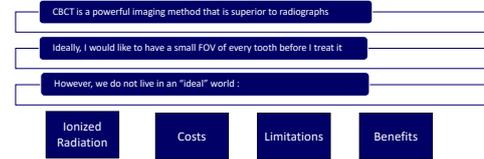




The possibilities and limitations of CBCT

Hagay Shemesh



How much (€) costs a CBCT scan to the patient in a University setting?



Validation & Reliability

• Part 1

Position statements / Guidelines

AAOMR
AAE
ESE
Position statement 2014
Position statement 2019
S3 guidelines 2023

European Society of Endodontology position statement: the use of CBCT in endodontics
S Patel, C Durack, F Abella, M Roig, H Shemesh, P Lambrechts, K Lemberg

IEJ 2014 **Every image must be justified and optimized. A record of the justification process must be maintained**

European Society of Endodontology position statement: Use of cone beam computed tomography in Endodontics
S. Patel, J. Brown, M. Semper, F. Abella, F. Mannocci

IEJ 2019 **Every image is justified, optimized and reported on...CBCT must be used cautiously**

Treatment of pulpal and apical disease: The European Society of Endodontology (ESE) S3-level clinical practice guideline.
Duncan HF, Kirkevang LL, Peters OA, El-Karim I, Krastl G, Del Fabbro M, Chong BS, Galler KM, Segura-Egea JJ, Kebschull M;
ESE Workshop Participants and Methodological Consultant.
IEJ 2023

• CBCT *may be considered* as an additional diagnostic measure in cases where there is doubt about the diagnosis.

Grade of recommendation	Syntax
STRONG	We recommend (not to)
WEAK	We suggest (not to)
OPEN	May be considered



J Am Dent Assoc 2024
 Applying the AAE and American Academy of Oral and Maxillofacial Radiology guidelines for CBCT prescription: Impact on endodontic clinical decisions
 Chugat et al.

Conclusions

- CBCT imaging contributed predominantly to Tx decisions rather than diagnostic determinations.

JADA 2024: Chugal et al.

Int Endod J 2021
 Clinical decision-making and importance of the AAE/AAOMR position statement for CBCT examination in endodontic cases
 M Bhatt et al.

Conclusion

- CBCT examinations were prescribed mainly to assist treatment planning rather than for diagnosis. The majority of CBCT examinations were performed on **previously root filled teeth**. The additional information obtained from CBCT scans resulted in the alteration of the initial diagnoses as well as subsequent treatment plans in 59 out of 128 cases.

IEJ 2021 Bhatt et al.

When do YOU use CBCT?

J Contemp Dent Pract . 2019 CBCT Usage: Survey of American Endodontists
 Alzamzami et al.

- 74.6% use CBCT in their practice for **surgery**, followed by 60.2% in **nonsurgical retreatment**. While 59.1% use CBCT in **initial nonsurgical treatment**, 44% reported that they use CBCT in endodontic recall and 9.2% use CBCT for pediatric patients.

J Contemp Dent Pract. 2019 Alzamzami et al.

- Assessment of CBCT Referral Reasons and the Impact of CBCT Evaluation on Decision Treatment Planning Procedure in Endodontics

JOE 2020: Kakavetos et al.

