

i-CAT FLX 3-D Cone Beam CT

Innovation in Orthodontics

YAN RAZDOLSKY D.D.S., L.T.D.



ORTHODONTIST

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Q1: What is the latest industry news about x-ray dosage and patients of all ages?

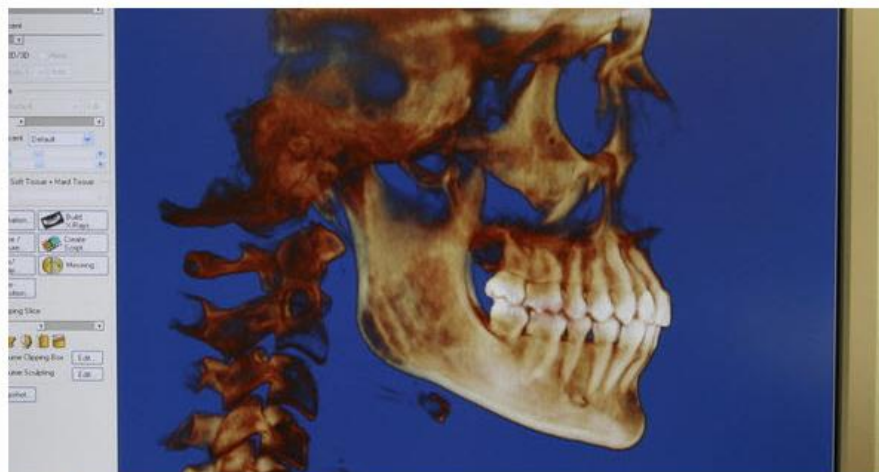
- A special report appeared in NY Times on November 22nd 2010. It was called 'Radiation worries for Children in Dental Chairs'. They claimed that the 3-D Cone Beam x-rays produce far greater radiation than the 2D x-rays (5 times more to be exact), orthodontists have very little knowledge of how much radiation is delivered by cone beam machines, and there is very little independent research done in this area. Unless used for oral surgery such as in implant planning these 3D images are of very little benefit to orthodontists and should not be used. The only reason the orthodontists are using the 3D Cone Beam is because they are mesmerized by the beauty of the images and are paid by the manufactures of the Cone Beam equipment. There is too much ionizing radiation going through the brain, eyes, tongue, salivary glands, spinal cord, and there is an increase chance in Thyroid Cancer in children.

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Radiation Worries for Children in Dentists' Chairs



An image from a cone-beam CT scanner used by dentists.

By WALT BOGDANICH and JO CRAVEN MCGINTY
Published: November 22, 2010

Because children and adolescents are particularly vulnerable to radiation, doctors three years ago mounted a national campaign to protect them by reducing diagnostic radiation to only those levels seen as absolutely necessary.

The Radiation Boom

Clarity at a Cost

Articles in this series examine issues arising from the increasing use of medical radiation and the new technologies that deliver it.

[Previous Articles in the Series »](#)

It is a message that has resonated in many clinics and [hospitals](#). Yet there is one busy place where it has not: the dental office.

Not only do most dentists continue to use outmoded [X-ray](#) film requiring higher amounts of radiation, but

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Radiation Doses in the Dentist's Chair

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Related

What Patients Might Want to Ask the Dentist About X-Rays
(November 23, 2010)

Enlarge This Image



Andy Manis for The New York Times
Practices and Promotion Dr. Edward Y. Lin, at top, uses cone-beam scanners in Green Bay, Wis.

some of it coming from dentists paid or sponsored by manufacturers to give speeches, seminars and continuing education classes, as well as by industry-sponsored magazines and conferences, according to records and dozens of interviews with dentists and researchers.

Last month, The Journal of the American Dental Association allowed one of the leading cone-beam manufacturers, [Imaging Sciences International](#), to underwrite an issue devoted entirely to cone-beam technology. That magazine, which the association sent to 150,000 dentists, included a favorable article by an author who has equated a cone-beam CT with an airport scan. In fact, a cone beam can produce hundreds of times more radiation, experts say.

Cone-beam CT scans can help dentists deal with complex cases involving implants, impacted teeth and other serious problems. But many experts in dental radiation have raised alarms about what they see as their indiscriminate use. They worry that with few guidelines or regulations, well-meaning orthodontists and other specialists are turning to a new technology they do not fully understand, putting patients at risk, particularly younger ones.

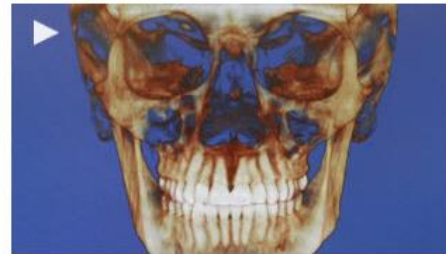
Some orthodontists now use cone-beam CT scans to screen all patients, even though a number of dental groups in this country and in Europe have questioned whether the benefit of routine use justifies the added risk.

"All these different cone-beam CT scanners came out to a world that was unprepared," said Keith Horner, a professor of oral radiology at the University of Manchester in Britain, who is coordinating a study of cone-beam scanners for the [European Commission](#). "They are just pushed out there by manufacturers with the message that a 3-D image is always going to be better than a 2-D image, and that isn't the case."

One popular new brand of braces has helped cone-beam sales because it requires 3-D images, which doctors can

The New York Times

[More Video »](#)

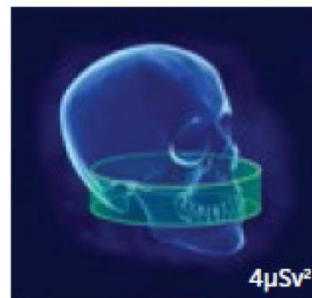


- Let us fast forward to October 2013! First of all I would like to give full disclaimer that **I have no financial interest in 3D Cone Beam technology**. The other disclaimer is that **not all 3D Cone Beam machines are created equally**. The facts I am about to present deal only with **i-CAT FLX 3D Cone Beam**, the only machine on the market to my knowledge which reduces radiation approximately 80% from their previous models;
- We now have facts from **independent sources** such as Dr. John Ludkow, University of North Carolina, School of Dentistry;
- The unit of measurement is **microSvert**. The amount of radiation from one i-CAT FLX 3D Cone Beam equals to **one 2D panoramic xray**, it also equals to **one to two days of back ground radiation exposure of just being outside if you live in Chicago and only ½ daily back ground exposure if you live in Colorado**. We can now **control the area of the skull** which we need to scan / examine. For example, if are looking to determine **3D orientation of an impacted canine in the upper jaw** we can choose a slice of just an **upper jaw**. Keeping the **location of the scan away from thyroid gland** and also **protecting thyroid with a lead apron** eliminates the **debate of predisposing children to thyroid cancer**. It also eliminates the debate of keeping radiation away from the **brain, eyes, spinal cord, etc..**

Control the area of the skull which we need to image



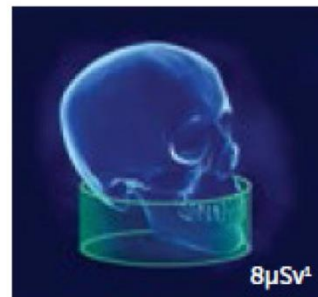
FOV 8 cm x 8 cm



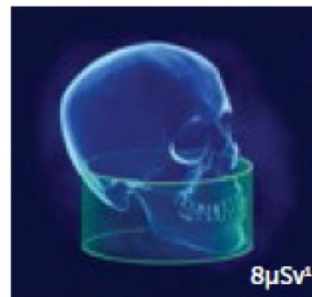
FOV 16 cm x 4 cm



FOV 16 cm x 6 cm
upper jaw TMJ



FOV 16 cm x 6 cm
lower jaw



FOV 16 cm x 8 cm



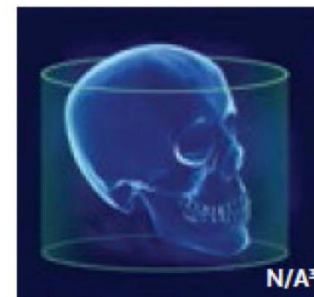
FOV 16 cm x 10 cm



FOV 16 cm x 11 cm



FOV 16 cm x 13 cm



FOV 23 cm x 17 cm

¹ Based on a study (not currently published) by John Ludlow, University of North Carolina, School of Dentistry, utilizing the i-CAT FLX QuickScan+ exposure protocol.

² Estimated dose measurements.

i-CAT FLX 3-D Cone Beam CT

superior diagnosis with the lowest dose of radiation on our planet!

2,920 uSv

Normal yearly background radiation
from living on Earth (8 uSv /day)

10-15,000 uSv

Normal yearly background radiation if
you live in Colorado (32 uSv /day)

8-20 uSv

i-CAT FLX 3-D Cone Beam CT
(Exposure is in "Pulsed" mode, actual exposure
time is about 2.4 seconds for a 8.9 second scan)

4.7 – 14.9 uSv

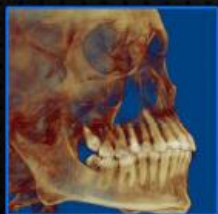
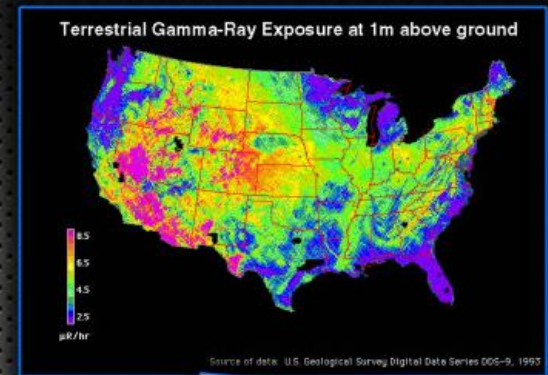
Digital Panoramic

150 uSv

Full mouth series

1,200-3,300 uSv*

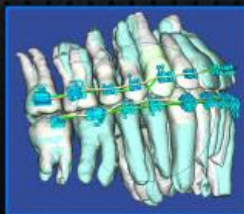
Medical CT



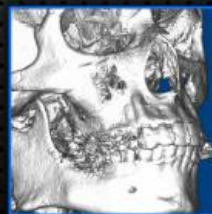
Full View iCat Benefits



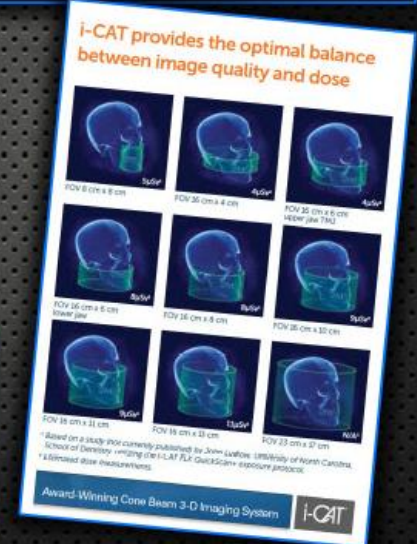
Implant Planning



Suresmile Evaluation



Diagnosis and treatment for your beautiful Forever Smile!



