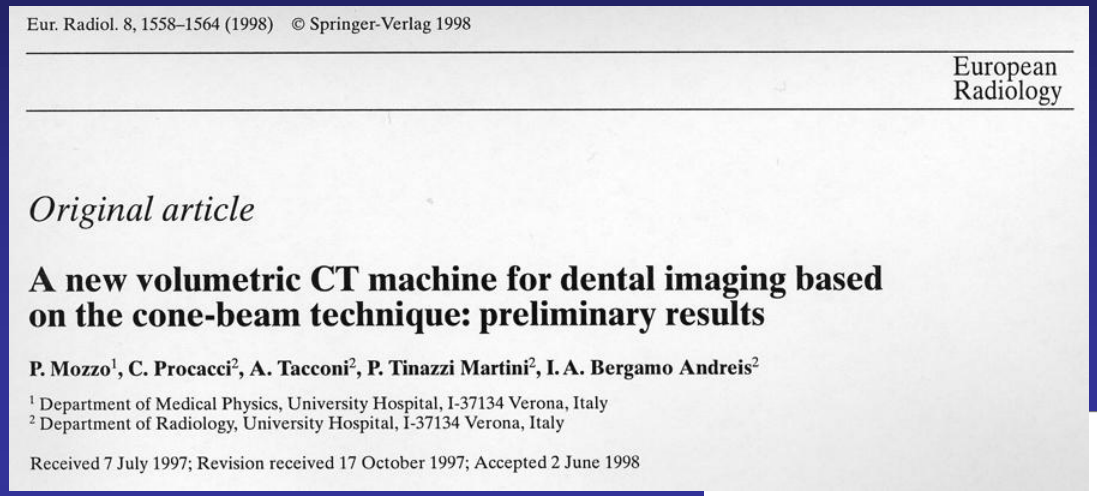
“The State of the Art” SEDENTEXCT Workshop on dental Cone Beam CT

31 March 2011

What a difference a decade makes....



Eur. Radiol. 8, 1558–1564 (1998) © Springer-Verlag 1998

European Radiology

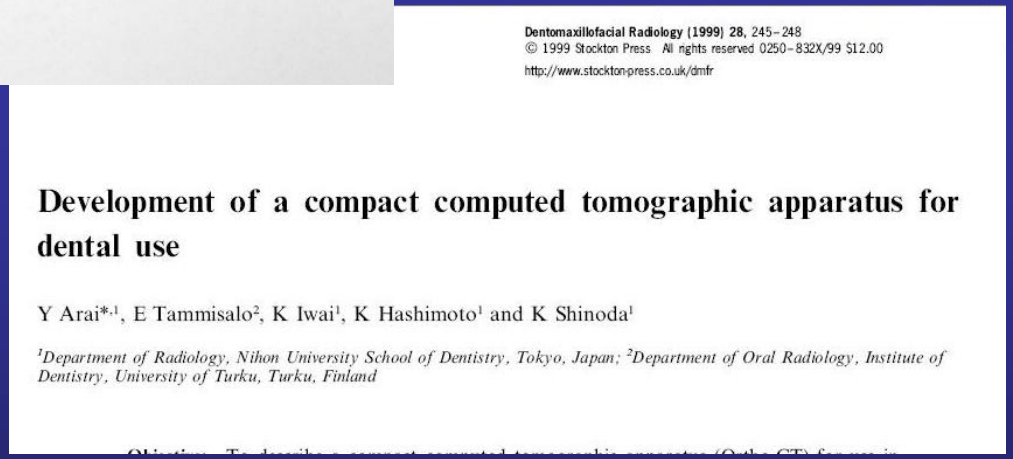
Original article

A new volumetric CT machine for dental imaging based on the cone-beam technique: preliminary results

P. Mozzo[1], C. Procacci[2], A. Tacconi[2], P. Tinazzi Martini[2], I. A. Bergamo Andreis[2]

[1] Department of Medical Physics, University Hospital, I-37134 Verona, Italy
[2] Department of Radiology, University Hospital, I-37134 Verona, Italy

