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SEDENTEXCT

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

Newsletter

Inside this issue:

Project partners

University of Manchester (UK), National and Kapodistrian University of Athens(Greece), "Iuliu Hategianu" University of Cluj-Napoca (Romania), Leeds Test Objects Ltd. (UK), Katholieke Universiteit Leuven (Belgium), Malmő University (Sweden), Vilnius University (Lithuania).

More about SEDENTEXCT at:

The Seventh Framework Programme of the European Atomic Energy Community (Euratom) for nuclear research and training activities (2007 to 2011)

Three years of SEDENTEXCT: time for "outputs"

The end of 2010 is quite a milestone in SEDENTEXCT. We have now completed three years of work and approach the "final lap". This is a hectic time, as most research work programmes come to an end and reports on "Deliverables" (tangible project outcomes) start to appear. In the final stages of the project the emphasis shifts onto dissemination and exploitation of our results, whether that be through scientific publications or presentations at meetings.

As I write this, I am surrounded by paper and confronted with folders and sub-folders on my PC as we revise and extend the Provisional Guidelines on dental CBCT document that we produced in 2009. This will be launched in April 2011, but not before embarking on a consultation with stakeholders in the European Academy of Dental and Maxillofacial Radiology. As far as our project website is concerned, behind the scenes we are building a set of training materials for users of CBCT. In other Work Packages, research work has reached completion and data is being analysed and manuscripts prepared. One element of the project I wish to highlight in this Editorial is work on Optimisation and Quality Assurance (QA).

Optimisation is one of the fundamentals of radiation protection. In the context of diagnostic radiology, the need to ensure that "*all doses.....shall be kept as low as reasonably achievable consistent with obtaining the required diagnostic information...*" is enshrined in Article 4 of the Council Directive 97/43 Euratom of 1997 and hence should be translated into national legislation within the European Union. A well-designed Quality Assurance (QA) programme provides a practical framework for achieving this. A QA programme should address several aspects of imaging, including image quality assessment, practical techniques, patient dose assessment, correct X-ray equipment function and image processing and viewing.

In hospital radiology departments and large clinics, QA is usually well established, with facilities, personnel and equipment available to support the programme. In dental practices, however, QA is far less well established. With conventional dental radiography, particularly with analogue (film-based) imaging, experience over many years tells us a story of inconsistent levels of attention placed upon QA. This is well illustrated by publications reporting high reject rates in image quality assessments and surveys of patient doses in primary dental care. This is not to say that dentists are uncaring or negligent; insufficient time and attention is often spent on radiology QA in a packed dental undergraduate training curriculum. Furthermore, in a business context, it is sometimes hard to motivate dental clinicians to invest in the equipment and time required for QA without evidence of an increase in profits or work efficiency. Again, this is not an indictment of dentists; primary care clinicians are faced with a barrage of regulations and requirements within which radiological QA can sink into the background very easily. Dentists will understandably be happy if, when they press the exposure button, x-rays are emitted and the resulting image is good enough to provide a readable image – not exactly optimisation.

With dental CBCT, the context is completely changed. The higher doses usually associated with CBCT, and the complexity of image production, necessitate a greater attention to undertaking a "solid" QA programme whether that be in hospital or primary dental care environments. There is inconsistent attention to QA amongst manufacturers. Some provide QA phantoms and a programme of actions for users and their medical physics expert advisers; others do not. Medical physics experts themselves may be unfamiliar with CBCT equipment and try to undertake tests that, while suitable for [medical] CT scanners, are not appropriate to CBCT. In the primary dental care situation, CBCT equipment is often sold and installed by third-party suppliers of dental equipment, who may be inadequately experienced and knowledgeable about QA of CBCT; thus the potential problem is compounded.

Addressing this problem was foreseen in the initial development of the SEDENTEXCT project plan by two actions: including a Work Package dealing with Optimisation and by full inclusion within the

project team of Leeds Test Objects Ltd., an internationally respected manufacturer of X-ray test objects. A key objective of the SEDENTEXCT project is "*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*". Over the three years of the project, Leeds Test Objects Ltd and the key Work Package 3 academic team from the Universities of Athens and Leuven have been working hard to achieve this objective by developing a QA phantom. At the time of writing, the phantom and associated software are in their final stages of development and approaching the point at which a commercial launch can be initiated.

Finally, as I said at the start of my Editorial, this is a period in which SEDENTEXCT addresses dissemination. On 31st of March 2011 we will present a one day Workshop on dental CBCT called "State of the Art", hosted by the British Society of Dental and Maxillofacial Radiology as part of their Annual Scientific Meeting in Leeds, UK. Further details of this Workshop are given within this Newsletter. I encourage you to attend.

Keith Horner

SEDENTEXCT Project Co-ordinator

Report on SEDENTEXCT project meeting in Vilnius

The project team assemble for a festive photograph. The scarves worn by some of us are gifts from the University of Vilnius

.The SEDENTEXCT Consortium met recently for its regular meeting in the beautiful, snowy, heart of historic Vilnius, Lithuania. We meet approximately every six months to check how we are performing against our planned milestones. This meeting was a little earlier in the timetable than is usual, in view of several forthcoming deadlines at the year end. We also hoped for slightly better weather than might have been the case later in December or in January. Unfortunately we managed to

coincide neatly with the snow and cold weather that hit Northern Europe at this time, resulting in some challenging journeys home! Nevertheless, everyone who planned to attend was able to be at the meeting, hosted beautifully by Deimante Ivanauskaite. A day of Work Package Workshops was followed on the following day by the formal project meeting. This started with a very kind welcome from Professor Vytaute Peciuliene, Director of the Institute of Odontology of the Faculty of Medicine of Vilnius University. The picture shows a very complete SEDENTEXCT team at the meeting. We are extremely grateful to Deimante for organising this extremely successful meeting.