The above courtesy of:
Dr. Sharon Brooks, Dept. of Radiology, University of Michigan
*Dr. Stuart White, Dept. of Radiology, UCLA

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International **i-CAT**
www.i-CAT.com

Q2: What is different about i-CAT FLX 3-D Cone Beam CT?

- Many **micro images/slices** taken in 3 planes. **I-CAT software reconstructs** all slices into one 3D image. Contrary to the **Medical CT** where **radiation stays constant** (1,200 – 3,000 micro-Sieverts per scan!), **i-CAT FLX 3D CT produces pulsed radiation**. So for 8.9 sec scan the area of interest is only radiated for approximately 2.4 sec.

Q3: Why would a patient need this x-ray?

- To rule out systemic diseases, to determine the exact orientation of the Impacted Canines, for Implant planning, for Suresmile orthodontic GPS planning, to identify the exact amount of bone covering the teeth, to diagnose the extend of periodontal breakdown, to assist in endodontic procedures, to fabricate one to one replica of a jaw of cranio-facial patient, patients with cleft palate, for pre-Surgical planning. The list goes on and on...

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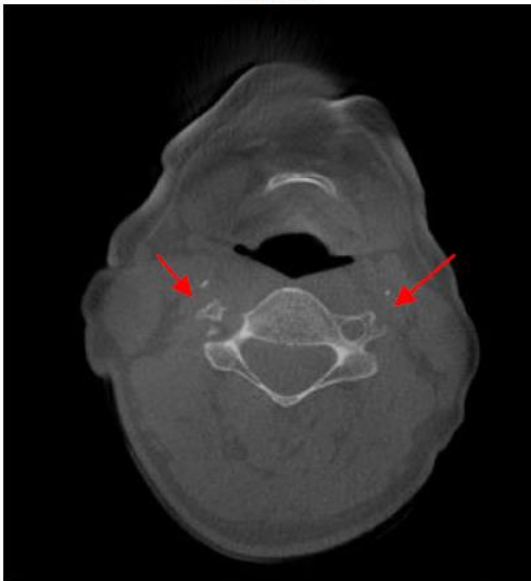
Benefits of iCat FLX

Radiology report – Rule out systemic diseases

IMPRESSIONS:

- Beginning atherosclerotic calcifications noted at the expected locations of the right and left external carotid arteries and right and left cavernous internal carotid arteries. Conebeam CT is not the proper modality to evaluate the significance of these findings. Consider referral if patient has other risk factors for vascular disease such as hypertension, hypercholesterolemia, obesity, diabetes and/ or smoker. They may wish to discuss the significance of this with their physician.

Axial



External carotid artery calcifications

Coronal



Internal carotid artery calcifications

Benefits of iCat FLX

Improved Diagnosis

Identification of Pathology



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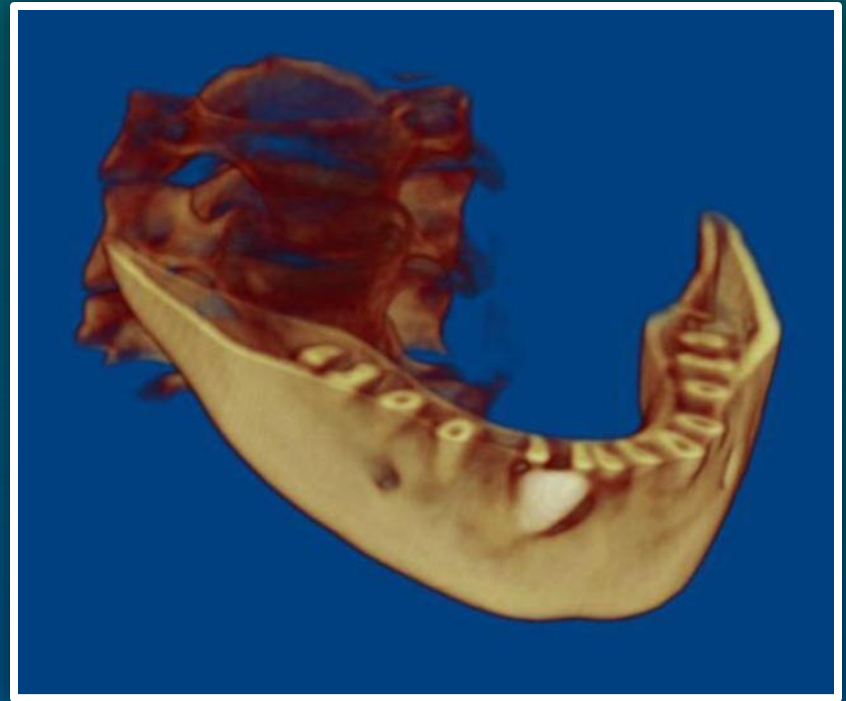
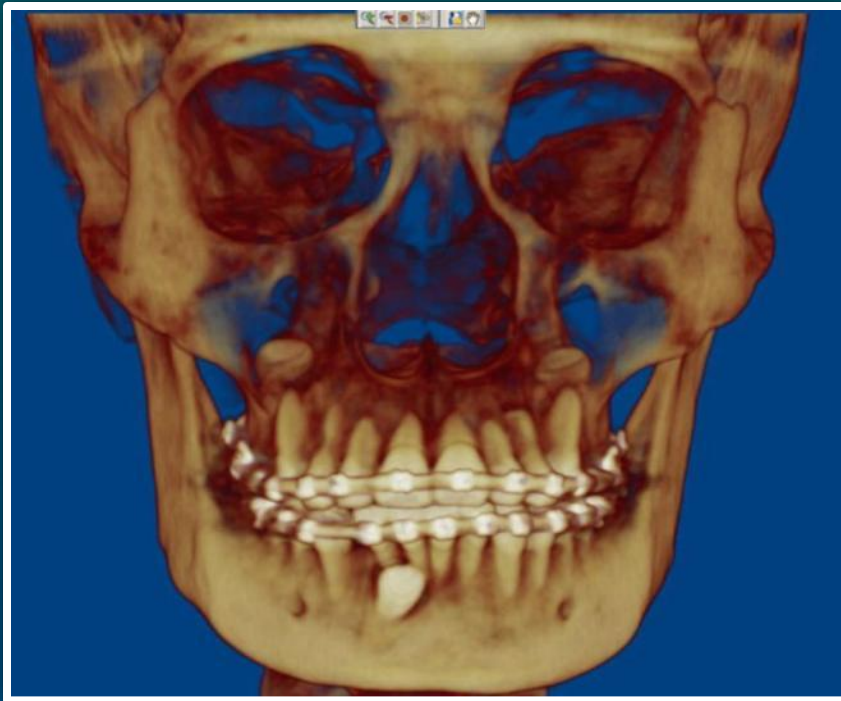