Received 7 July 1997; Revision received 17 October 1997; Accepted 2 June 1998



Dentomaxillofacial Radiology (1999) 28, 245–248

http://www.stockton-press.co.uk/dmfr

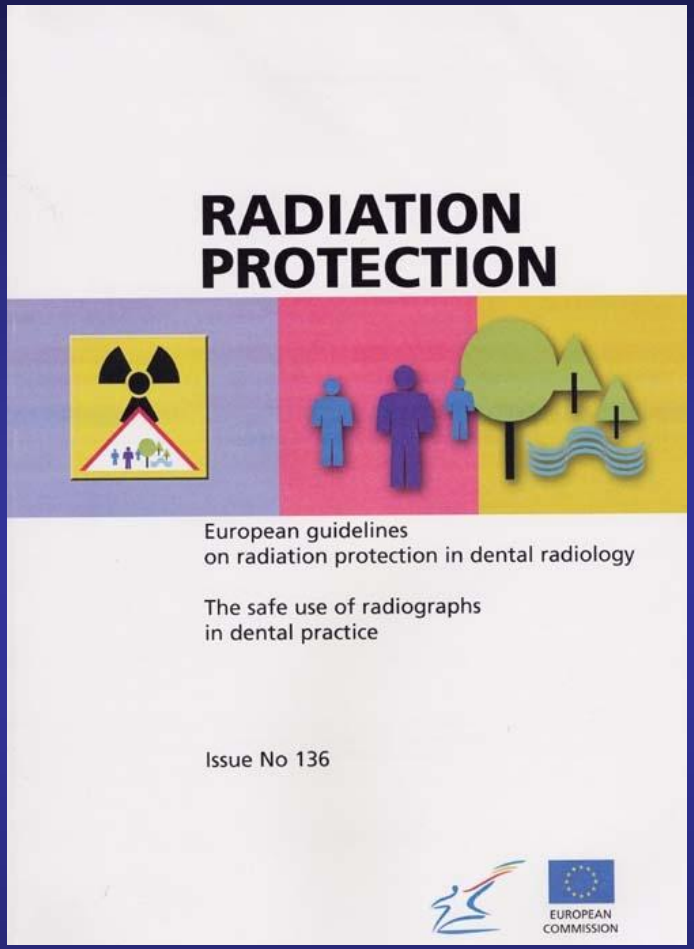
Development of a compact computed tomographic apparatus for dental use

Y Arai*[,1], E Tammisalo[2], K Iwai[1], K Hashimoto[1] and K Shinoda[1]

[1]Department of Radiology, Nihon University School of Dentistry, Tokyo, Japan; [2]Department of Oral Radiology, Institute of Dentistry, University of Turku, Turku, Finland

(Mozzo et al., 1998; Arai et al., 1999)

European Guidelines on Radiation Protection in Dental Radiology (2004)