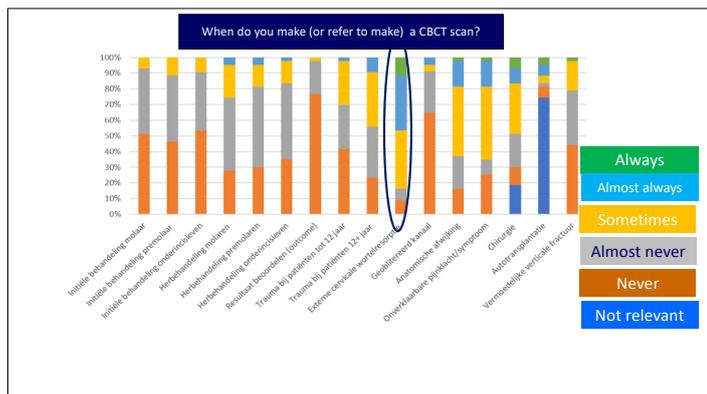
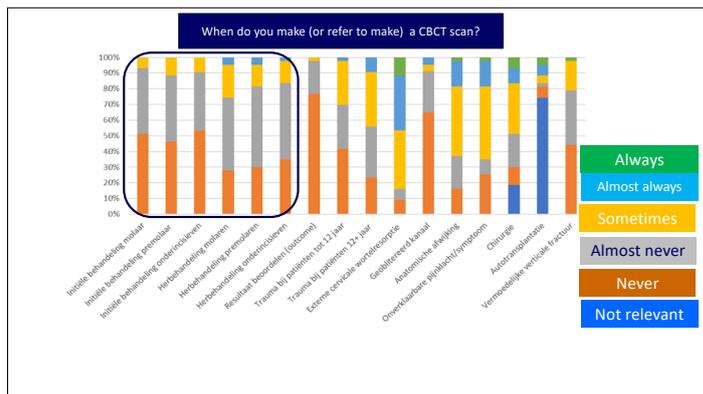
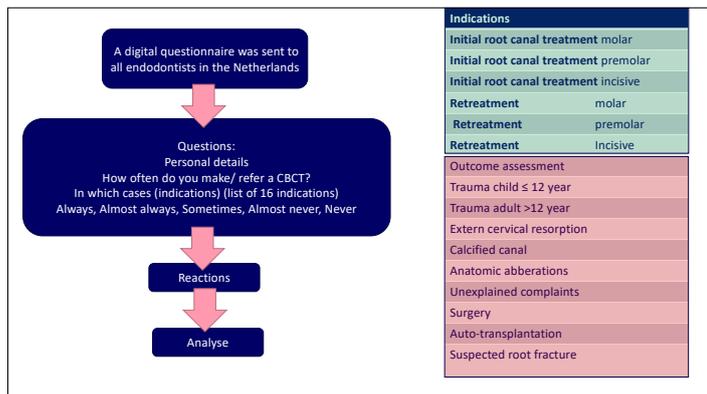
- CBCT-Predictors and characteristics of usage in Australia and New Zealand, a multifactorial analysis

Aust Endod J 2022: Isaac-Mathew et al.

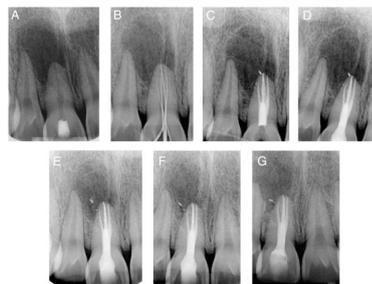
THE USE OF CBCT BY ENDODONTISTS IN THE NETHERLANDS 2022

BACHELOR THESIS

Christian van Mierlo and Rob Vergouwen
(supervisors: **F. Dommering & H. Shemesh**)



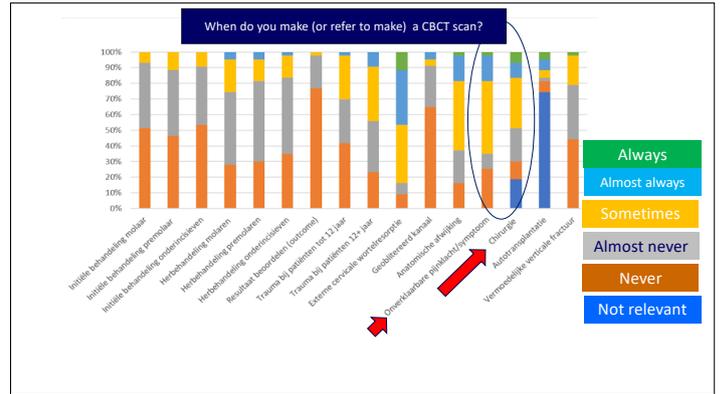
A Central Incisor with 4 Independent Root Canals: Case Report



JOE 2015 : Aznar Portoles, Moinezh, Shemesh

The present report is the first to describe a maxillary central incisor with 4 canals in a tooth with no developmental abnormalities. It stresses the importance of using a dental operating microscope during endodontic treatment **as well as questioning the routine use of CBCT imaging for similar cases.**

JOE 2015 : Aznar Portoles, Moizadeh, Shemesh



- Limitations of previously published systematic reviews evaluating the outcome of endodontic treatment.

