

# Dental Imaging in Clinical Photon-Counting CT at a Quarter of DVT Dose

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# Background

- Clinical PCCT systems offer an **increased spatial resolution** in the order of **150  $\mu\text{m}$**  compared to previous generations of CTs.
- This spatial resolution is in the order of dental cone-beam CT/digital volume tomography (DVT) systems.
- However, clinical systems provide several other potential benefits:
  - detectors with a **high dynamic range**
  - **powerful x-ray tubes**
  - higher **absorption efficiency** of the detector material
- With these properties, PCCT systems promise a dose reduction compared to classic energy-integrating systems.
- We want to compare the image quality of a **standard-dose DVT** protocol (Orthophos SL 3D) to a custom **dose-reduced** protocol in a clinical **PCCT** (Naeotom Alpha).

# Imaging Systems

Digital Volume Tomography (DVT)

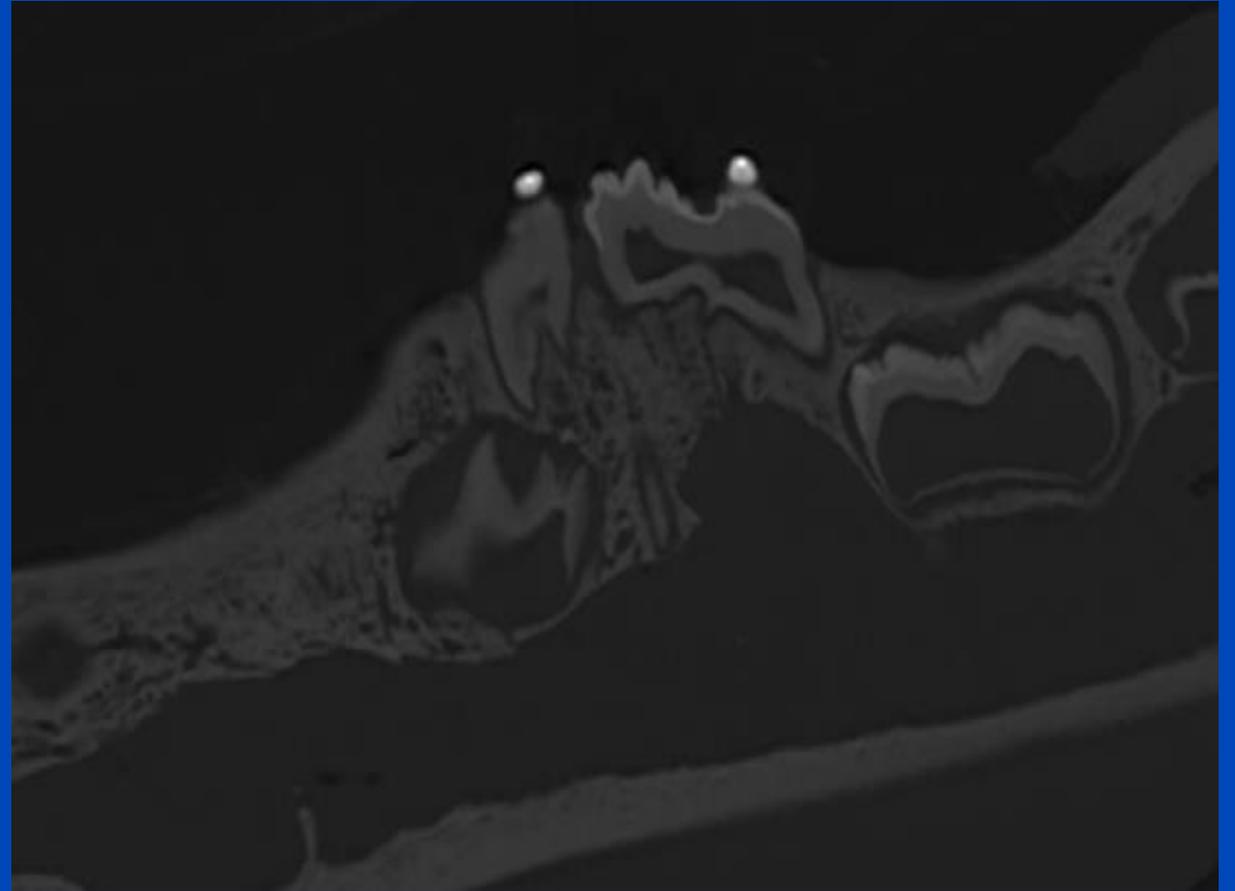


Photon-Counting CT (PCCT)