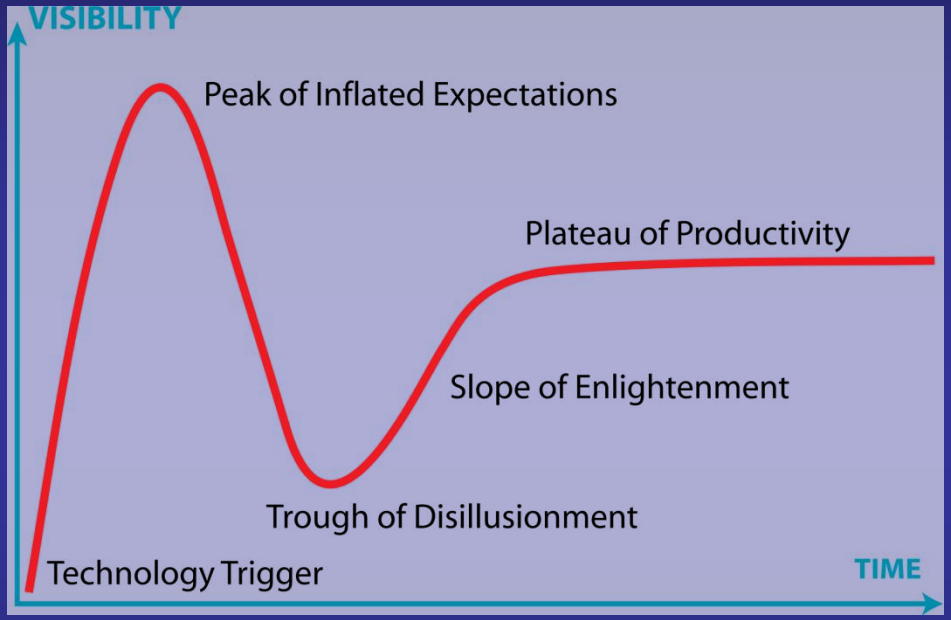


Many CBCT machines on the market

Scientific literature growing exponentially

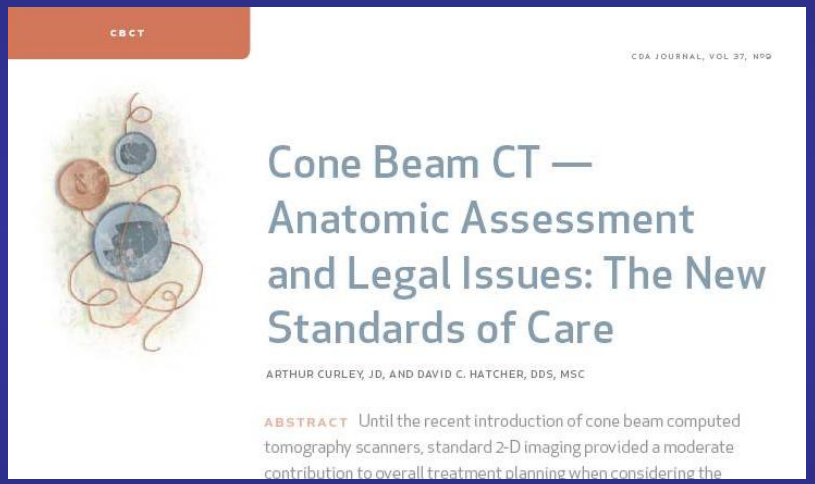
CBCT has revolutionised dental and maxillofacial radiology

Provoking controversy



Gartner hype cycle

"In cases of full-mouth orthodontics, the offer of CBCT 3-D imaging has become a standard of care"


CBCT

CDA JOURNAL, VOL 37, NO9

Cone Beam CT — Anatomic Assessment and Legal Issues: The New Standards of Care

ARTHUR CURLEY, JD, AND DAVID C. HATCHER, DDS, MSC

ABSTRACT Until the recent introduction of cone beam computed tomography scanners, standard 2-D imaging provided a moderate contribution to overall treatment planning when considering the

Curley A, Hatcher DC. J Calif Dent Assoc. 2009 Sep;37(9):653-62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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

RECOMMEND

TWITTER

E-MAIL

New York Times
22 November 2010

European Atomic Energy Community's Seventh Framework Programme FP7/ 2007-2011

SEDENTEX CT

Safety and Efficacy of a New and Emerging Dental X-ray Modality

Aims:

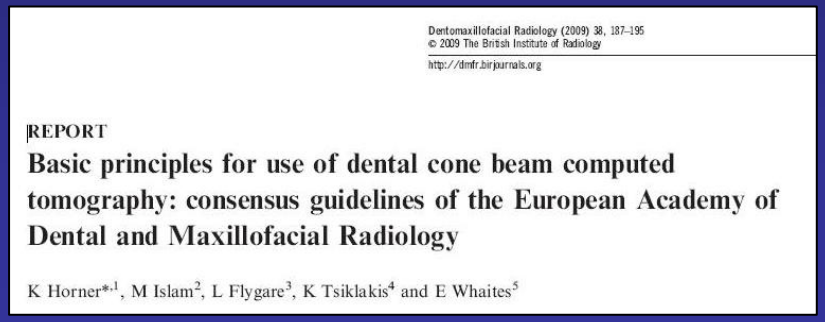
"The aim of this proposal is the acquisition of key information necessary for sound and scientifically based clinical use of dental Cone Beam Computed Tomography (CBCT). In order that safety and efficacy are assured and enhanced in the 'real world', the parallel aim is to use the information to develop evidence-based guidelines dealing with justification, optimisation and referral criteria and to provide a means of dissemination and training for users of CBCT."

Six component "Work Packages"

Work package 1

Justification and Guideline development

To develop evidence-based guidelines on use of CBCT in dentistry, including referral criteria, quality assurance guidelines and optimisation strategies. Guideline development will use systematic review and established methodology, involving stakeholder input.



