



Comparative study between cone-beam and digital lateral head film cephalometric measurements

Estudio comparativo entre mediciones cefalométricas en cone-beam y radiografía lateral digital

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ABSTRACT

Objective: The objective of the present study was to determine the differences between cephalometric measurements obtained by two different methods: cone-beam tomography and digital lateral head film. **Material and methods:** Measurements were performed (anterior facial height, mandibular length, upper incisor to the A-Pog line, lower incisor to the A-Pog line, ANS-PNS, ANB angle) on 30 patients by means of lateral digital radiography and cone-beam. The statistic test used was the t-Student. **Results:** The measurement that presented a statistically significant difference was the mandibular length ($p = 0.001$). **Conclusion:** Measurements performed in cone-beam scans for a 3D cephalometric analysis did not show evidence of being more effective or reliable in comparison with measurements performed in 2D.

Key words: Cone-beam, lateral head film, cephalometry, reliability.

Palabras clave: Cone-beam, radiografía lateral, cefalometría, confiabilidad.

RESUMEN

Objetivo: El objetivo del presente estudio fue determinar las diferencias de las mediciones cefalométricas realizadas por dos métodos diferentes: cone-beam y la radiografía lateral de cráneo. **Material y métodos:** Se realizaron mediciones (altura facial anterior, longitud mandibular, incisivo superior a A-pg, incisivo inferior a A-pg, ENA-ENP, ANB) de 30 pacientes por medio de radiografía lateral digital y cone-beam, se usó la prueba t-Student. **Resultados:** La longitud mandibular del lado derecho e izquierdo del cone-beam presentó diferencia estadísticamente significativa con las radiografías laterales ($p = 0.001$). **Conclusión:** La mediciones realizadas en tomografías para la realización de un trazado cefalométrico en 3D no presentaron una evidencia de una mayor eficacia y fiabilidad en comparación a las medidas realizadas en 2D.

INTRODUCTION

Radiographic imaging is an important diagnostic tool for the orthodontic patient's assessment; since the introduction of cephalometry by Brodie in 1931, cephalometry has contributed to the analysis of both dental and skeletal malocclusions and has become a standardized diagnostic method in orthodontic practice and in research since it provides a detailed morphological analysis through the sagittal and vertical evaluation of bony, dental and soft tissues. Likewise, it permits a thorough analysis of growth through the comparison of cephalograms in different time intervals or by means of predictions.^{1,2}

Conventionally, cephalometric analysis is performed in geometric projections of a 2D radiograph in which landmarks for bone and dental structures are identified. These projections present some difficulties such as:^{3,4}

- Distortion: it is the result of an inadequate patient's head orientation in the cephalostat, incorrect aligning of the film or the central beam.

- Magnification: it is defined as the enlargement of an object's real size. The factors that influence enlargement are the size of the silver halide crystals in the emulsion or several characteristics of the intensifying screens.⁴

Cone-beam computerized tomography (CBCT) is a technology initially developed for angiographs in 1982 and was subsequently applied in maxillofacial imaging.

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Since 1990 it was possible to manufacture smaller and less expensive clinical systems.³

The advantages of CBCT is that it allows the clinician to locate cephalometric points in 3D images in order to personalize cephalometric analysis with linear and angular measurements on the left and right side of the patient.^{5,6}

One of the most important advantages is the localization of cephalometric landmarks through cone-beam imaging. Their location can be described in the three planes of space: sagittal, axial and coronal.⁷⁻¹⁰

In 1995 Jacobson and Gereb developed a 3D cephalometric analysis which was capable of accurately measuring oral and facial surfaces in three dimensions. This program defined distances between anatomical landmarks.⁴

Among the disadvantages of cone-beam imaging is the high dose of radiation that the patient receives. However it should be considered that for an orthodontic patient, additional radiographs may be required such as a panoramic X-Ray or lateral head film which in sum result in higher doses of radiation compared to those of the cone-beam.^{7,10}

The objective of this study was to determine the differences between linear cephalometric measurements performed on conventional lateral radiographs and in cone beam scans of patients who attended the Orthodontics clinic of the Division of Postgraduate Studies and Research, Faculty of Odontology, UNAM, between the years of 2011 and 2013.

MATERIALS AND METHODS

To conduct this study, thirty-two patients who attended the Orthodontics Clinic in the scholar year 2011-2013, who signed an informed consent and had digital lateral head films or cone-beam scans were randomly selected. Inclusion criteria were the radiographs of patients with complete permanent dentition, without any syndrome regardless of the gender.

Radiographs and CBCT that were not taken with the cephalostat orthopos XG plus and the NewTom VGI tomograph were excluded. Digital radiographs were taken with the orthopos XG Plus cephalostat under the following conditions: 25 KVa, 15 mA and an exposure time of 0.04 second.

The CBCT were taken with a NewTom VGI tomograph, at 70 Kv, 1-20 mA amperage, 3.6 to 5.4 seconds exposure with a sensor of 15 x 15 cm and a 0.03 x 0.03 x 0.03 Voxel measurement.

The following linear measurements were analyzed: anterior facial height, right side and the left side

Table I. Definition of variables.

Measurements	Definition
Anterior facial height	Plane formed by Nasion and Menthon points
Mandibular plane	Tangent line to the mandibular lower rim that connects Me point with the lowest point of the mandibular ramus
Upper incisor to A-Pg	Distance between the most labial portion of the upper central incisor and the A-Pg plane
Lower incisor to A-Pg	Distance between the most labial portion of the lower central r incisor and the A-Pg plane
ANS-PNS	Distance between the anterior nasal spine point and the posterior nasal spine point
ANB	Angle formed by the NA-point B plane and the NA-point A plane

mandibular length, nasal spine length, upper and lower incisor to plane A-P of the right side and on the left side. The angular measurement was ANB (*Table I*).

The linear and angular measurements in the digital radiographs were obtained through the Nemotec Dental Studio NX program software (Nemotec Software 2005, SL, Madrid, Spain) while the Conebeam were obtained through the viewfinder OnDemand.

Each of the measurements was taken twice with a difference of two weeks between them and they were performed by a single operator. The statistical analysis was obtained with SPSS version 15 using a Student's t-test and ANOVA with a post-hoc Tukey test.

RESULTS

The operator performed previous tests for measurement calibration; an intraclass correlation coefficient (ICC) was used thus obtaining a 0.83 to 0.99 reliability. Once the calibration was performed, the measurements for the study were obtained.

A Kolmogorov-Smirnov test was used to determine data distribution. According to the results, the statistical tests would be parametric.

The anterior facial height, ANS-PNS and ANB in the lateral head film and in the cone-beam were compared using a Student's t-test ($p < 0.05$). No statistically significant differences were found (*Table II*). Subsequently, the mandibular length, upper incisor to A-Po and lower incisor to A-Po were compared in the

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