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Benefits of iCat FLX

Determine the exact orientation of the Impacted Canines



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Benefits of iCat FLX

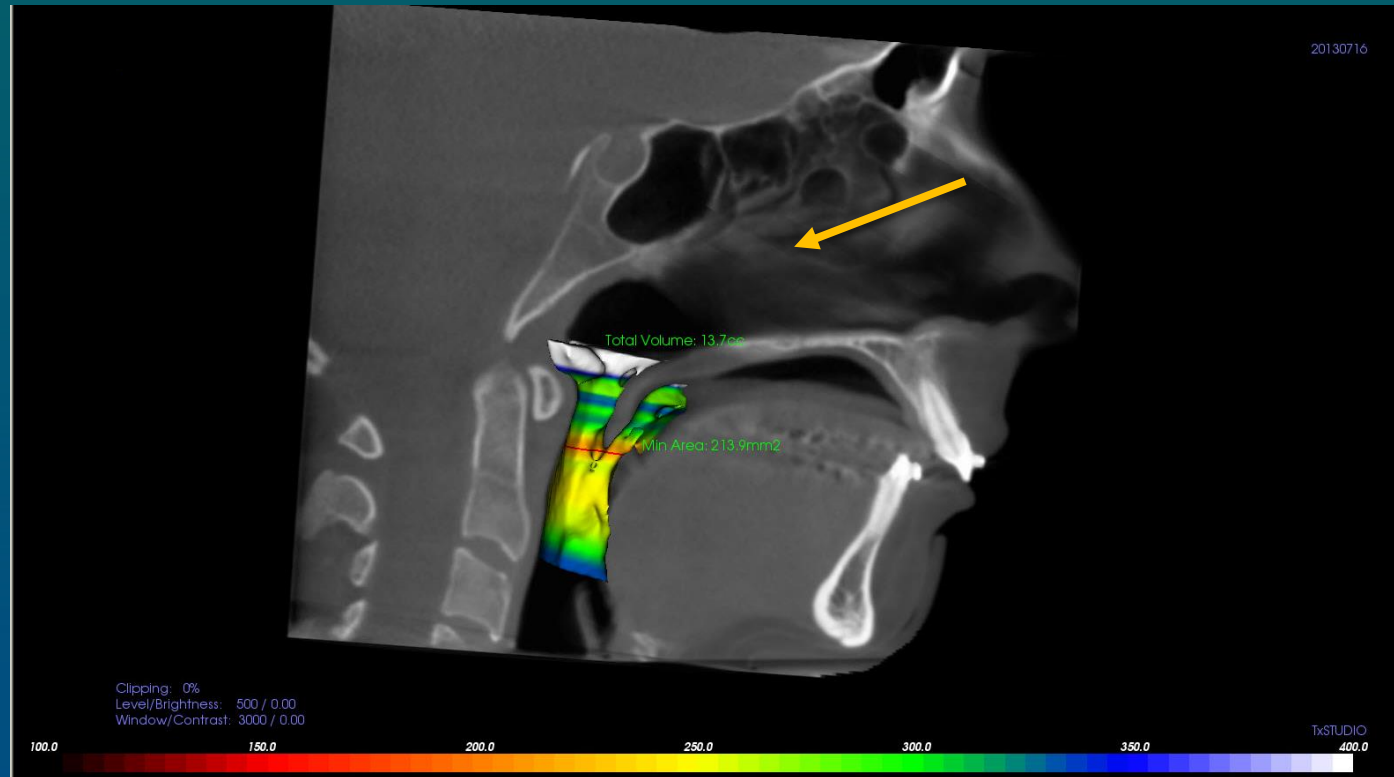


Fabricate one to one replica of a jaw of a cranio-facial patient, patients with cleft palate, for pre-Surgical planning

Steriolithic model fabricated from an iCat FLX Cone Beam CT

Benefits of iCat FLX

Airway measurements for Obstructive Sleep Apnea patients



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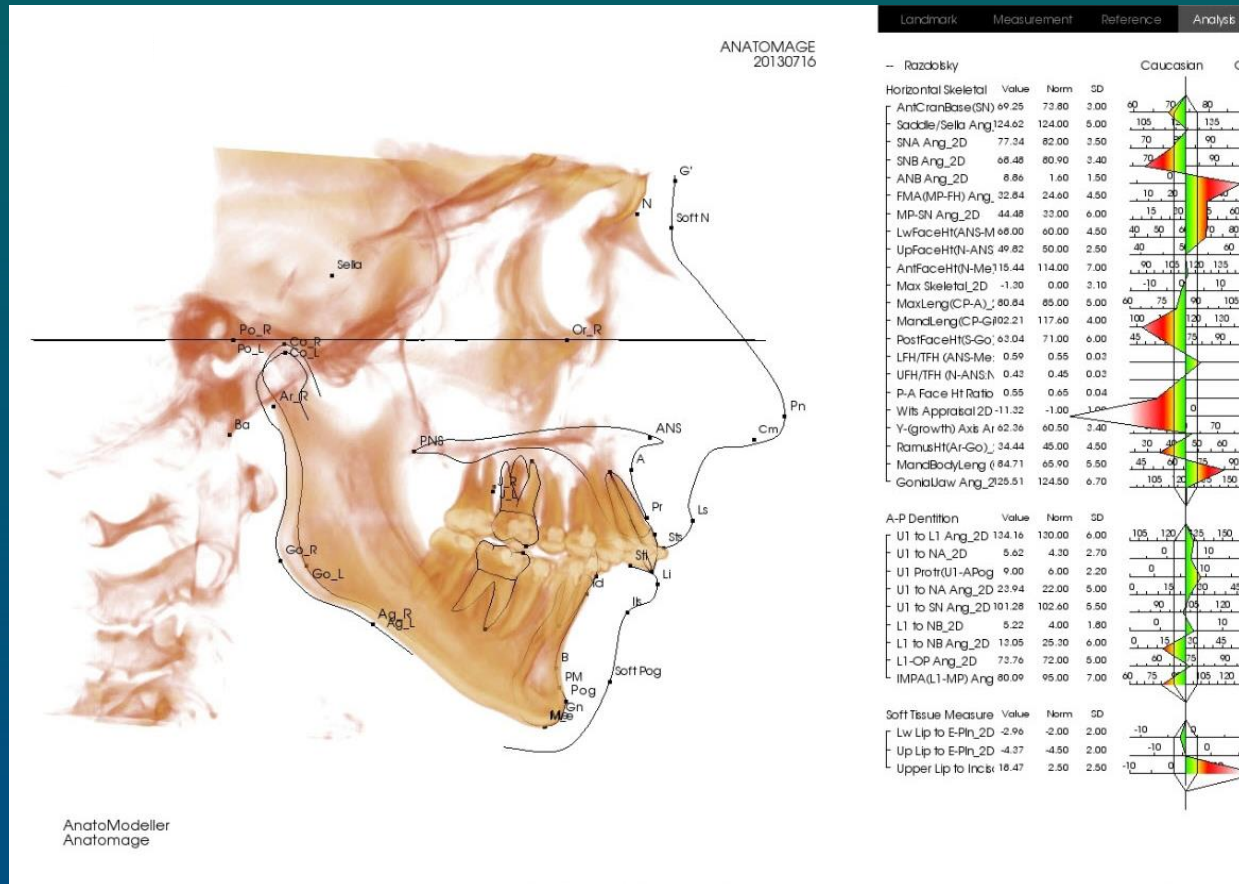


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Benefits of iCat FLX

Cephalometric Analysis



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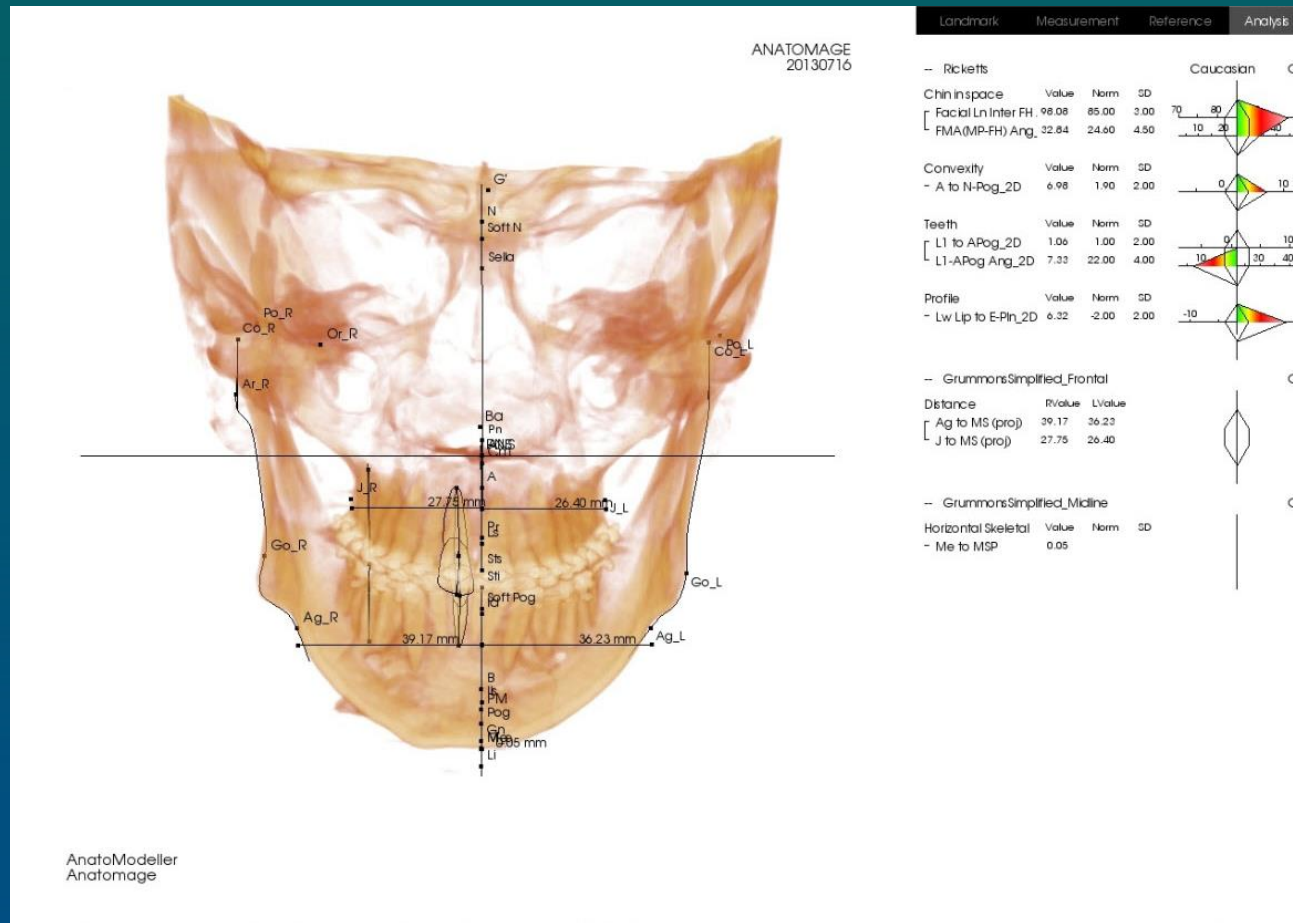