Dentomaxillofacial Radiology (2009) 38, 187–195
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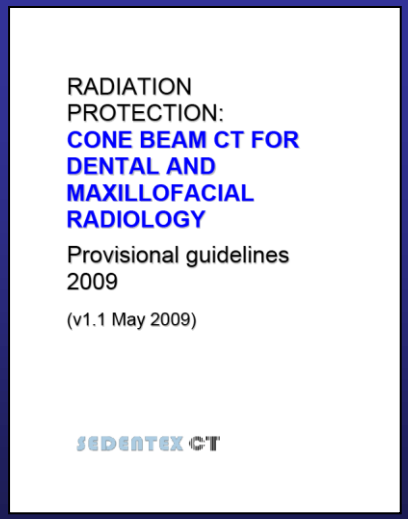
http://dmfr.birjournals.org

REPORT

Basic principles for use of dental cone beam computed tomography: consensus guidelines of the European Academy of Dental and Maxillofacial Radiology

K Horner*[,1], M Islam[2], L Flygare[3], K Tsiklakis[4] and E Whaites[5]



RADIATION PROTECTION:
CONE BEAM CT FOR DENTAL AND MAXILLOFACIAL RADIOLOGY

Provisional guidelines 2009

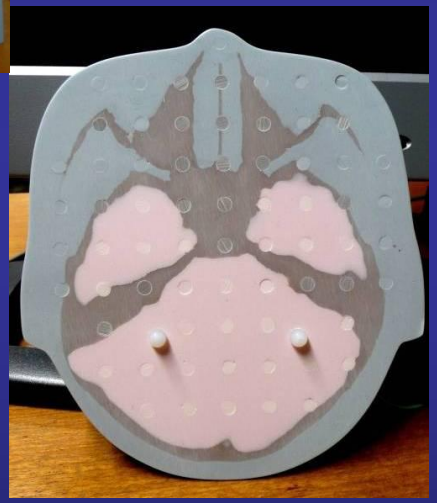
(v1.1 May 2009)

SEDENTEX CT

Work package 2

Dosimetry

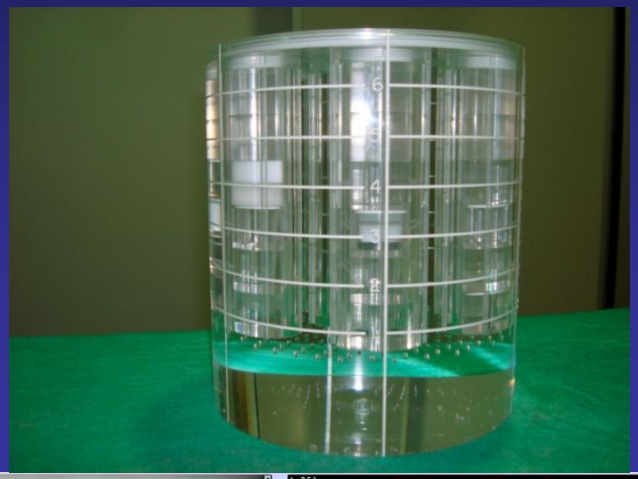
To determine the level of patient dose in dental CBCT, paying special attention to paediatric dosimetry, and personnel dose.

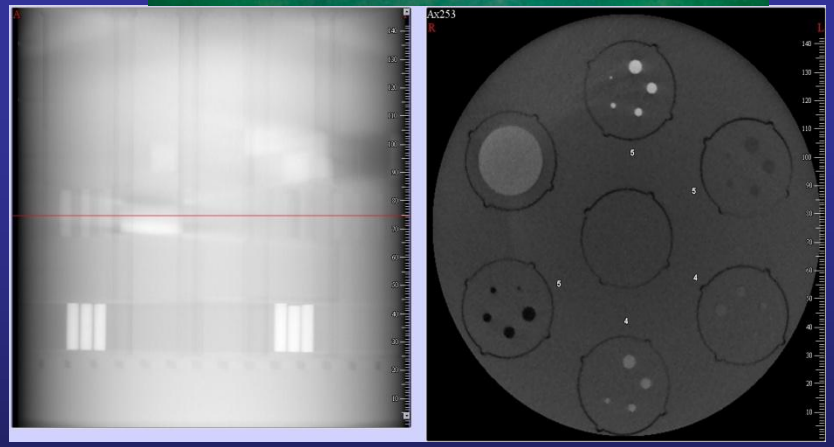


Work package 3

Optimisation

To develop a quality assurance programme, including a tool/tools for quality assurance work (including a marketable quality assurance phantom) and to define exposure protocols for specific clinical applications.

