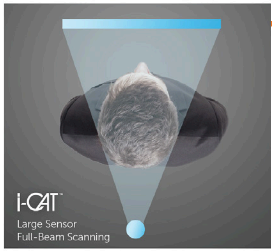
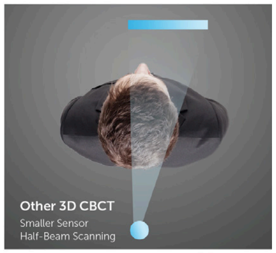
Not all 3D imaging is created equal - They Are Right

LET THE EVIDENCE SPEAK FOR ITSELF



NO OFFSET SCANNING

With our PureScan™ technology and full-size sensor, i-CAT FLX V-Series scanners capture a 3D scan without compromising image quality. This full-beam scanning maximizes the use of the large sensor to provide more anatomical information at a higher quality compared to other smaller sensors.



Unlike the i-CAT FLX V-Series, some 3D CBCT imaging machines use a smaller sensor, which only capture half of the volume at a time requiring images to be stitched together. Offset or half-beam scanning allows a smaller sensor to shift and scan a slightly larger volume than its size, although the cost associated is the sacrifice of image quality and anatomical accuracy.

Excerpt from "iCAT™ FLX V-SERIES" brochure.
https://p.widencdn.net/kqedba/IC-0129_i-CAT_FLX_V-Series_Brochure

1. DEFINITION OF IMAGING STITCHING BY A RADIOLOGIST*

"Traditionally, "stitching" means that one or more smaller CBCT volumes are first acquired and then, as a separate procedure on the computer, the software will "stitch" or join together the smaller volumes to derive a single larger volume. All CBCT machines including the i-CAT devices acquire numerous single frames and the single frames are combined automatically by the software to create the volume (stitching). **The iCAT use of the term "stitching" is not consistent with the use of this term in common radiological practice."**

*Dr. Robert Langlais BA,DDS, MS, PhD and Board Certified Oral & Maxillofacial Radiologist.

TAKEAWAY

All CBCT images are stitched volumes. Since non-offset (symmetric) and offset (asymmetric) scans use the exact same Feldkamp (FDK) based back projection algorithm for reconstruction(2), then by iCAT's own correlation, all scans, whether symmetric or asymmetric, would be "stitched" including theirs. It can be inferred that iCAT's message mistakenly associated asymmetric scanning with "stitching" which are two completely separate concepts. "Stitching" is an accepted standard used in all medical imaging(1) when taking larger FOVs due to detector size limitations.

2. SCANNING METHODOLOGY - SYMMETRICAL VS ASYMMETRICAL (OFFSET)

According to iCAT's message, asymmetric scanning is associated with the sacrifice in image quality and anatomical accuracy. This is not the case with Planmeca's 3D technology.

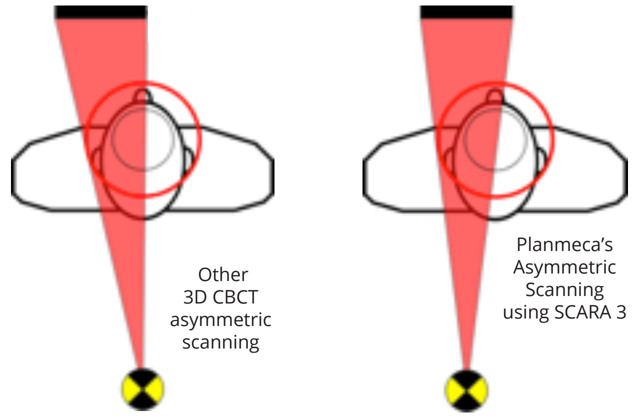
Asymmetric scanning has many benefits both to users and to patients. Asymmetric scanning allows for the use of smaller flat panel detectors, therefore reducing cost and overall footprint of the x-ray device. Asymmetric scanning also has the statistically proven benefit to significantly reduce radiation to the patient over symmetric scanning. (4)

In addition, our proprietary Planmeca CALM™ (corrective algorithm for latent movement) minimizes artifacts associated with patient movement during scanning, addressing the #1 disruptor in quality image scanning. Planmeca CALM™ is an industry first.

3. REDUCTION IN IMAGE QUALITY: CLINICAL EVIDENCE DEMONSTRATES OTHERWISE

Although there are no existing studies that directly test the image quality of a symmetric scan against an asymmetric (offset) scan, the study "Dosimetry of Orthodontic Diagnosis FOVs Using Low Dose CBCT protocol" by JB Ludlow and J Koivisto, found that **Planmeca's Ultra-Low Dose®** achieved a **SIGNIFICANT reduction in radiation with "no statistical reduction in image quality"**. This study utilized Planmeca's asymmetric scanning for the large FOVs in the study. Therefore, it could be inferred that the quality of a Planmeca asymmetric scan has no statistical reduction in image quality, even when using the lowest doses to follow the ALADA principle (As Low As Diagnostically Acceptable).