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Frontal Analysis



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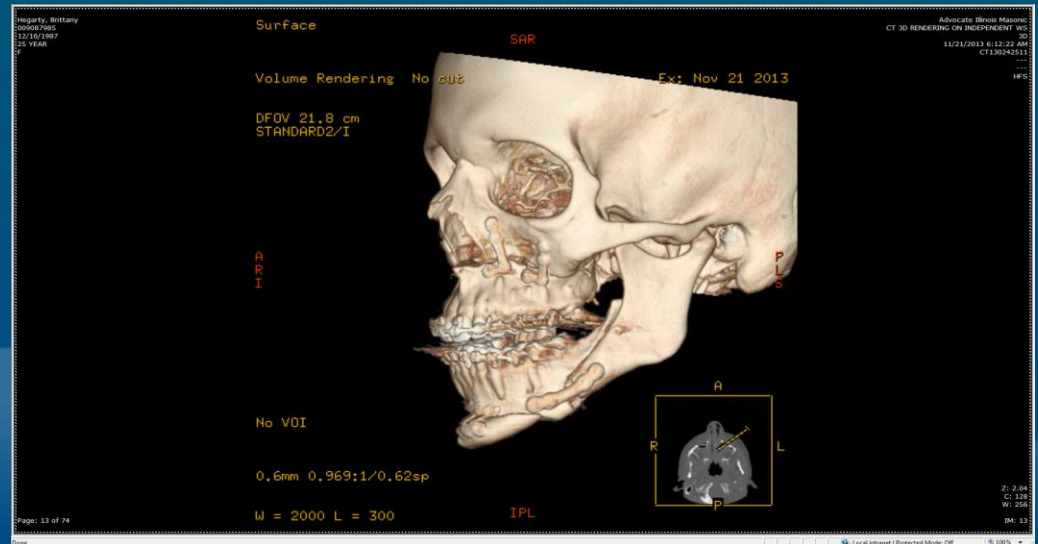
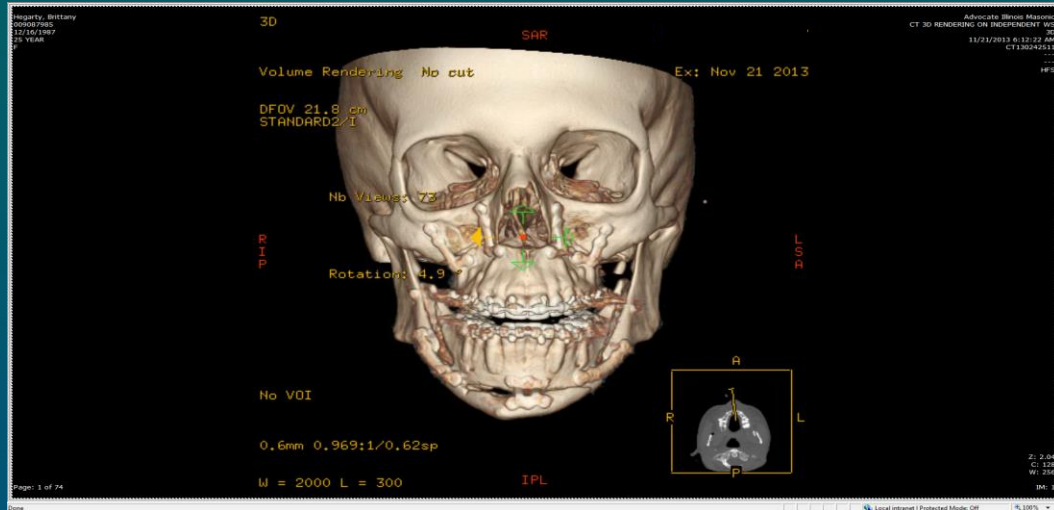


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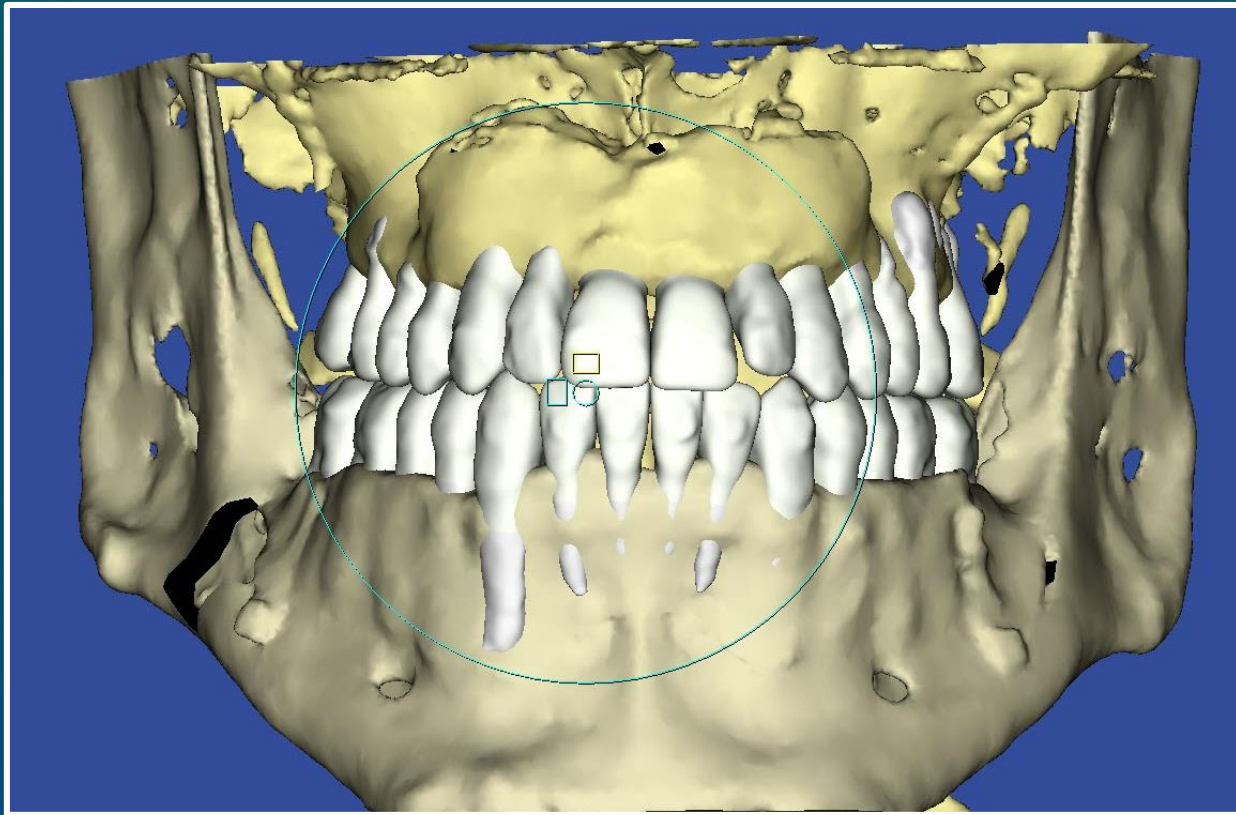
Benefits of iCat FLX

Post – surgical assessment



Benefits of iCat FLX

Identify the exact amount of bone covering the teeth, to diagnose the extend of periodontal breakdown



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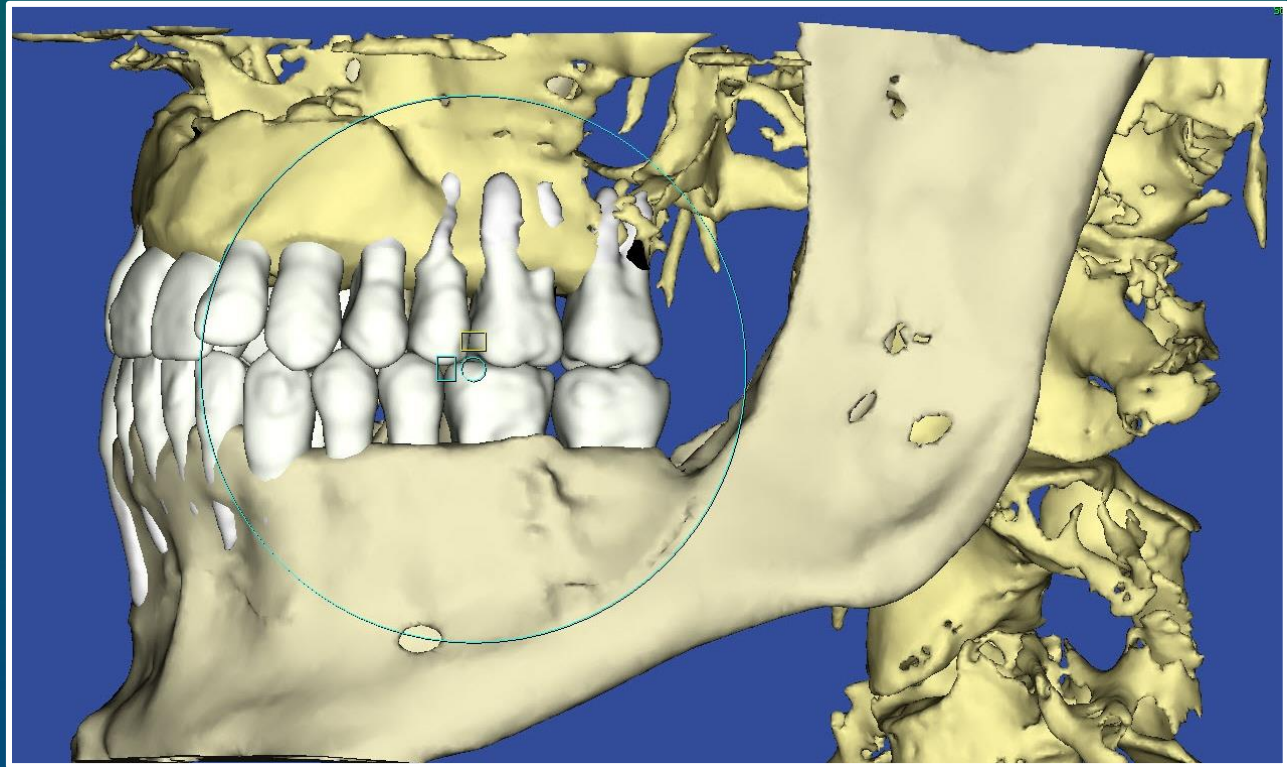