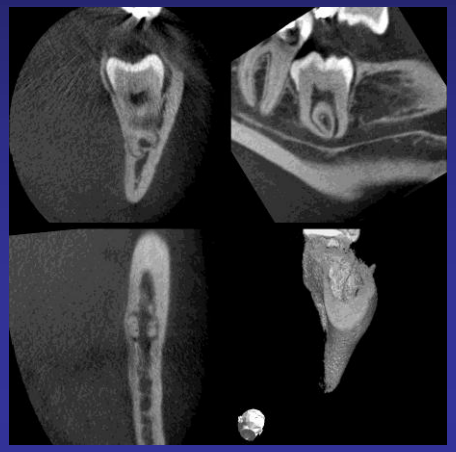


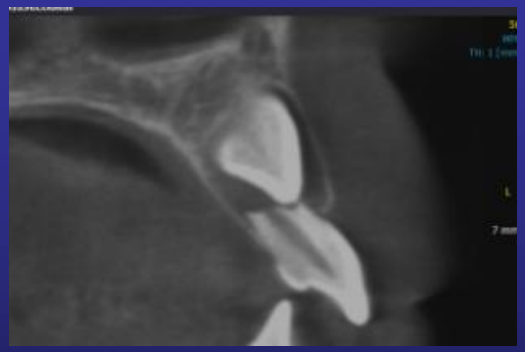


Work package 4

Diagnostic accuracy

To perform diagnostic accuracy studies for CBCT for key clinical applications in dentistry by use of in vitro and clinical studies.





Work package 5

Cost effectiveness

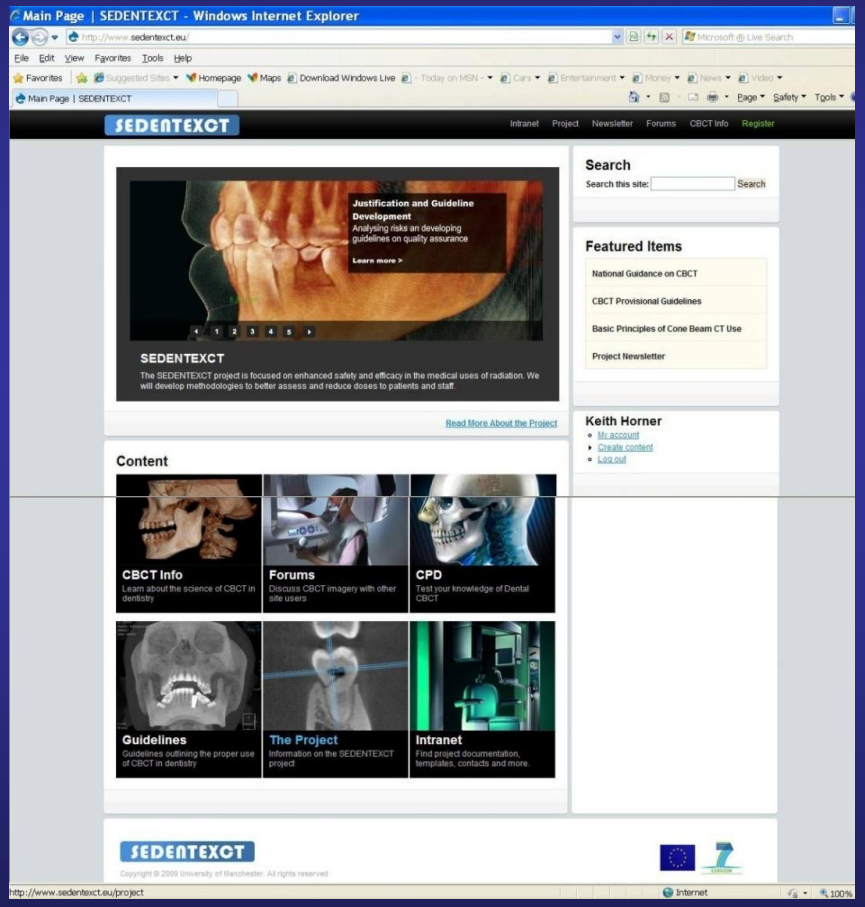
To measure cost-effectiveness of important clinical uses of CBCT compared with traditional methods.

