COULD PHOTON-COUNTING COMPUTED TOMOGRAPHY BE A NOVEL IMAGING MODALITY FOR CHALLENGING ENDODONTIC DIAGNOSIS?

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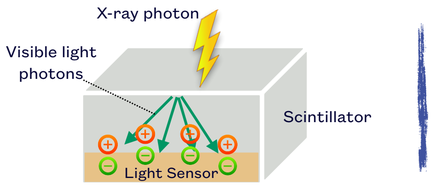
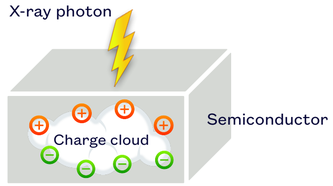
Conventional detector



Indirect conversion to electrical signal

Photon-counting detector

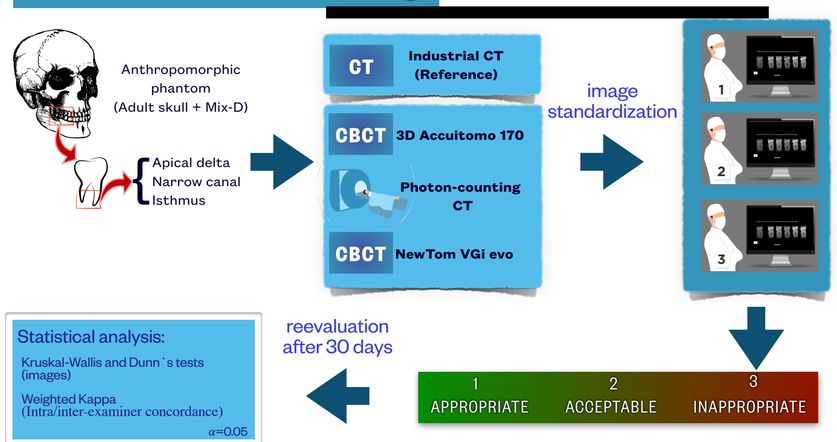


Direct conversion to electrical signal

OBJECTIVE

To assess the diagnostic ability of photon-counting computed tomography (PCCT) in comparison to two cone-beam computed tomographic (CBCT) devices with industrial CT acting as a reference for challenging endodontic diagnostic tasks.

MATERIALS AND METHODS



Statistical analysis:
Kruskal-Wallis and Dunn`s tests (images)
Weighted Kappa (Intra/inter-examiner concordance)
α=0.05

Table 1. Scanning parameters and effective dose for adults of the imaging devices tested according to the different protocols

Imaging devices	Protocol	Voxel (mm)	FOV (cm)	Tube voltage (kV)	Exposure time * tube current (mAs)	Effective dose (mSv) adults
3D Accuitomo 170	Standard	125	8 x 8	90	154	0.13
3D Accuitomo 170	High-resolution	0.08	4 X 4	90	154	0.04
NewTom VGi evo	Standard	125	8 x 8	110	20.96	0.03
NewTom VGi evo	High-resolution	0.10	5 x 5	110	24.96	0.01
Photon-Counting CT	Not applicable	0.20	8 x 8	120	64	0.85

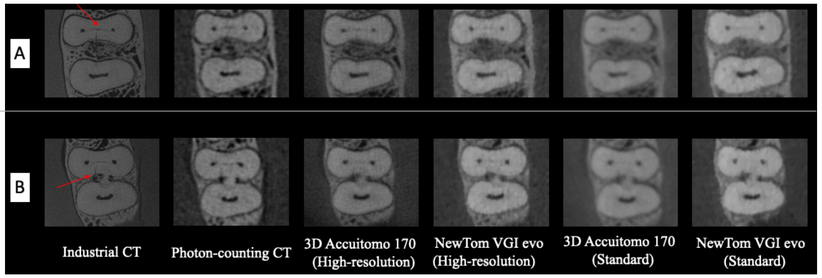


Figure 1. Cropped images representing the assessment of isthmus (A) and cracks (B) for all devices and protocols tested. The examiners were blinded for the device, but not for the task.

RESULTS

Weighted Kappa

	Examiner 1	Examiner 2	Examiner 3
inter-examiner			
Examiner 1	0.91	0.95	0.96
Examiner 2		0.83	0.82
Examiner 3			0.90
intra-examiner			

Table 2. Mode values of visualization assessment of delta, narrow canal, isthmus, and root cracks

			High Resolution (HR)		Standard Resolution (SD)	
Endodontic task	Control	Photon-counting CT	3D Accuitomo 170	NewTom VGI evo	3D Accuitomo 170	NewTom VGI evo
Delta	1*	2-3	1*	3	2	2-3
Narrow canal	1*	1*	1*	2	2	2
Isthmus	1*	1*	1*	1 - 2*	2 - 3	3
Endodontic tasks grouped[1]	1*	1*	1*	2	2	2
Crack	1*	2	1*	3	3	3

* Indicates statistical similarity with the reference industrial CT scan, which is shown as 'Control' (1.0 – appropriate for visualizing the anatomical structures); [1] Indicates the endodontics tasks (delta, narrow canal, and isthmus) grouped.

DISCUSSION

- Innovative
- Experimental
- Promising results

- Extracted teeth x clinical scenario
- Higher effective dose

Although the proposed diagnostic tasks were challenging, the PPCT results obtained in the current study were promising. Our results showed similar performance of the PCCT with the reference image for most diagnostic tasks, except for the cracks. Overall, this good diagnostic performance was only observed for one CBCT device in its high-resolution protocol. PCCT performed somewhat inferior for crack detection, which could be expected due to its larger voxel size as compared to typical crack sizes (< 200 μm).

CONCLUSION

Photon-counting CT and one CBCT HR protocol showed a similar performance to the reference industrial CT for detection of challenging endodontic diagnostic tasks, with this HR CBCT protocol being superior for crack detection as compared to PCCT and other CBCT protocols.

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