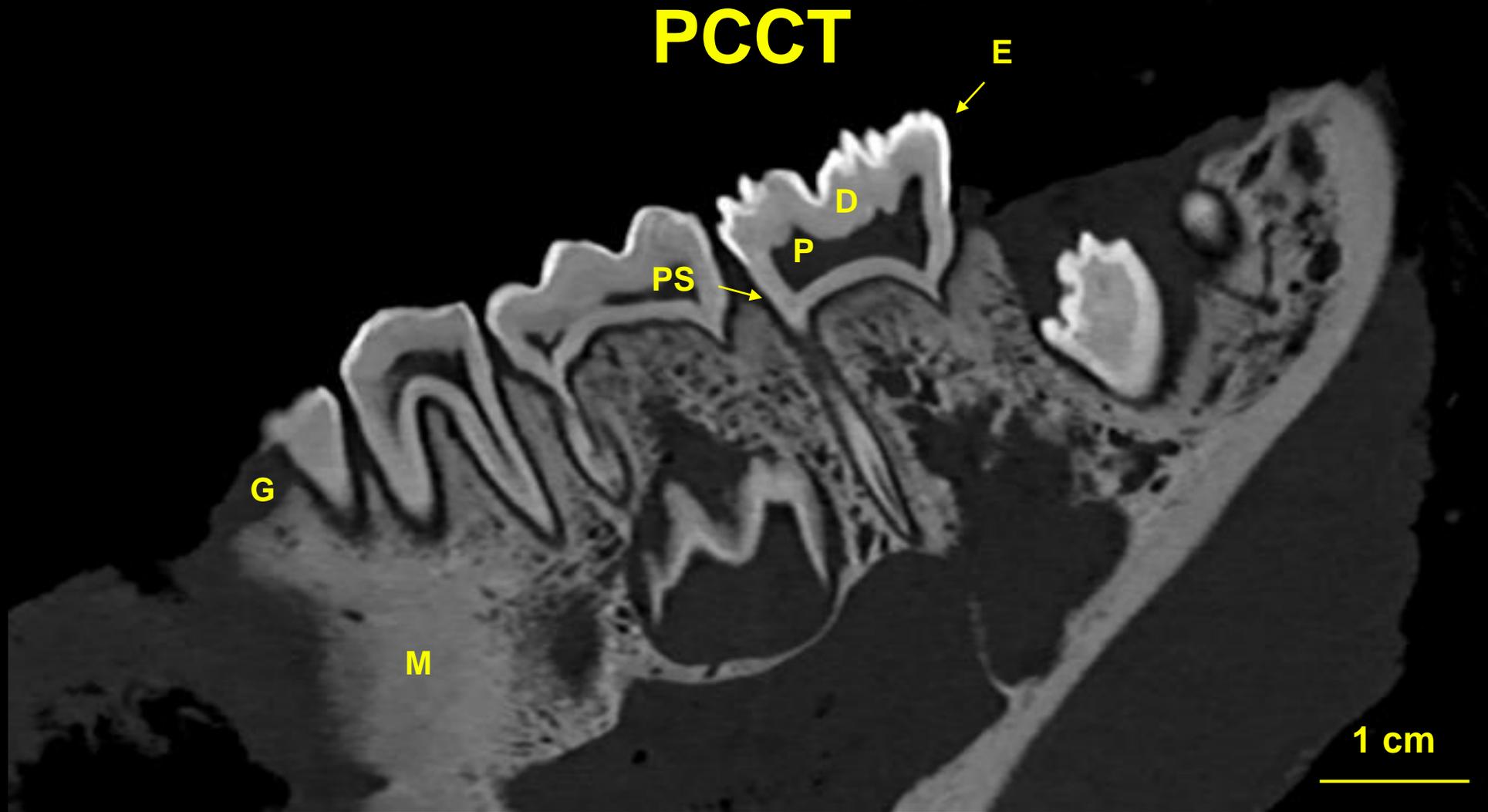
# Sample Preparation

- A total of 10 porcine jaws are used in this study.
- Teeth were free of carious decay and restoration materials.
- The gingiva was intact.
- To allow for registration between DVT and PCCT, radio-opaque markers were attached to all samples.