Work package 6

Training and valorisation

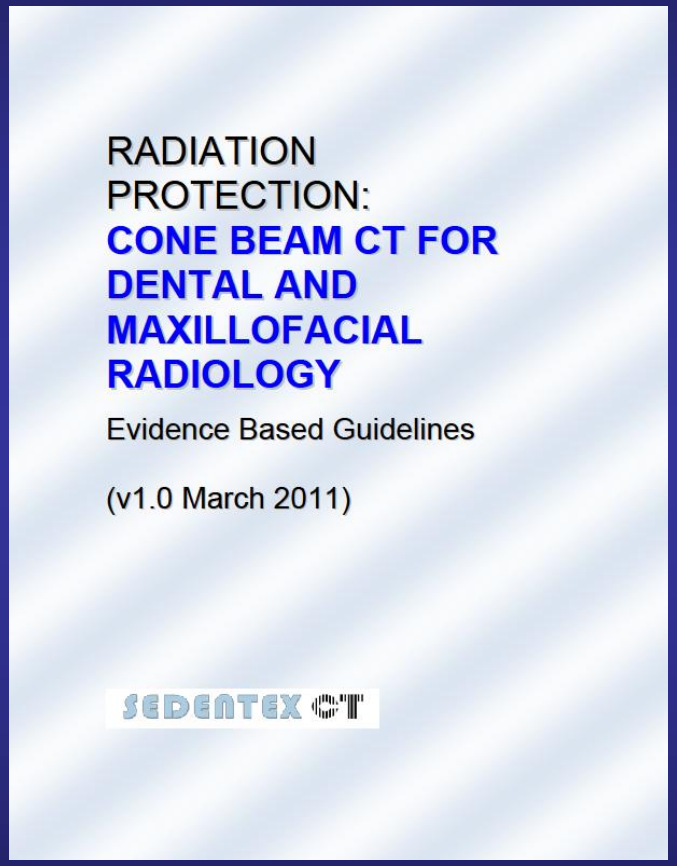
To conduct valorisation*, including dissemination and training, activities via an ‘open access’ website.

*Validation and proof of worth through earnings or a yield



New Guidelines

v1.0 March 2011



Guideline methodology

Multidisciplinary Guideline development panel

Identification of the literature

MEDLINE (OVID) (1950 onwards)
EMBASE (OVID) (1980 onwards)
Web of Science
Scopus
UK Clinical Research Network
Clinical Trials.gov
Register of Controlled Trials (www.controlled-trials.com)
NICE guidelines (www.nice.org.uk)
FDI World Dental Federation Guidelines (www.fdiworldental.org).

Guideline methodology

Multidisciplinary Guideline development panel

Identification of the literature

Box 1. Search strategy developed for MEDLINE (OVID)

1. cone beam computed tomography.mp.
2. volumetric radiography.mp.
3. volumetric tomography.mp.
4. digital volumetric tomography.mp.
5. digital volume tomography.mp.
6. Cone-beam.mp. or exp Cone-Beam Computed Tomography/
7. (volume ct or volumetric ct).mp.
8. (volume computed tomography or volumetric computed tomography).mp.
9. (cbct or qcbct).mp.
10. or/1-9
11. (dental or dentistry).mp.
12. exp dentistry/
13. (intra-oral or intraoral).mp. [title, original title, abstract, name of substance word, subject heading word]
14. oral surgery.mp. or exp surgery, oral/
15. endodontics$.mp. or exp endodontics/
16. orthodontics$.mp. or exp orthodontics/
17. (periodontic$ or periodontology).mp. or exp periodontics/
18. exp dental caries/
19. maxillofacial.mp.
20. or/11-19
21. 10 and 20

Guideline methodology

National CBCT documents

Box 2. National guidelines used as source material

- Advies van de Hoge Gezondheidsraad, 2011. www.hgr-css.be
- Haute Autorité de Santé., 2009. http://www.has-sante.fr
- Health Protection Agency, 2010a.
- Health Protection Agency, 2010b.
- Leitlinie der DGZMK., 2009:
- Qualitätssicherungs-Richtlinie – QS-RL, 2004, S. 731-777.
- Schulze D, Schulze R. 2006
- Statens strålevern, 2010.
- Sundhedsstyrelsen, 2009.