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Benefits of iCat FLX

Identify the exact amount of bone covering the teeth, to diagnose the extend of periodontal breakdown



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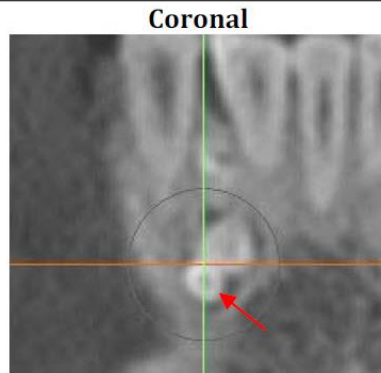
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Benefits of iCat FLX

Identify Dental tumors

IMPRESSIONS:

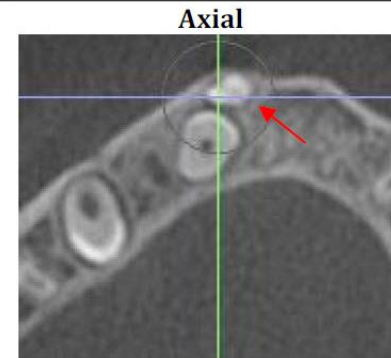
- There is a compound odontoma noted in the right mandible. Radiographically it appears to be delaying the eruption of tooth # 27. It is located to the facial mesial aspect of the mandible. (please see description above and images below).



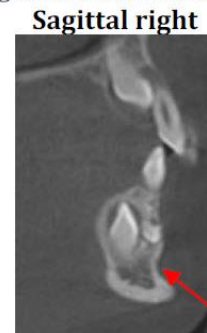
Right anterior mandible



Compound odontoma and primary canine #R



Right anterior mandible



Delayed eruption tooth #27 and compound odontoma

What does the research say?

Accuracy of cone-beam computed tomography imaging of the temporomandibular joint: Comparisons with panoramic radiology and linear tomography

Oana Bida Honey,^a William Charles Scarfe,^b Michael J. Hilgers,^c Kathleen Klueber,^d Anibal M. Silveira,^e Bruce S. Haskell,^f and Allan G. Farman^g

Louisville, Ky

Introduction: Cone-beam computed tomography (CBCT) is increasingly being used as an imaging modality, particularly in the assessment of the temporomandibular joint (TMJ). A blinded observational cross-sectional in-vitro study was conducted to compare the diagnostic accuracy of observers viewing images made with CBCT, panoramic radiography, and linear tomography. The task was to detect cortical erosions affecting the mandibular condylar head. **Methods:** The sample consisted of 37 TMJ articulations from 30 skulls with either normal condylar morphology ($n = 19$) or erosion of the lateral pole ($n = 18$). The articulations were imaged by using corrected angle linear tomography (TOMO), normal (Pan-N) and TMJ-specific (Pan-TM) panoramic radiography, and CBCT. Digital images were obtained with photostimulable phosphor plates for all modalities except CBCT. The CBCT detector used an amorphous silicon flat-panel array combined with cesium iodide. Images and 10 rereads were presented to 10 observers on a flat-panel display at a pixel-to-monitor ratio of 1:1. CBCT multi-planar images were presented both statically (CBCT-S) and interactively (CBCT-I). The observers were permitted to scroll through axial (0.4 mm) and para-sagittal (1 mm) sections and then independently rate their confidence about the presence or absence of cortical erosion. Intraobserver reliability was determined by weighted kappa and diagnostic accuracy by the fitted area under the ROC curve. Means were compared by using ANOVA ($P \leq .05$). **Results:** Intraobserver reliability was moderate (0.57 ± 0.22 ; range, 0.34-0.78). Pan-N (0.72 ± 0.15), CBCT-I (0.65 ± 0.21), and CBCT-S (0.65 ± 0.17) reliability was significantly greater than TOMO (0.44 ± 0.25). The diagnostic accuracy of CBCT-I (0.95 ± 0.05) and CBCT-S (0.77 ± 0.17) was significantly greater than all other modalities (Pan-N [0.64 ± 0.11], Pan-TM [0.55 ± 0.11], TOMO [0.58 ± 0.15]). CBCT-I was also more accurate than CBCT-S, and Pan-N was more accurate than Pan-TM and TOMO. **Conclusions:** CBCT images provide superior reliability and greater accuracy than TOMO and TMJ panoramic projections in the detection of condylar cortical erosion. (Am J Orthod Dentofacial Orthop 2007;132:429-38)

What does the research say?

Introduction: The introduction of cone-beam computed tomography (CBCT) in dentomaxillofacial radiology has created new diagnostic challenges, including some potential opportunities for evaluating impacted teeth. The diagnostic accuracy for detection of simulated canine-induced external root resorption lesions in maxillary lateral incisors was compared between conventional 2-dimensional panoramic radiographic imaging and two 3-dimensional CBCT systems. **Methods:** A child cadaver skull in the early mixed dentition was obtained from the Department of Anatomy, Hasselt University, Diepenbeek, Belgium, with ethical approval. This skull had an impacted maxillary left canine and allowed a reliable simulation. Simulated root resorption cavities were created in 8 extracted maxillary left lateral incisors by the second author.

Ali Alqerban,^a Reinhilde Jacobs,^b Paulo Couto Souza,^c and Guy Willems^d
Leuven, Belgium

Three sets of radiographs were taken: a panoramic radiograph (Soredex, Malmö, Sweden), a Cranex cone (Soredex, Helsinki, Finland), Accuitomo-XYZ Slice View radiograph (J. Morita, Kyoto, Japan), and Scanora 3D CBCT (Soredex, Tuusula, Finland) for each tooth setup. Eight observers examined the 3 sets of 10 radiographs for resorption cavities. **Results:** The differences in correct detection of simulated root resorption for all cavity sizes were significantly different ($P < 0.05$) between the panoramic and both CBCT systems. CBCT imaging performance was significantly better than that of panoramic radiography for determining root resorption in the categories of slight and severe resorption.

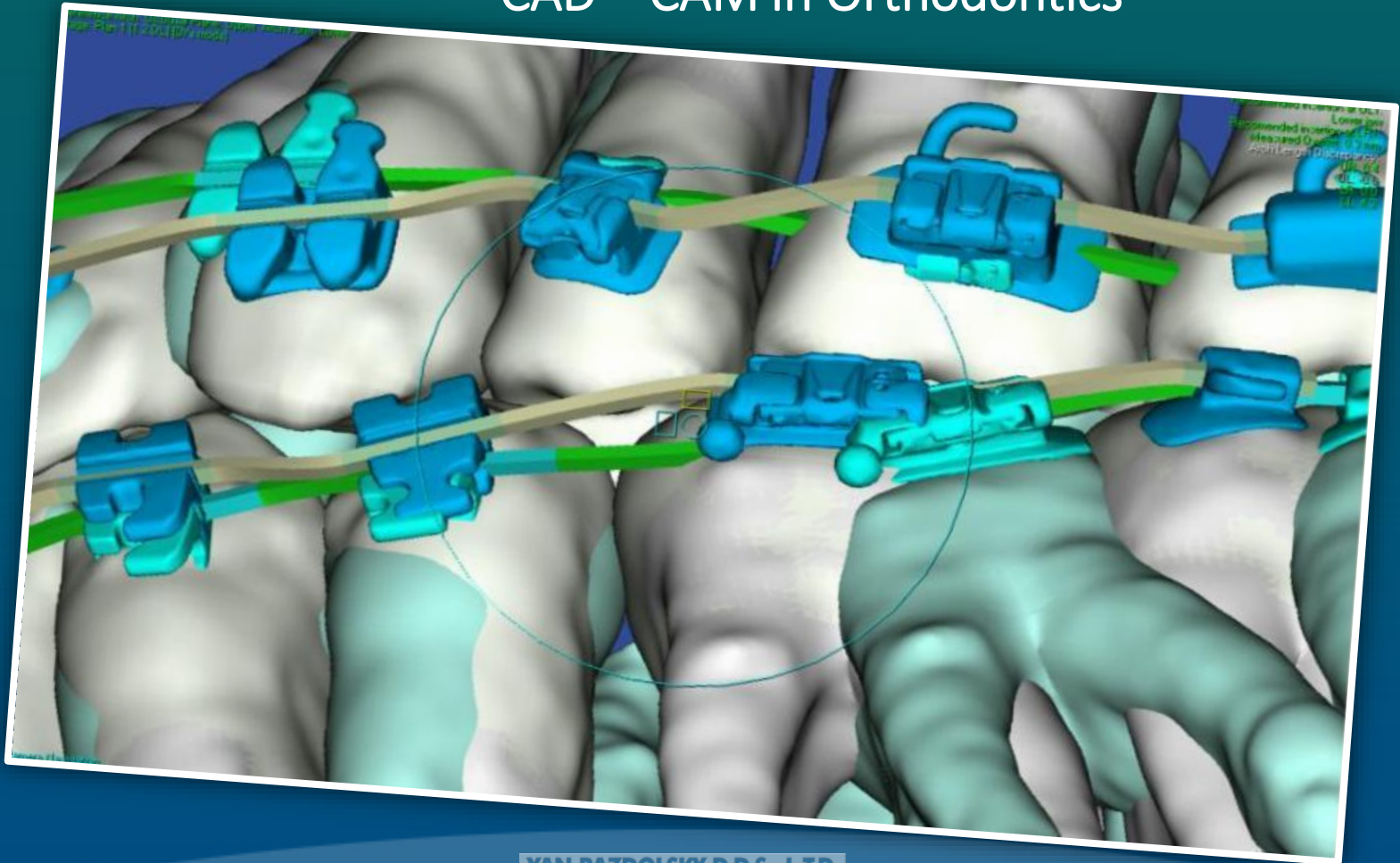
Conclusions: These results suggest that the CBCT radiographic method is more sensitive than conventional radiography to detect simulated external root resorption cavities. (Am J Orthod Dentofacial Orthop 2009;136:764.e1-764.e11)

Q5: What is Suresmile and what are the benefits of this latest technology? How does it relate to i-CAT FLX 3-D Cone Beam CT?