IEJ 2009 : Wu, Shemesh & Wesselink

- Editorial Int Endod J
- Radiographs and CBCT--time for a reassessment?

IEJ 2011 : Patel, Mannocci, Shemesh, Wu, Wesselink, Lambrechts



A comparative investigation of CBCT and periapical radiography in the diagnosis of a healthy periapex

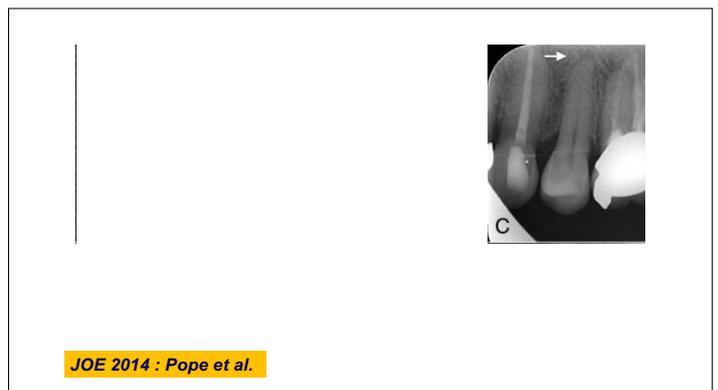
CBCT's of 200 patients

200 *healthy* premolars

Clinical investigation

verify *healthy* premolars

JOE 2014 : Pope et al.



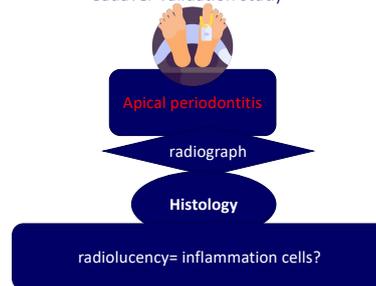
JOE 2014 : Pope et al.

Conclusions: the PDL space of a healthy tooth demonstrated significant variation when examined by CBCT. The radiographic interpretation of health and disease on CBCT must be further investigated ...



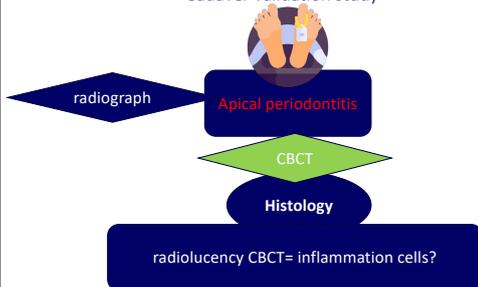
JOE 2014 : Pope et al.

Cadaver validation study



Brynolf 1967 : thesis

Cadaver validation study



IEJ 2017 : Kanagasingham et al.

IEJ 2019 : Kruse et al.

Validation study No. 1

Diagnostic accuracy of periapical radiography and CBCT in detecting apical periodontitis using histopathological findings as a reference standard.

IEJ 2017 : Kanagasingham et al.

- 9 unclaimed bodies before cremation (Malaysia)
- Maximal 14 days old
- 67 teeth
- Apical periodontitis detection on radiographs and CBCT
- Histopathological investigation

IEJ 2017 : Kanagasingham et al.

- Positive predictive value (If there is a lesion on CBCT, there is indeed also a visible inflammation process on histology)
- = 1

IEJ 2017 : Kanagasingham et al.

What a relief!

Validation study No. 2

Diagnostic accuracy of CBCT used for assessment of apical periodontitis: an ex vivo histopathological study on human cadavers.

IEJ 2019 : Kruse et al.

- Donated bodies for research (Denmark)
- Fixed bodies in Formalin
- Jaw sections with 223 teeth in them
- Apical periodontitis detected by CBCT
- Histopathological investigation

IEJ 2019 : Kruse et al.

- Positive predictive value (If there is a lesion on CBCT there is also a visible inflammation process on histology)
- = 0,77 (Teeth with a root-canal-treatment: 0,48-0,64)

IEJ 2019 : Kruse et al.

Diagnostic validity of periapical radiography and CBCT for assessing periapical lesions that persist after endodontic surgery

- 149 patients after Apex-resection (about 7 years ago)
- 108 were called again for evaluation
- Those with still a periapical lesion present got offered a re-surgery for free (20 patients accepted)
- Biopsy



Dentomaxillofac Radiology : Kruse et al.

