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3D cephalometric analysis obtained from computed tomography. Review of the literature

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Summary

Introduction. The aim of this systematic review is to estimate accuracy and reproducibility of craniometric measurements and reliability of landmarks identified with computed tomography (CT) techniques in 3D cephalometric analysis.
Methods. Computerized and manual searches were conducted up to 2011 for studies that addressed these objectives. The selection criteria were: (1) the use of human specimen; (2) the comparison between 2D and 3D cephalometric analysis; (3) the assessment of accuracy, reproducibility of measurements and reliability of landmark identification with CT images compared with two-dimensional conventional radiographs. The Cochrane Handbook for Systematic Reviews of Interventions was used as the guideline for this article.
Results. Twenty-seven articles met the inclusion criteria. Most of them demonstrated high measurements accuracy and reproducibility, and landmarks reliability, but their cephalometric analysis methodology varied widely.
Conclusion. These differences among the studies in making measurements don't permit a direct comparison between them. The future developments in the knowledge of these techniques should provide a standardized method to conduct the 3D CT cephalometric analysis.

Key words: three-dimensional cephalometry, computed tomography, accuracy, reliability, reproducibility.

Introduction

Conventional cephalometric analysis presents the same limits of the radiograph on which it is performed: the two-dimensional character and geometric distortion of the

anatomical structures being imaged. The 2-D cephalometric radiography allows bidimensional evaluation of craniofacial morphology and growth, but ignore the mediolateral axis. Frontal cephalometric radiographs are useful for facial asymmetry assessment but neglect the postero-anterior dimension.

These problems may be overcome using computed tomography (CT) imaging techniques that produce three-dimensional images of cranial bone, jaws and the surrounding tissues, allowing to focus the anatomic structures more accurately than 2D conventional radiography. Different techniques has been developed in order to obtain three-dimensional landmarks and to generate 3-D cephalograms, after combining and integrating the data of both 2-D cephalograms (lateral and postero-anterior).

The advantages of three-dimensional medical computed tomography (CT) imaging are already well established in different dental specialties: management of trauma to the maxillofacial skeleton, surgical facial reconstruction, orthognathic surgery, dental implants, complicated extractions and endodontic treatments (1-3). Nevertheless, its use has been limited in orthodontics due to high-radiation dose, cost, lack of availability, poor resolution and difficulty in interpretation. These issues may be addressed by recent cone beam innovations in CT technology, and could substantially alter the way that patients who have potentially complex orthodontic problems are managed.

Afterwards, the advantages brought by Cone Beam Computed Tomography (CBCT) technology, as lower radiation dose, clearer images, more precision and reliability during the visualizing of landmarks compared with conventional CT, bring to ask if 3D cephalometry obtained with CBCT technology can fully replace the traditional cephalometry. Moreover, because many of the patients had conventional cephalometric records in the past as part of their documentation, it is important to know whether cephalometric radiographs obtained from CBCT scans are comparable to conventional cephalometric records when evaluating a longitudinal series that contains both types of radiographs. If the two types of radiographs are not comparable, then the cephalometric data obtained from CBCT scans cannot be used to evaluate growth and treatment outcomes longitudinally.

The aims of this review are to assess the quality of three-dimensional cephalometric analysis obtained from computed tomography and to determine if there is general consensus in the literature concerning the reliability, accuracy and reproducibility of cephalometric landmarks and measurements obtained from CT 3D images.

Methods

Criteria for considering studies for this review
 The follow criteria were used to select the studies for this



번호	명칭	평균값	분산값	편차
1	SNA	82.0 ± 2.0°	87.8°	5.8°
2	SNB	80.0 ± 1.8°	80.9°	0.9°
3	SN-FH	8.2 ± 2.3°	7.1°	-1.1°
4	ANB	2.4 ± 2.0°	60.9°	58.5°
5	Inter-incisal angle	124.0 ± 8.3°	133.6°	9.6°
6	Mx. Depth	90.0 ± 3.0°	90.8°	0.8°
7	Mchamara's N per	0.0 ± 2.0 (mm)	99.9 (mm)	99.9 (mm)
8	N per pog	-1.8 ± 4.5 (mm)	3.2 (mm)	5.0 (mm)
9	U1 to SN	103.0 ± 6.0°	100.9°	-2.1°
10	U1 to FH	116.0 ± 5.5°	109.6°	-6.4°
11	Facial angle	88.9 ± 2.8°	89.0°	0.1°

FMA (deg)	34	34	35
SN-GoGn (deg)	36	36	37
Saddle angle	111	111	112
Articular angle	163	162	162
Gonial angle	122	123	127
LAFH (ANS-Me) mm	74	72.5	72
Y-Axis (deg)	61	60	60
Jarabak's ratio	61.2%	60.4%	61.9%
Base plane angle	26	26	27
Inclination angle	84	84	81
Mx OP to TVL (deg)	94	96	101
Dental parameters: maxilla			
1 to NA (mm)	4.5	4	7
1 to NA (deg)	29	24	27
1 to A (mm)	5	3.5	7.5
1 to TVL (mm)	-15	-14	-10
1 to Mx OP (deg)	55	58	54
1 to NF (mm)	25	27	29
6 to NF (mm)	19	26	26
Dental parameters: mandible			

