2D / 3D Cone-Beam CT images or conventional radiography: Which is more reliable?

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Abstract

Objective: To compare the reliability of two different methods used for viewing and identifying cephalometric landmarks, i.e., (a) using conventional cephalometric radiographs, and (b) using 2D and 3D images generated by Cone-Beam Computed Tomography. **Methods:** The material consisted of lateral view 2D and 3D images obtained by Cone-Beam Computed Tomography printed on photo paper, and lateral cephalometric radiographs, taken in the same radiology clinic and on the same day, of two patients selected from the archives of the Specialization Program in Orthodontics, at the School of Dentistry, Fluminense Federal University (UFF). Ten students from the Specialization Program in Orthodontics at UFF identified landmarks on transparent acetate paper and measurements were made of the following cephalometric variables: ANB, FMIA, IMPA, FMA, interincisal angle, 1-NA (mm) and 1-NB (mm). Arithmetic means were then calculated, standard deviations and coefficients of variance of each variable for both patients. **Results and Conclusions:** The values of the measurements taken from 3D images showed less dispersion, suggesting greater reliability when identifying some cephalometric landmarks. However, since the printed 3D images used in this study did not allow us to view intracranial landmarks, the development of specific software is required before this type of examination can be used in routine orthodontic practice.

Keywords: Cone-Beam Computed Tomography. Radiography. Orthodontics.

Editor's summary

Cone-Beam Computed Tomography (CBCT) offers the advantage of enabling image reconstruction from a lateral radiograph in conventional orthodontic cephalometry. This investigation aimed to compare how reliably cephalometric landmarks can be identified when viewed on conventional radiographs (Fig 1), and when viewed on two different CBCT images, i.e., conventional 2D reconstruction and maximum intensity projection (MIP), depicted in Figures 2 and 3, by analyzing the dispersion of the values obtained from measurements performed on each image. CBCT-generated images were printed on photographic paper and cephalometric tracings were manually performed by 10 examiners at two different times.

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Coefficient of variance was applied with the purpose of assessing the dispersion of cephalometric values. Values from the measurements performed on the 3D CBCT images showed less dispersion in seven situations. This result was repeated—considering the data of patients 1 and 2, for the FMA angle only. This finding seems to suggest that three-dimensional images are more reliable for identifying some cephalometric landmarks which are difficult to detect in 2D images, such as porion (Po), orbitale (Or), subspinale (A), supramentale (B) and nasion (N). Likewise, the inferior mandibular border seemed easier to identify. Nevertheless, 3D images do not seem to be as reliable when identifying the intersection of the long axes of maxillary and mandibular central incisors. It is interesting to note also that printed 3D images, as used in this study, did not allow the viewing of intracranial points, often essential for cephalometric analysis. No difference was pointed out between conventional images and 2D Cone-Beam CT reconstruction.

FIGURE 1 - Lateral cephalometric radiograph.

FIGURE 2 - 2D image obtained with Cone-Beam Computed Tomography, in lateral view.

FIGURE 3 - 3D image obtained with the Cone-Beam Computed Tomography, in lateral view.

Questions to the authors

1) Did the examiners report any difficulties in marking the points on the 3D image?

No, the cephalometric landmarks were easily identified on the 3D image and the lines and angles were easily traced and measured, respectively. Not many differences were found compared to cephalometric tracings commonly performed by examiners on a conventional cephalometric image.

2) Did the examiners notice any differences in structure identification between conventional cephalometric images and 2D CBCT reconstruction?

The investigators reported greater difficulty in identifying cephalometric landmarks and in performing cephalometric tracings on the 2D CBCT-generated reconstruction.

3) Do the authors find it feasible to use 2D CBCT-generated reconstruction in cephalometry?

Yes. Not only in 2D but in 3D as well, provided that cephalometric analyses are adapted to three-dimensional images.

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