- Think of **CAD/CAM** the engineers' use. Instead of **trying to eyeball** the adjustments in the mouth we use **i-CAT FLX 3-D to visualize the tooth movements needed**. Once **virtual set up** is produced Orametrix (Suresmile) corporation manufactures **custom made robotic flexible memory wires** for us to move the teeth into their final destination. The result:
 - **29% Reduction in Treatment Time**
 - **Fewer office visits**
 - **Less discomfort**
 - **High quality results**

Suresmile

CAD – CAM in Orthodontics

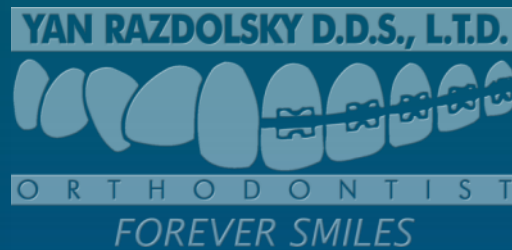


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Lingual / Suresmile – prior to treatment

Case Study Lingual / Suresmile



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Case Study Lingual / Suresmile

Suresmile Upper Lingual treatment

The screenshot displays the Suresmile 5.7 software interface. The main window shows a 3D model of the upper teeth with lingual retainers. An orange arrow points to the retainers. The interface includes a patient photo, a panoramic X-ray, and a quality control panel. The quality control panel shows a table of occlusal penetrations and a total score of 37.

Quality	Discrepancy Index
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
12	12
13	13
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35	35
36	36
37	37

Current Sum: 6 Penetrations: 10 Standard: 14 Suresmile: 13 Total: 37

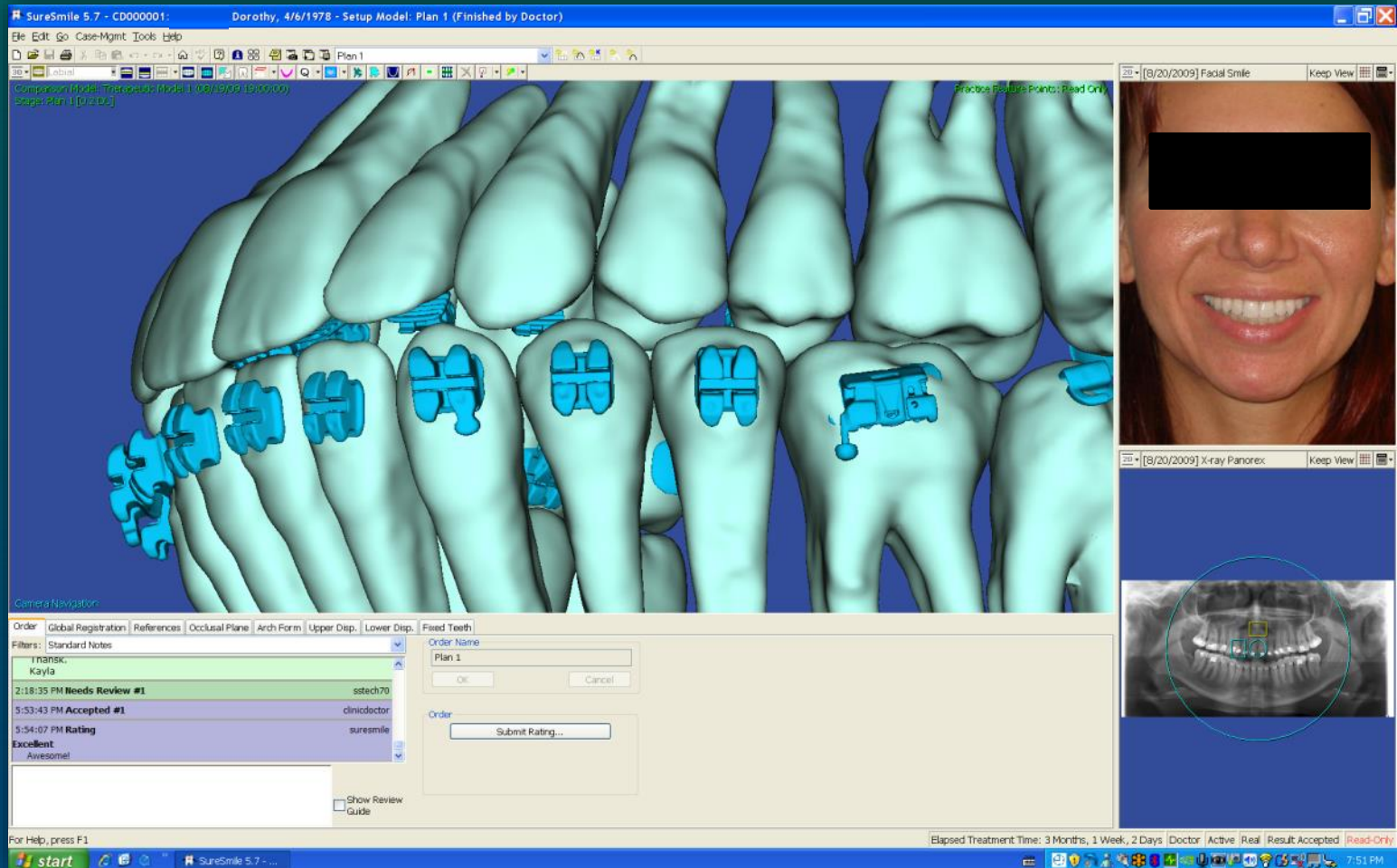
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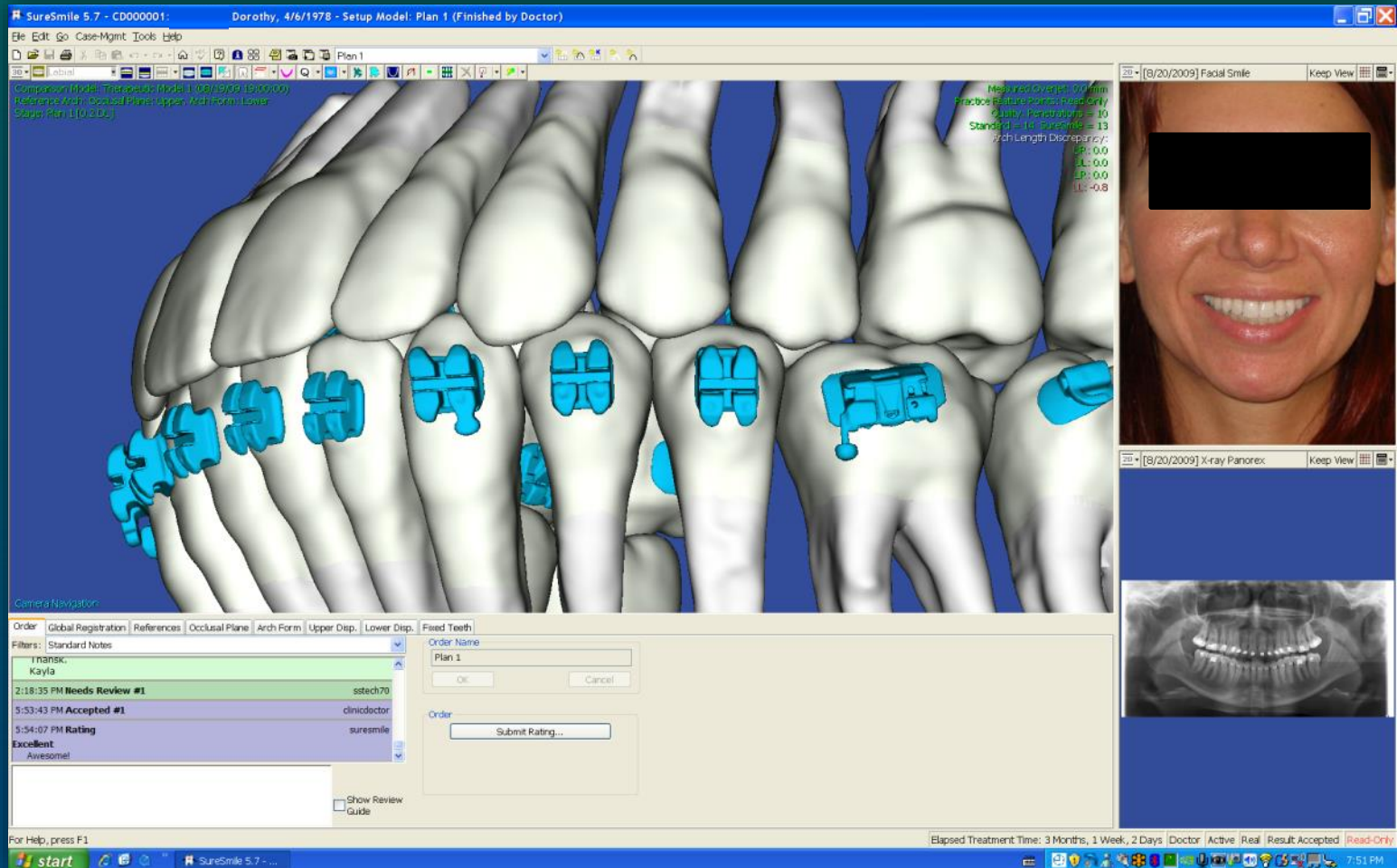
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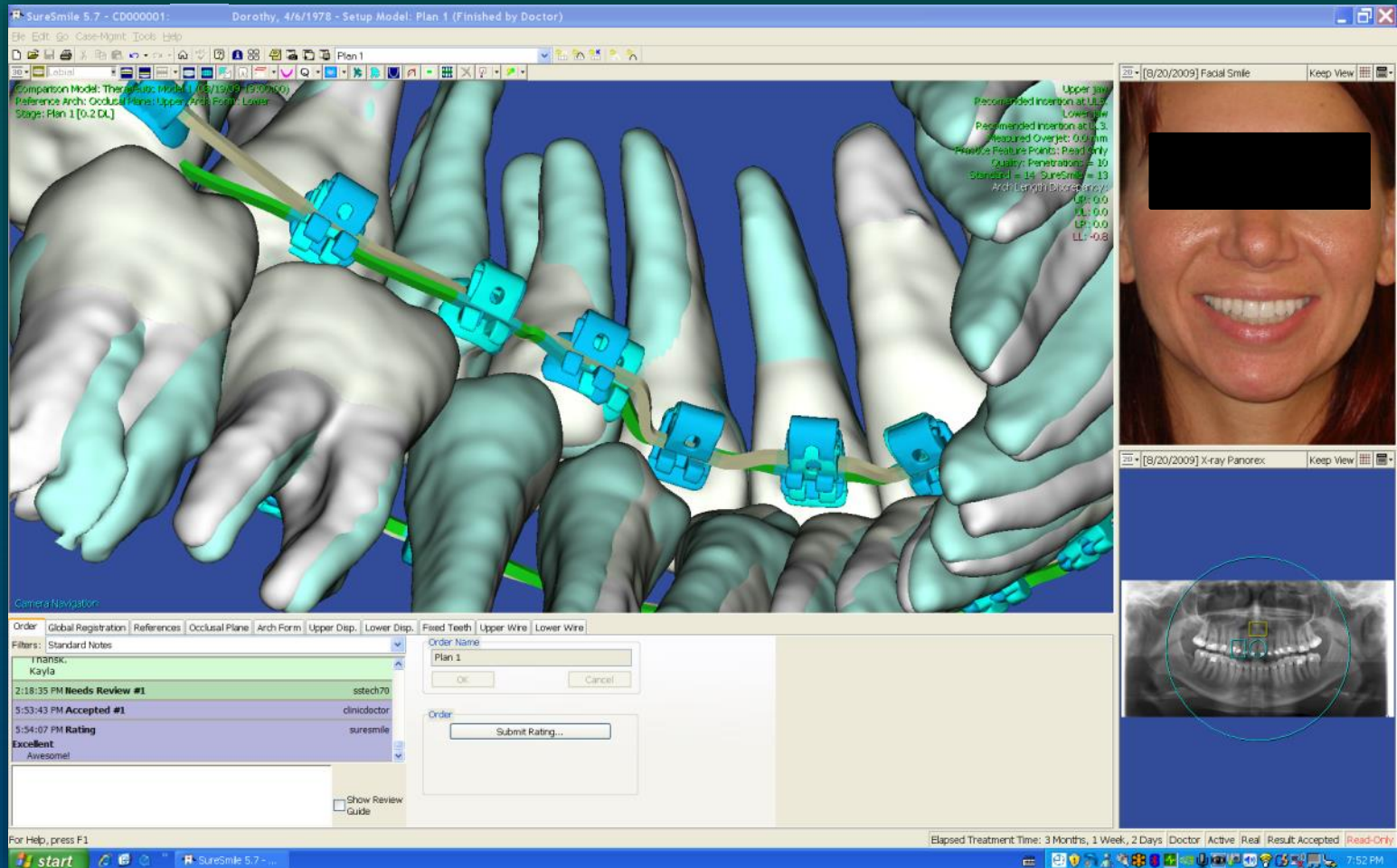
Case Study Lingual / Suresmile