# Image Acquisition & Reconstruction

- We investigate a **standard-dose** (4 mGy CTDI<sub>16 cm</sub>) protocol at the DVT in comparison to a custom **dose-reduced** (1 mGy) protocol at the PCCT.
- Data were acquired using a tube voltage of **85 kV** in case of the DVT and using **90 kV** in case of the PCCT.
- Image reconstruction was performed with the best available methods at each system:
  - Filtered backprojection (**FBP**) in case of the DVT
  - Quantum Iterative Reconstruction (**QIR3**) for the PCCT
- The spatial resolution of the PCCT was matched to the DVT by using an appropriate reconstruction kernel (Hr72, 15.7 lp/cm MTF<sub>10%</sub>).



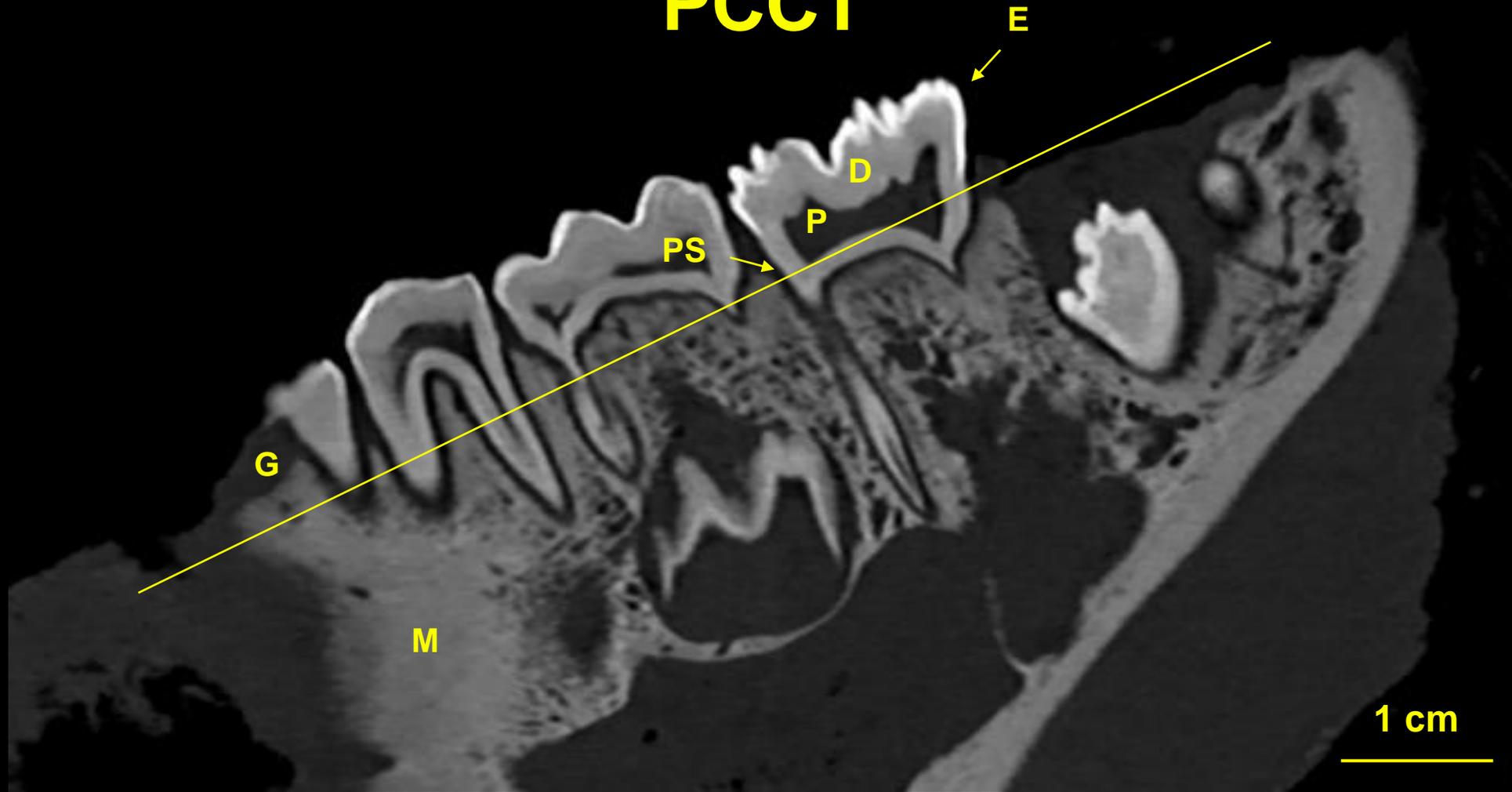
M - mandibula  
P - pulp cavity

D - dentine  
E - enamel

G - gingiva  
PS - peridontal space

C = 900 HU, W = 4200 HU

# PCCT



M - mandibula  
P - pulp cavity

D - dentine  
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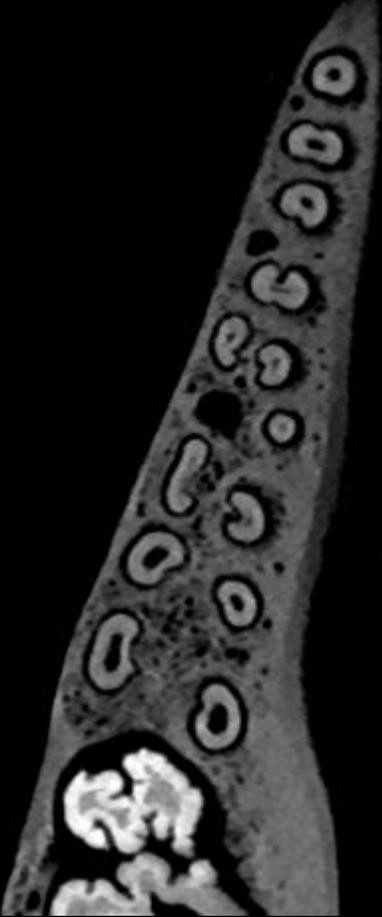
C = 900 HU, W = 4200 HU

# DVT vs. PCCT

DVT (4 mGy)



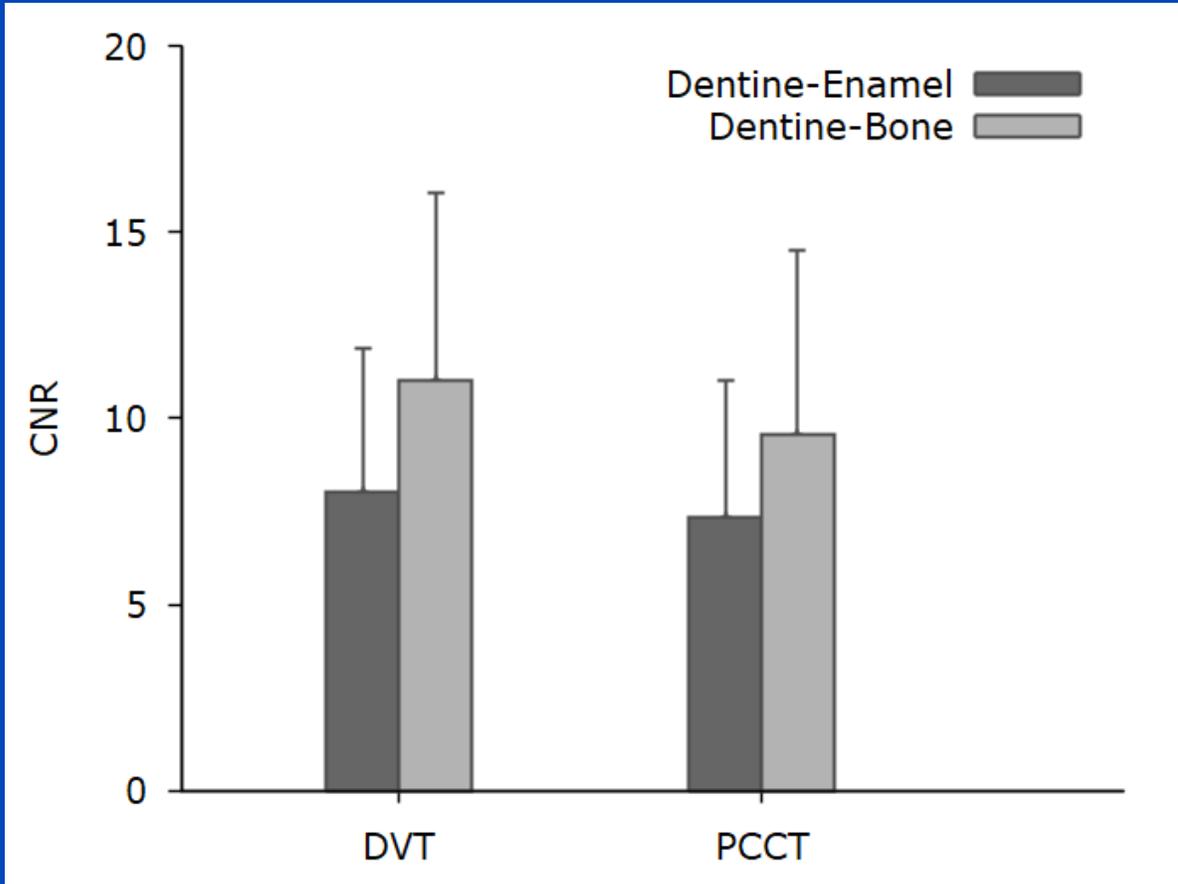
PCCT (1 mGy)