Planmeca, due to its revolutionary triple jointed robotic arm technology (SCARA 3), can do asymmetric scanning by shifting over the sensor and the tube head together, allowing the object of interest being scanned to be center of the radiation beam and center of the detector, maintaining the quality and integrity of the scan. This is another industry first for Planmeca.



*"i-CAT manufacturer suggests that the manner in which Planmeca CBCT machines acquire the 3-D scan is "associated with the sacrifice of image quality and anatomical accuracy" is exactly the opposite of the truth. Dr. Ludlow(3) also tested the ICAT FLX and also found a significant reduction in radiation, but it was associated with a SIGNIFICANT LOSS in image quality. Therefore, **the iCAT claims presented above are not reflected in the available literature on the topic.**"*

*Dr. Robert Langlais BA,DDS, MS, PhD and Board Certified Oral & Maxillofacial Radiologist.

Clinical Evidence / References

1. **ACCURACY AND RELIABILITY OF STITCHED CONE-BEAM COMPUTED TOMOGRAPHY IMAGES**

Nicholas Egbert, David R. Cagna, Swati Ahuja, and Russell A. Wicks

Imaging Sci Dent. 2015 Mar; 45(1): 41–47.
Published online 2015 Mar 13. doi: 10.5624/isd.2015.45.1.41

PMCID: PMC4362990
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4362990/

RESULTS

The anatomic linear dimension measurements and stitched small FOV CBCT measurements were statistically evaluated for linear accuracy. The mean difference between the anatomic linear dimension measurements and the stitched small FOV CBCT measurements was found to be 0.34 mm with a 95% confidence interval of +0.24 - +0.44 mm and a mean standard deviation of 0.30 mm. The difference between the control and the stitched small FOV CBCT measurements was insignificant within the parameters defined by this study.

2. **WHAT IS CONE-BEAM CT AND HOW DOES IT WORK**

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http://www.perfendo.org/docs/CBCT/CBCThowdoesitworkScarfeetal2008.pdf

The number of images comprising the projection data throughout the scan is determined by the frame rate (number of images acquired per second), the completeness of the trajectory arc, and the speed of the rotation. The number of projection scans comprising a single scan may be fixed (eg, NewTom 3G, Iluma, Galileos, or Promax 3D) or variable (eg, i-CAT, PreXion 3D). More projection data provide more information to reconstruct the image; allow for greater spatial and contrast resolution; increase the signal-to-noise ratio, producing “smoother” images; and reduce metallic artifacts.

3. **DOSIMETRY OF ORTHODONTIC DIAGNOSTIC FOVS USING LOW DOSE CBCT PROTOCOL**

JB Ludlowa, J Koivistob a. University of North Carolina-Chapel Hill, School of Den0stry, Chapel Hill, North Carolina, b. University of Helsinki, Department of Physics, Helsinki, Finland

“Effective doses resul.ng from combinations of field size and exposure parameters that might be used for orthodontic diagnosis tasks were acquired using a Planmeca ProMax® 3D Mid CBCT unit (Planmeca Oy, Finland). Specifically doses for a protocol involving reduced exposure and proprietary reconstruction called “ultra low dose” (ULD) was compared with standard exposures.”

“An average reduction in dose of 77% was achieved using ULD protocols when compared with standard protocols. While this dose reduction was significant, no statistical reduction in image quality between ULD and standard protocols was seen. This would suggest that patient doses can be reduced without loss of diagnostic quality.”

4. **REDUCED EXPOSURE USING ASYMMETRIC CONE BEAM PROCESSING FOR WIDE AREA DETECTOR CARDIAC CT**

Arash Bedayat, Frank J. Rybicki, Kanako Kumamaru, Sara L. Powers, Jason Signorelli, Michael L. Steigner, Chloe Steveson, Shigeyoshi Soga, Kimberly Adams, Dimitrios Mitsouras, Melvin Clouse, and Richard T. Mather

Int J Cardiovasc Imaging. Author manuscript; available in PMC 2013 Feb 1.
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Published online 2011 Feb 19. doi: 10.1007/s10554-011-9814-5

PMCID: PMC3111872
NIHMSID: NIHMS276225
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3111872/

“In summary, an asymmetric reconstruction algorithm implemented into wide area detector CT has an approximate 20–25% reduction in exposure when compared to the symmetric algorithm currently in practice. Early clinical experience with the asymmetric approach gives a dose reduction with no degradation in image quality and supports its routine use.”