✓ No more annual licenses. ✓ Suitable packages for your needs. ✓ We offer two services: Do it Yourself and We Do it For You. ✓ Experience our services with one of our demo minipackages. • You personally run our exclusive Online Cephalometric software. • Load the X-Ray image and trace your preferred analysis in a few easy steps. • It requires no special equipment. • Inexpensive and practical service. • Within five minutes you can have your preferred analyses, more info... • Maximize your time. • You just load the X-ray image and the necessary data for the analysis. • Within two (2) business days your preferred analyses will be in your easyceph® STUDIO inbox. • You always have the quality control in your hands. Once the tracings are done you can edit the cephalometric points and lines, more info... Clinician and researchers sometimes need to assess what changes have occurred in the patient with the treatment and/or growth. We have developed an interesting way to make cephalometric superimpositions, when a patient has at least two lateral cephalometric analysis performed, more info... WeDoCeph will help you clear up the stack of x-ray images that is building up on your desk in no time. Start sending X-ray images to tracing today and save hours of your valuable time. Create account Upload X-ray from your computer and the image will show up in a Step 1 window. If it is the right X-ray click Analyze to start. The artificial intelligence will instantly analyze your ceph and mark all landmarks and generate a tracing. From the dropdown window easily change between analyses and interpret results using Chart and Assessment columns. Learn more After the analysis is done fill form with patient details and save it as a PDF

report or image. Test it Select two analyses which you want to compare and the superimposition will be done automatically. Interp results and save a PDF report. Learn more Sign up and analyze up to 10 your own X-rays over the next 7 days. Give it a try and test how easy it is to get a comprehensive analysis. Try It Choose our package that suits you best. This package is valid for one month. This package is valid for one year. This package is valid for one year. © Cephio. All rights reserved. Orisline Software per dentisti, laboratori odontotecnici, odontoiatri, gestione studio dentistico, cefalometrici, cefalometria, gestione laboratorio odontotecnico, programma dentista OrisCeph Rx CE is a CE marking medical device to realize accurate cephalometric tracings and plan orthodontic treatments, in a quick and easy way. The most complete solution for the planning of orthodontic treatments. With OrisCeph Rx CE you can realize cephalometric tracings with more than 30 default techniques, in a quick and easy way. The programme can guide you for the insertion of cephalometric points and anatomical structures. You can see the diagnosis in real time with parametric values and normogram. NEWS: added new techniques Bimler, Petrovic, Sato, Gianni 48 Factors, Gianni AP Extended, Rocabado. For each patient you can associate different orthodontic charts with the anamnesis, clinical examination and ATM, intraoral examination, space analysis and treatment planning. You can insert visits in the clinical diary and capture pictures in the image record. Make your patients aware of the treatment benefits by creating automatically a case presentation. Advanced tools to manage orthodontic treatments. With OrisCeph Rx CE you can easily overlay the patient's photograph over the tracing, carry out the surgical VTO, move the cephalometric points, modify the image according to the new measures. You can display and print the patient's photograph simulating the growth forecast or post-treatment. Introducing Our AUTOMATED DENTAL SERVICES The highly sophisticated and superior capabilities of CephX means our reports, analyses and segmentations always come with full and accurate measurements, classification and insights for perfect examinations every time. All you have to do is to upload DICOM or X-ray files, and CephX software will immediately do the work for you. Then, you can view the findings online, or download them to your computer or share them with your colleagues. CephX software allows getting the dental information in just a few minutes, automatically. CephX helps to avoid unnecessary risks, by the early discovery of anatomical abnormalities. CephX algorithms autonomously detect hard-to-discover anatomical conditions such as airway obstruction, root absorption, nerve pathway location and root inclination. Directly available from your browser. 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An AI powered orthodontic productivity app. Works like magic on your iPhone Whether you're a busy clinician, a passionate academician or an enthusiastic dental student, CephNinja is sure to make your life easier. Discover a smooth, fun experience on iPad "I loved CephNinja and told all my colleagues about it. The tracing tools are simple, fun to use, and easy. I found that I could trace a ceph, save the pdf, and AirDrop it to my TC's computer in less than 3 minutes, which was awesome compared to doing it on other softwares" -Dr. Tyler Hart, Orthodontist, Durham, North Carolina "By far the most accurate and convenient cephalometric analysis software available globally. I Had never imagined that a phone app could be so good. Have been using it for nearly three years. It gives the best PC softwares a run for their money. My clinical staff just cannot do without CephNinja because it's right there at the fingertips to have an analysis done in a couple of minutes....super easy. 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Clinical reliability is of paramount importance and various studies performed and published in reputed scientific journals reveal a high clinical reliability of CephNinja 5 7 , 6 2 1 members Get the app.

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