42% without a periapical inflammation process
Correct diagnosis with CBCT: 58%
and 63% with regular radiographs

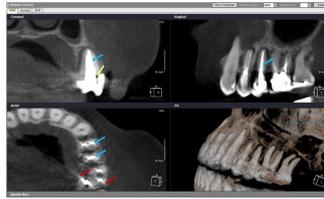
- Of the resurgerged teeth 42% showed no inflammation process and thus had no benefit in the re-surgery

Overtreatment

Dentomaxillofac Radiology : Kruse et al.

Root canal treated teeth can demonstrate a periapical lesion also when there is no inflammation

• Beam Hardening and streaking artefacts



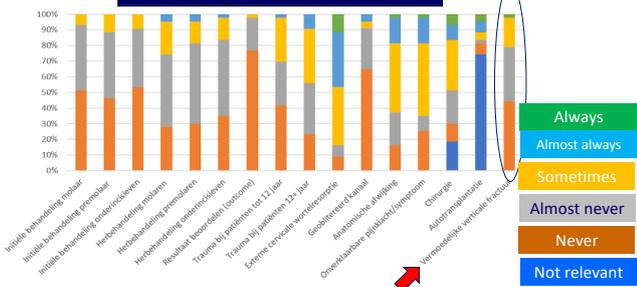
Detection of periapical periodontitis by CBCT

- Is reliable in teeth without a root canal treatment
- Is much less reliable in endodontically treated teeth

Limitations

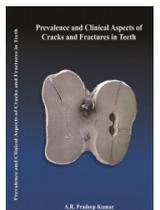
- Part 2

When do you make (or refer to make) a CBCT scan?



Diagnosis of VRF by CBCT in Root-filled Teeth with Confirmation by Direct Visualization: A Systematic Review and Meta-Analysis.

“CBCT imaging is still not a good tool for diagnosing VRFs in root-filled teeth compared with direct visualization”.



JOE 2021: PradeepKumar et al.

PhD thesis : 2022

CBCT can help with the diagnosis of VRF, together with clinical signs and symptoms :

- The combination of a deep pocket a sinus tract , and a lateral lesion on a radiograph in an endodontically treated tooth (especially maxillary premolars and the mesial roots of lower molars) is usually enough for the diagnosis of VRF
- CBCT-scan can demonstrate bone-defects patterns that can aid in the diagnosis.

But do not expect to see the VRF on the CBCT scan

Remember

- Technology evolves !



Additional aspects of CBCT

• Part 3

- Outcome
- Parameters
- New applications

INTERNATIONAL ENDODONTIC JOURNAL
The official journal of the British Endodontic Society and the European Society of Endodontology



Volume 42, Issue 8
August 2009
Pages 656-666

Free Access

Limitations of previously published systematic reviews evaluating the outcome of endodontic treatment

M.K. Wu, H. Shemesh, P. R. Wesselink

First published: 08 July 2009 | <https://doi.org/10.1111/j.1365-2591.2009.01600.x> | Citations: 149

REVIEW ARTICLE

CBCT-Assessed Outcomes and Prognostic Factors of Primary Endodontic Treatment and Retreatment: A Systematic Review and Meta-Analysis



João Filipe Brochado Martins, DDS, MSc,¹
Athina Christina Georgiou, DDS, MSc, PhD,¹
Patrícia Diogo Nunes, MSc, PhD,^{1,2} Ralph de Vries, MSc,³
Vera Mónica Almeida Afonso, MSc, PhD,¹
Paulo Jorge Rocha da Palma, DMD, MSc, PhD,^{1,2} and Hagay Shemesh, DDS, PhD^{1*}