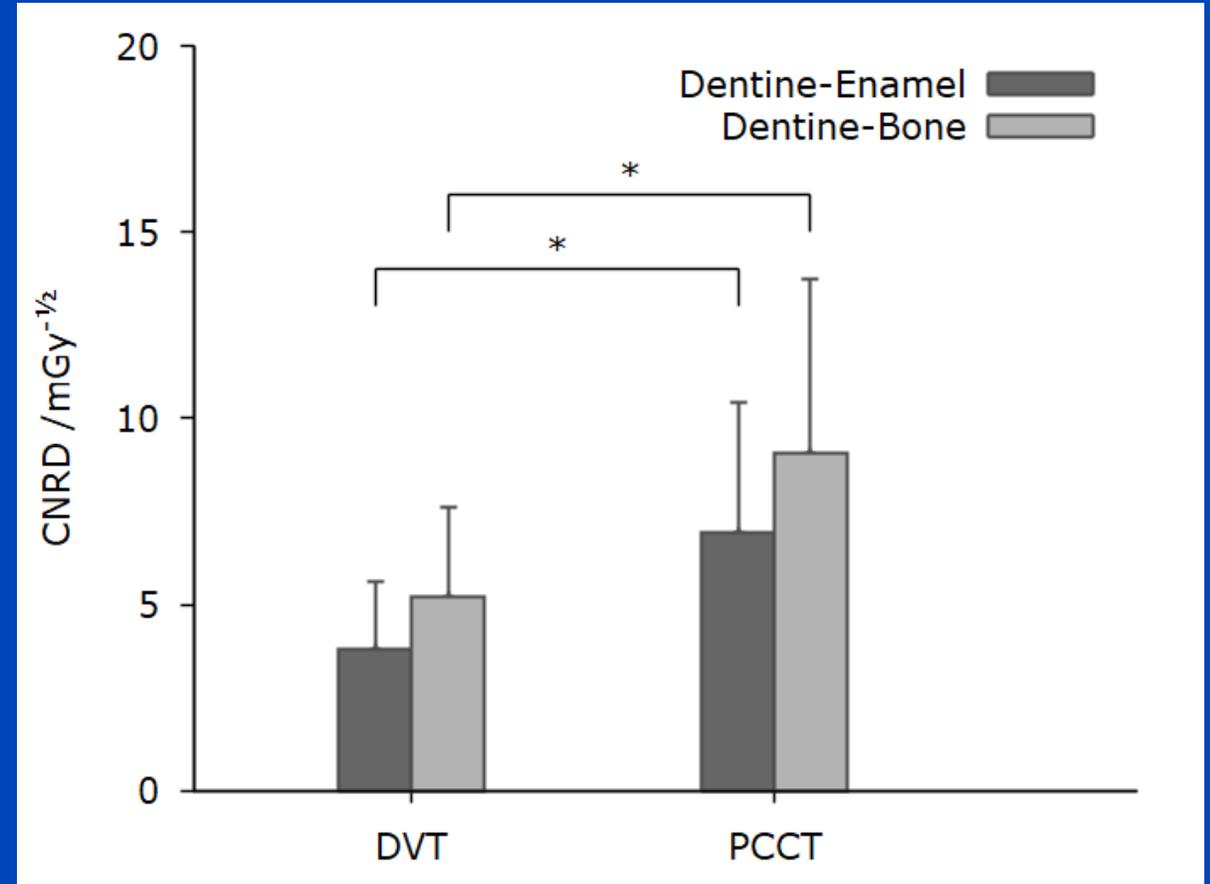
Window/Level settings differ between imaging modalities.