Case Study Lingual / Suresmile



Case Study Lingual / Suresmile



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Case Study Lingual / Suresmile- Final



Case Study Congenitally missing teeth



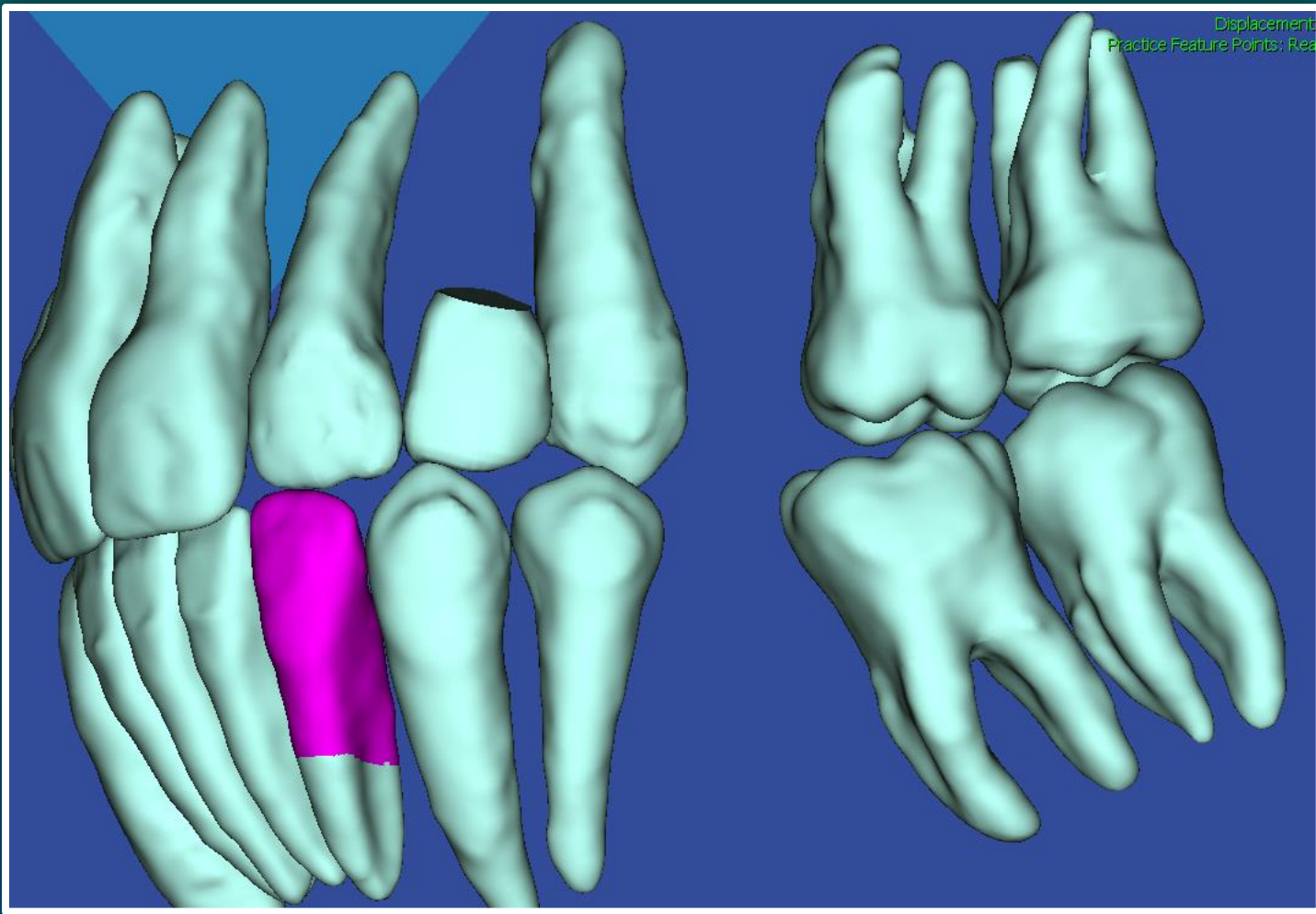
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Case Study Congenitally missing teeth



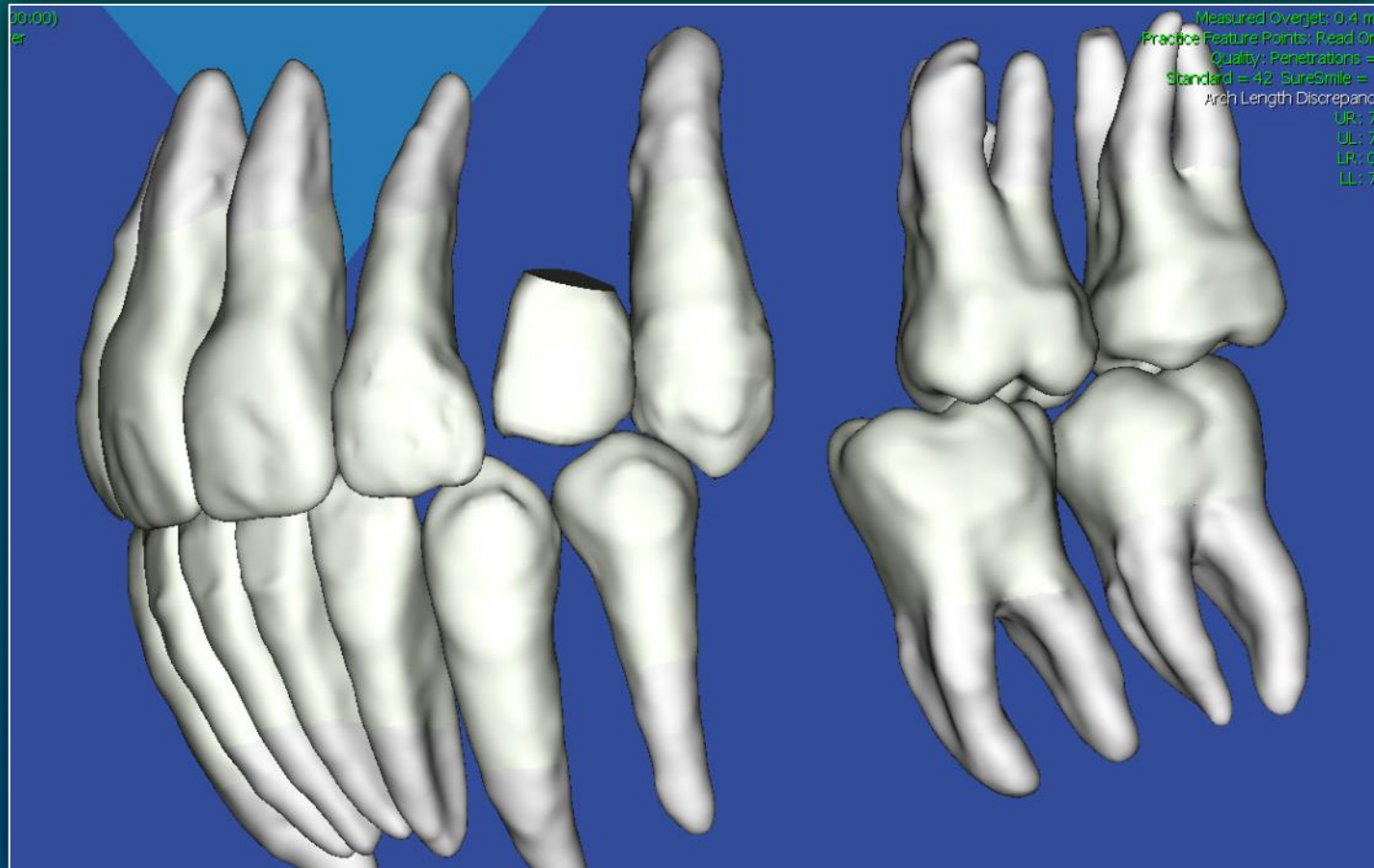
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Case Study Congenitally missing teeth