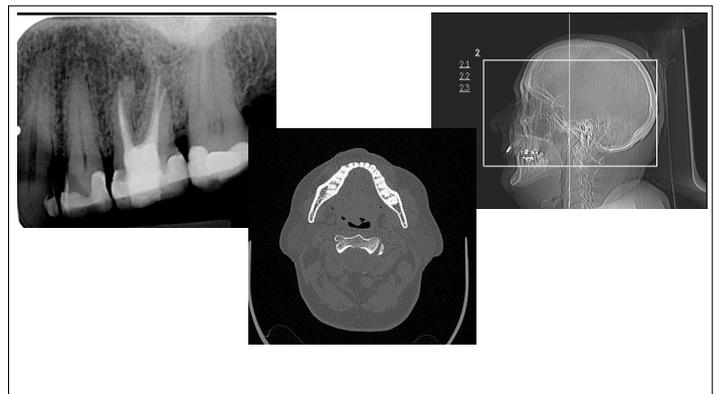
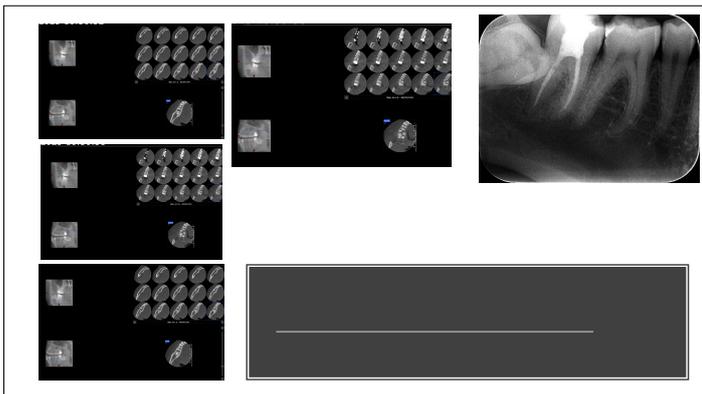
JOE 2025: Brochado-Martins et al.

Healing rates	CBCT	Radiographs
Loose criteria	88%	= 89,1/ 86
Strict criteria	36%	< 83 /86

JOE 2025: Brochado-Martins et al.

While CBCT offers greater diagnostic accuracy, its routine use for outcome evaluation may not be necessary, as it yields results like periapical radiographs under loose criteria. (J Endod 2025;51:687–706.)

JOE 2025: Brochado-Martins et al.



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ELSEVIER

Review article

Cone beam computed tomography in dentistry: Clinical recommendations and indication-specific features

Rocharies Cavalcante Fontenele^{a,b,c,d,*}, Hugo Gaêta-Araujo^{a,b,c}, Reinhilde Jacobs^{b,c,d,e}

^a Department of Stomatology, Public Health and Forensic Dentistry, Division of Oral Radiology, School of Dentistry of Ribeirão Preto, University of São Paulo, Ribeirão Preto, São Paulo, Brazil