# Quantitative Results

## CNR



## CNRD



# Reader Study

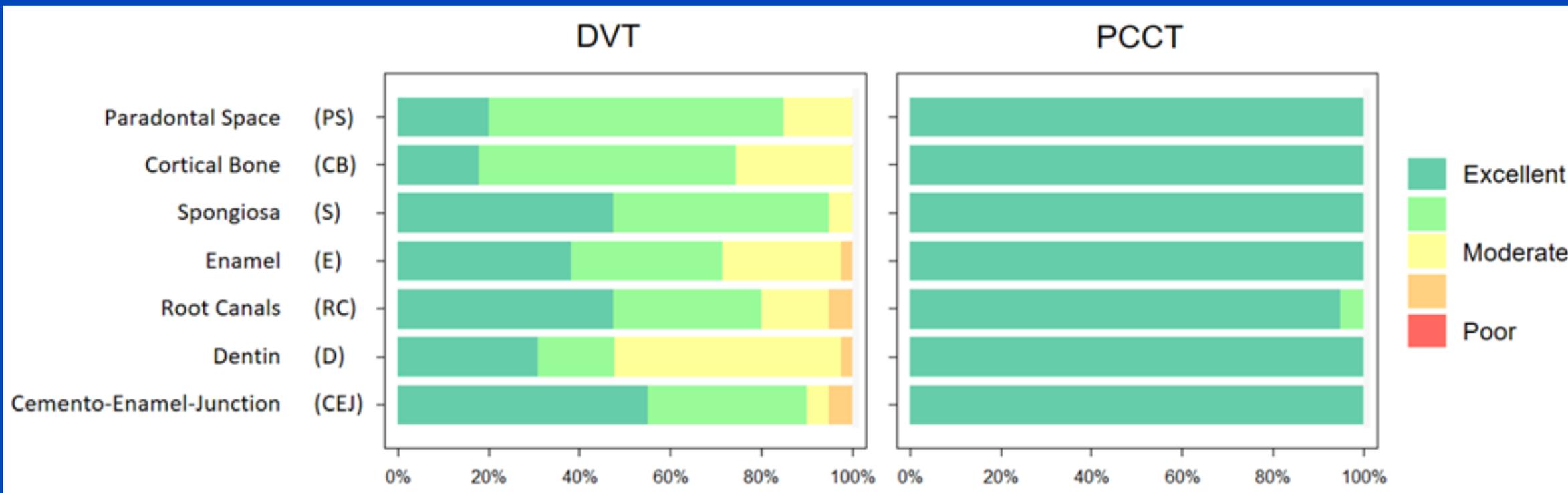


Image quality was assessed by two experienced readers (Gehrig, Rütters).

# Summary & Conclusions

- Clinical PCCT offers an advantage in terms of **image quality** and **radiation dose efficiency** in comparison to conventional DVTs for dental diagnostics.
- This is further aided by **reduced motion artifacts** due to faster scan speeds and a prone position of the patient in clinical systems.
- However, access to PCCTs for dental diagnostics is mostly limited to university hospitals.

# Thank You!

- This presentation will soon be available at [www.dkfz.de/ct](http://www.dkfz.de/ct).
- Job opportunities through DKFZ's international PhD or Postdoctoral Fellowship programs ([marc.kachelriess@dkfz.de](mailto:marc.kachelriess@dkfz.de)).
- Parts of the reconstruction software were provided by RayConStruct<sup>®</sup> GmbH, Nürnberg, Germany.



## The 8<sup>th</sup> International Conference on Image Formation in X-Ray Computed Tomography

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[www.ct-meeting.org](http://www.ct-meeting.org)



Conference Chair

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