Guideline methodology

Critical appraisal

Bias grading

- \- High risk
- \+ Moderate risk
- ++ Low risk

"Justification" studies

- SIGN
- QUADAS tool for assessment of studies of diagnostic accuracy

Other studies

- Generic proformas

Guideline methodology

Grade	
A	At least one meta analysis, systematic review, or RCT rated as 1++, and directly applicable to the target population; or a systematic review of RCTs or a body of evidence consisting principally of studies rated as 1+, directly applicable to the target population, and demonstrating overall consistency of results
B	A body of evidence including studies rated as 2++, directly applicable to the target population, and demonstrating overall consistency of results; or extrapolated evidence from studies rated as 1++ or 1+
C	A body of evidence including studies rated as 2+, directly applicable to the target population and demonstrating overall consistency of results; or extrapolated evidence from studies rated as 2++
D	Evidence level 3 or 4; or extrapolated evidence from studies rated as 2+
GP	Good Practice (based on clinical expertise of the guideline group)

Examples

CBCT may be indicated for the localised assessment of an impacted tooth (including consideration of resorption of an adjacent tooth) where the current imaging method of choice is conventional dental radiography and when the information cannot be obtained adequately by lower dose conventional (traditional) radiography

C

All CBCT examinations must be justified on an individual basis by demonstrating that the benefits to the patients outweigh the potential risks. CBCT examinations should potentially add new information to aid the patient's management

ED BP

New Guidelines

57 recommendations or statements

A grade: 0
B grade: 6
C grade: 9
D grade: 10
GP: 24
ED/BP: 8

Consensus process by EADMFR and EFOMP

Contents

Quality Control for Dental Cone Beam Computed Tomography (CBCT) Systems

1 Introduction

A Quality Control Programme lays out the necessary testing to ensure that all parameters during the examination procedure are in accordance with the standard operating protocol, thus resulting in images with diagnostic value, without exposing the patient to unnecessary risk.

A programme of equipment tests for dental cone beam CT should consider the following aspects:

- Performance of the X-ray tube and generator
- Patient dose
  Quantitative assessment of image quality
- Display screen performance

Such a programme is a requirement of the European Union Medical Exposures Directive[I] as part of the optimisation process to ensure patient dose is as low as reasonably practicable whilst achieving clinically adequate image quality. Any practice undertaking medical exposure should have access to the advice of a medical physics expert on such matters. The Medical Exposures Directive is currently under revision[II] and the role of the Medical Physics Expert is given higher prominence in the most recent draft.

Testing and patient dose assessment is carried out when the equipment is first installed as part of the commissioning process and then throughout the life of the equipment[III]. This protocol outlines those physical tests and measurements that are considered to be part of a standard quality control programme for a dental CBCT unit. It does not cover quality assurance of the clinical image.

A range of tests are appropriate for dental CBCT looking at different aspects of the equipment and image display. National guidance exists in some EU countries [IV] and the SEDENTEXCT project[V] has developed phantoms to facilitate carrying out a wide range of measurements. Some of the tests are straightforward and can be readily performed by the clinical staff using the CBCT equipment. Other tests are more complex and the input of a medical physicist is required.

Routine quality control tests primarily involve comparison of results with those determined during commissioning. Significant variation, as indicated by pre-determined action levels, should be investigated, either with the help of a medical physics expert (MPE) or the equipment service engineer.

Not all possible methods of assessment are considered essential. It is important to perform enough tests to confirm that the equipment is operating as intended. More complex tests do add extra information that is helpful in the optimisation process and they are detailed here for completeness. However, whether the more detailed tests

Programme for the day:

10.15	Dosimetry of dental CBCT	Ria Bogaerts
10.55	Optimisation and quality control	Kostas Tsiklakis
11.35	*Break*	
12.00	Diagnostic efficacy	Reinhilde Jacobs
12.40	*Lunch*	
13.40	Breakout groups and plenary meeting	
14.20	Professional Education in CBCT	Hugh Devlin
14.50	Health Economics of CBCT	Christina Lindh
15.20	*Break*	
15.50	Justification of CBCT and Guidelines for clinical use	Vivian Rushton
16.30	Audience and panel discussion	
16.50	Concluding remarks	
17.00	*Close*	

Acknowledgement: *The research leading to these results has received funding from the European Atomic Energy Community's Seventh Framework programme FP7/ 2007-2011 under grant agreement no. 212246 (SEDENTEXCT: Safety and Efficacy of a New and Emerging Dental X-ray Modality).*