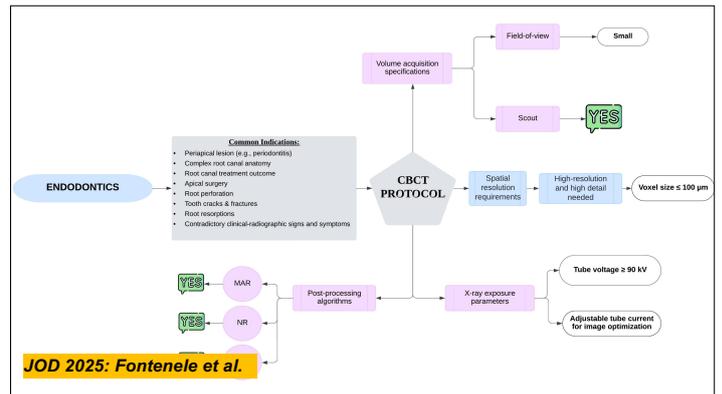
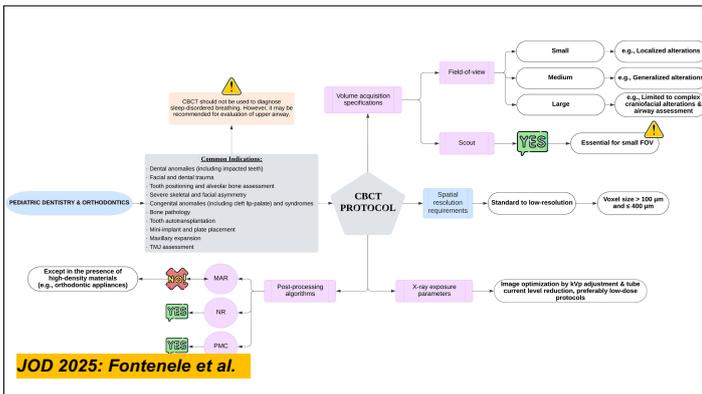
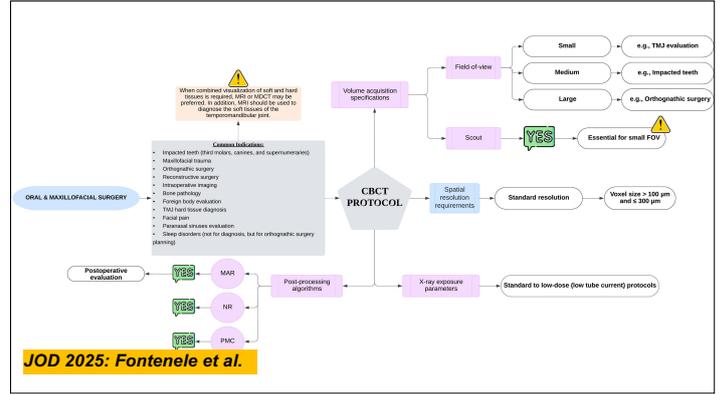
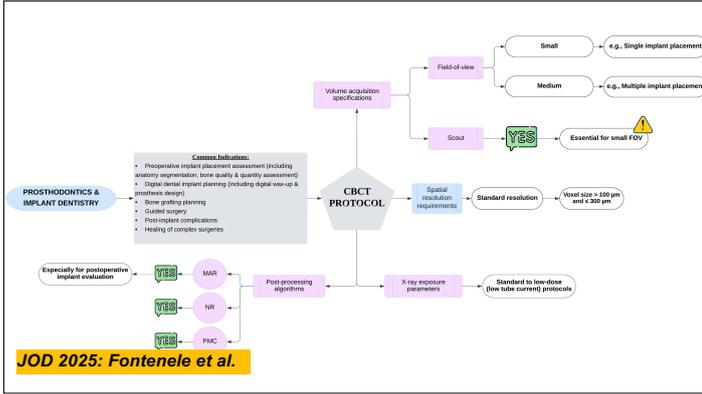
^b OMPs/MPATH Research Group, Department of Imaging and Pathology, Faculty of Medicine, KU Leuven, Leuven, Belgium

^c Department of Oral and Maxillofacial Surgery, UZ Hospital, Leuven, Belgium

^d Department of Dental Medicine, Karolinska Institute, Stockholm, Sweden

- Common indications
- FOV size and correct patient positioning (scout) FOV↓=Radiation ↓
- Spatial resolution (voxel size ≤100 μm =high) Res ↑= Radiation ↑
- Exposure parameters mA ↓= Radiation ↓
- Post-processing algorithms :
 - MAR -reduces artefacts caused by high-density materials
 - NR -improves image quality by reducing image noise
 - PMC -corrects motion artefacts caused by patient movement during the scan.

JOD 2025: Fontenele et al.



ACTA Academic Centre for Dentistry Amsterdam

In some countries, you must obtain a certificate after completing a training to prescribe or interpret a CBCT scan

Post-graduate programs

Accreditation of postgraduate speciality training programmes in Endodontology. Minimum criteria for training Specialists in Endodontology within Europe ESE 2010

ESE Undergraduate Curriculum Guidelines for Endodontology ESE 2024

UNIVERSITY OF AMSTERDAM Vrije Universiteit Amsterdam

Teaching

60 03-09-2025 Footer

ACTA



• Guided endodontics

ACTA

62 03-09-2025 Voetregel

Selective retreatment

Received: 31 May 2022 | Accepted: 14 November 2022
DOI: 10.1111/iej.13878

ORIGINAL ARTICLE

INTERNATIONAL
ENDODONTIC JOURNAL | WILEY

Outcome of selective root canal retreatment—A retrospective study

João Filipe Brochado Martins¹ | Olavo Guerreiro Viegas² | Roberto Cristescu² |
Patricia Diogo² | Hagay Shemesh¹

63 03-09-2025 Voetregel

- Part 1- Validation & reliability
- Part 2- Limitations
- Part 3- Additional aspects

ACTA

64 03-09-2025 Voetregel

Conclusions

- CBCT is a powerful tool and gives advantage in diagnosis & treatment of difficult cases
- Like every tool it should be used wisely, especially because it comes with more ionized radiation and costs