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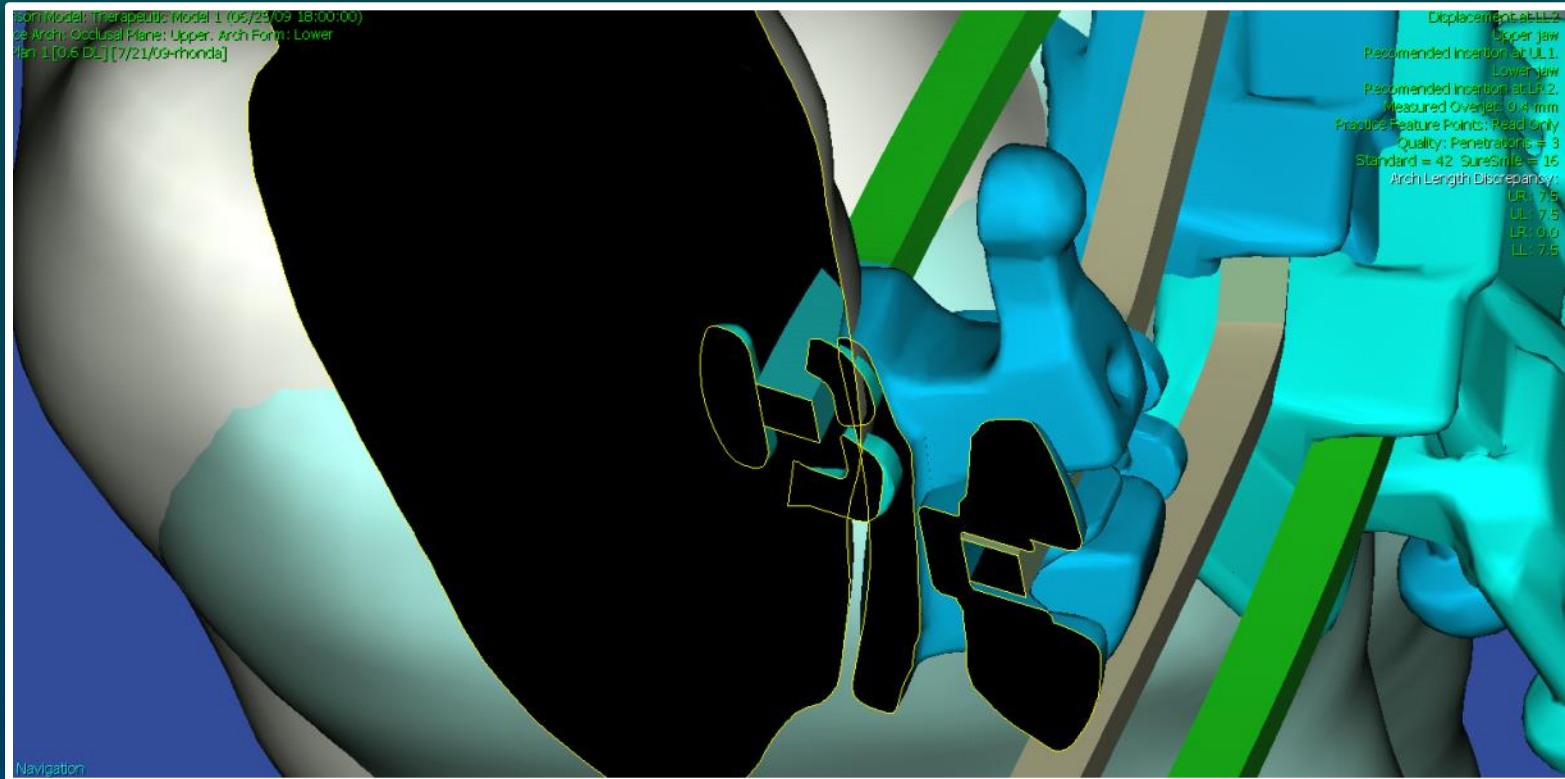
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**Root alignment in
preparation for
implants**

Case Study Congenitally missing teeth

Designing the Robotic wires



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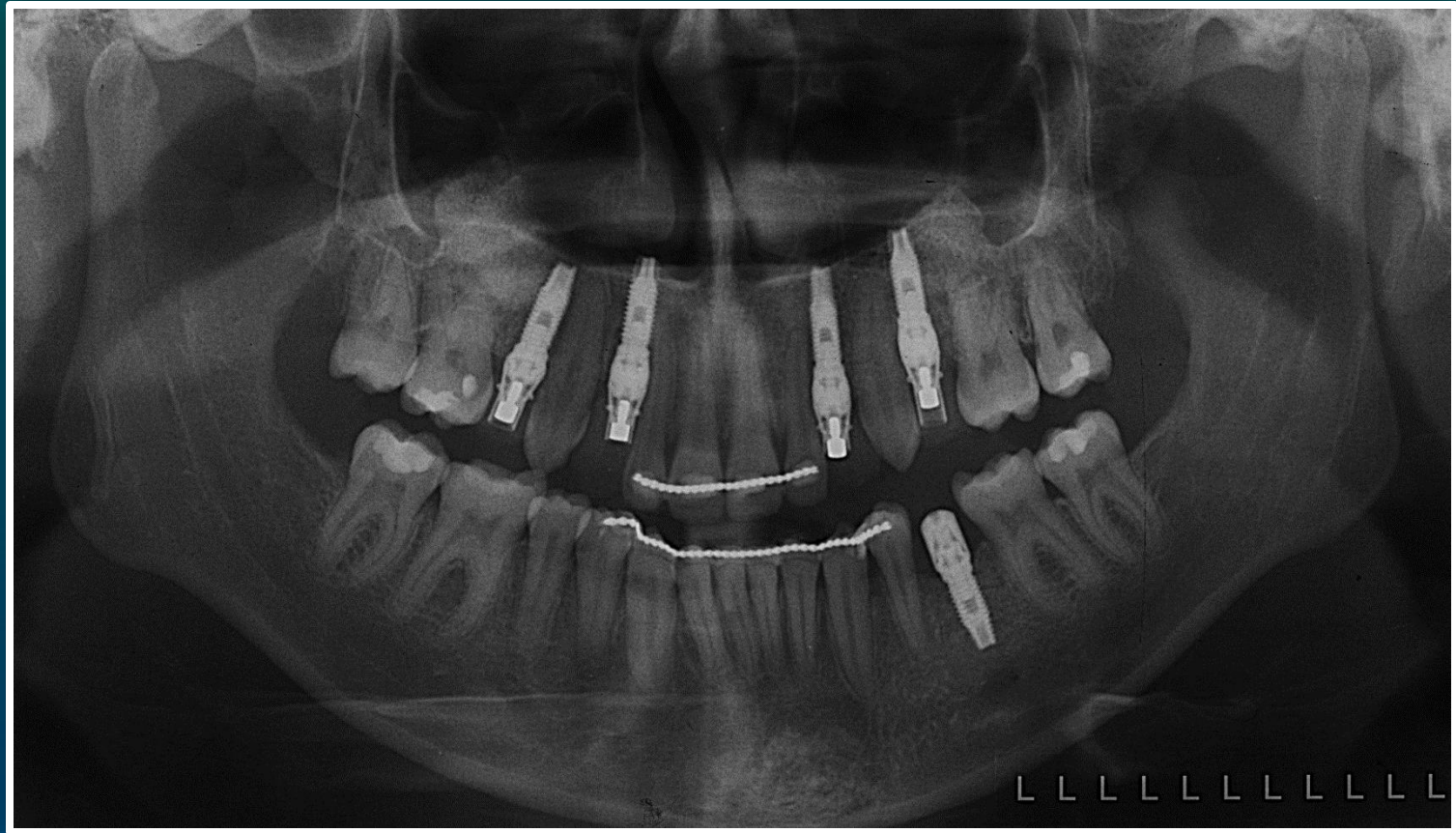


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Case Study Congenitally missing teeth

Implants in place



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Q4: Are other orthodontists carrying this machine?

- I am only aware of one more orthodontist (I do not know his name) in Illinois who has **i-CAT FLX**