicates a steep mandibular plane and therefore, a backward growth direction, while reduced gonial angle indicates a forward growth.[4] Monitoring the change in this angle may provide us with necessary information about the growth direction. Measurement of the gonial angle from lateral cephalogram is not precise because of the superimposed right and left sides of the mandible.[2,5] This limitation does not exist in panoramic views.

The aim of this study was to clarify the possible application of panoramic radiographs as a tool for measuring mandibular steepness and vertical mandibular growth.

METHODS AND MATERIAL

The material for this study comprised the lateral cephalometric and panoramic radiographs of 95 subjects undergoing orthodontic treatment for different malocclusions (46 females, mean age 12.4 ± 1.2 years; 49 males, mean age 12.1 ± 1.3 years).

Panoramic and cephalometric radiographs were taken with a Siemens Orthophos-5 machine (Munich, Germany) using a standardized technique. The magnification of radiographic machine, which was not corrected for, was 11.3.

The gonial angle measured from panoramic radiographs was formed by intersection of the tangents of the lower border of the mandible (ML) and the distal border of the ascending ramus and the condyle (RL) on the panoramic radiographs (Figure 1) and from cephalometric radiographs as the angle between Articulare, Gonion and Menton (Figure 2).

Method error

Ten randomly selected panoramic and lateral cephalometric radiographs were retraced and measured after one week. One sample t-test was applied to test systematic error. The method errors were calculated as recommended by Dahlberg[6] and Houston.[7] There was no systematic error detected. Dahlberg error was 0.5 and 0.6 degrees for gonial angle from cephalometric and panoramic radiographs respectively. Houston's coefficient of reliability was above 0.90 for both measurements.

Statistical analysis

A paired t-test was performed to determine any difference between right and left sides of the panoramic radiographs. A correlation test was performed on both sides of the panoramic radiographs and between the mean values of the panoramic and cephalometric measurements.

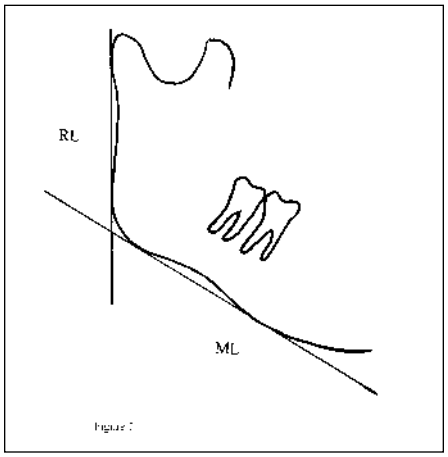

Figure 1. Gonial angle illustrated on panoramic radiographs.

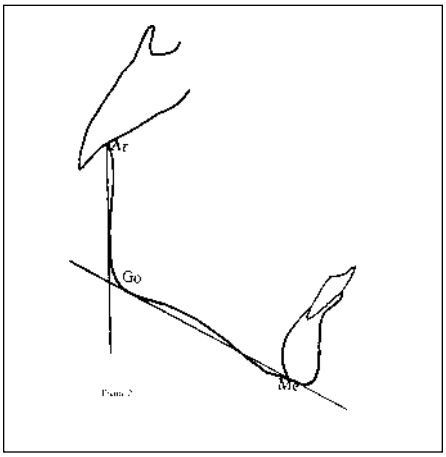

Figure 2. Gonial angle illustrated on lateral cephalometric radiograph.

RESULTS

The correlation test for left and right measurements of the panoramic radiographs showed high and significant correlations (r=0.99, P<0.001). The mean values for the gonial angle were 127.2 ± 6.2 and 125.7 ± 6.5 from the panoramic and cephalometric radiographs respectively. There was a high correlation between the measurements taken from both radiographs (r=0.83, P<0.001).

DISCUSSION

Panoramic radiographs are usually taken by all dental specialties and not only by orthodontists, therefore, these radiographs are considered as an available tool for diagnosis and screening. The potential of these radiographs in skeletal diagnosis has been studied recently[8] in attempt to predict the vertical dimensions of craniofacial structures from panoramic radiographs. They reported significant correlations between the variables measured from panoramic and cephalometric radiographs.

A common drawback of panoramic radiographs is distortion and magnification of the images. This problem is usually minimized by taking the radiographs using standardized technique.

It has been shown that linear vertical measurements are not reliable from panoramic views[5,9] so, gonial angle was used in our study to record mandibular steepness using the tangent of the condyle rather than the center of the condyle to avoid any distortion in the condylar area in the lateral cephalometric radiographs.

Larheim and Svanaes[5] found that gonial angle assessed from the panoramoic film was almost identical to that measured on dried mandible. The high correlation between the measurements of gonial angle from the panoramic radiographs and that from the lateral cephalograms is in agreement with some early findings.[2,5] Mattilla *et al.*[2] reported that the gonial angle can be determined from the panoramic radiographs with the same accuracy as from the commonly used lateral cephalograms. Larheim and Svanaes[5] found that gonial angle assessed from the panoramoic film was almost identical to that measured on dried mandible. On the other hand, Akcam *et al.*[8] using regression analysis reported that the predictability of the vertical cephalometric measurements from the panoramic views is low (11-20%).

These findings are important because lateral cephalometric radiographs do not allow precise registration of the gonial angle due to the superimposed right and left sides in addition to the availability of the panoramic radiographs more than the lateral cephalometric radiographs.

CONCLUSION

Panoramic radiograph is a useful tool for the measurement of gonial angle, which is an indicator of manibular steepness and growth direction.

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