Publication abstract

Effective dose range for dental cone beam computed tomography scanners. Pauwels R, Beinsberger J, Collaert B, Theodorakou C, Rogers J, Walker A, Cockmartin L, Bosmans H, Jacobs R, Bogaerts R, Horner K; The SEDENTEXCT Project Consortium.
Eur J Radiol. 2010 Dec 31. [Epub ahead of print]

OBJECTIVE: To estimate the absorbed organ dose and effective dose for a wide range of cone beam computed tomography scanners, using different exposure protocols and geometries.

MATERIALS AND METHODS: Two Alderson Radiation Therapy anthropomorphic phantoms were loaded with LiF detectors (TLD-100 and TLD-100H) which were evenly distributed throughout the head and neck, covering all radiosensitive organs. Measurements were performed on 14 CBCT devices: 3D Accuitomo 170, Galileos Comfort, i-CAT Next Generation, Iluma Elite, Kodak 9000 3D, Kodak 9500, NewTom VG, NewTom VGi, Pax-Uni3D, Picasso Trio, ProMax 3D, Scanora 3D, SkyView, Veraviewepocs 3D. Effective dose was calculated using the ICRP 103 (2007) tissue weighting factors.

RESULTS: Effective dose ranged between 19 and 368μSv. The largest contributions to the effective dose were from the remainder tissues (37%), salivary glands (24%), and thyroid gland (21%). For all organs, there was a wide range of measured values apparent, due to differences in exposure factors, diameter and height of the primary beam, and positioning of the beam relative to the radiosensitive organs.

CONCLUSIONS: The effective dose for different CBCT devices showed a 20-fold range. The results show that a distinction is needed between small-, medium-, and large-field CBCT scanners and protocols, as they are applied to different indication groups, the dose received being strongly related to field size. Furthermore, the dose should always be considered relative to technical and diagnostic image quality, seeing that image quality requirements also differ for patient groups. The results from the current study indicate that the optimisation of dose should be performed by an appropriate selection of exposure parameters and field size, depending on the diagnostic requirements.

SEDENTEXCT project progress

A regular part of our Newsletter is an update on the activities of the scientists in the SEDENTEXCT project. At times, the reader may feel that we are being "opaque" in our descriptions of work; this is necessary because some of the work is not yet ready for placing in the public domain, particularly where this involves potential intellectual property issues. Nonetheless, we hope that a useful idea of our work can be gained.

Work package 1 (http://www.sedentexct.eu/content/work-package-1-justification-and-guideline-development)

This WP addresses guideline development through an "evidence-based" approach.

At this time we are writing the Definitive Guidelines on dental CBCT, to update our previous Provisional Guidance from 2009. We have continued to review the literature as it appears using strict systematic review processes. Now is the task of translating the findings into a coherent and evidence-based set of guidelines. We are also preparing to consult with the membership of

EADMFR on any recommendations that we make which lack a clear evidence-base. In the absence of any good evidence, such guidelines would merely be expert-based and achievement of consensus amongst a larger group of stakeholders would add weight. We hope to launch the Guidelines at the Workshop being held in Leeds at the end of March (*see elsewhere in this issue*).

Work package 2 (http://www.sedentexct.eu/content/work-package-2-dosimetry)

This Work package works to conduct dosimetry studies on CBCT (patient and staff doses) and to develop effective methods for dosimetry modelling.

In the final stages of WP2, the dose indices defined in WP2.1 were measured in practice using a variety of exposure protocols, and adult phantom measurements were reported in the European Journal of Radiology (Pauwels et al., *see abstract above*). A second paper on paediatric phantom measurements is "in press" in the British Journal of Radiology (Theodorakou et al.) and at the EADMFR congress in Istanbul. Additionally, a Monte Carlo simulation framework was validated and the effective dose for a wide range of CBCT devices using different phantom models was simulated. The information from these three WP tasks was combined to determine conversion factors between dose index and patient risk.

Work package 3 (http://www.sedentexct.eu/content/work-package-3-optimisation)

This Work package involves the SME partner, Leeds Test Objects Ltd, and there are important IP issues that prevent detail entering the public domain. As such, this is a limited report.

Essentially, the development work is complete. The beta testing of the software accompanying the phantom has been performed and final "bugs" dealt with. We have now written the manual on Quality assurance which accompanies the phantom. The next stage will be moving to a launch of the phantom.

Work package 4 (http://www.sedentexct.eu/content/work-package-4-diagnostic-accuracy)

This Work package deals with "diagnostic accuracy" in clinical applications.

The last months, the work on WP4 consisted in the report of the clinical research that was performed on the following applications: Implant planning, Impacted third molars, Impacted canines and Sinus grafting.

As a general result, we found that there was a significant increase of the confidence of observers to start a treatment. Usually, surgical events could be better predicted based on CBCT than on 2D imaging. When planning implants, the implant dimensions changed depending on using CBCT or 2D imaging. For the patient group in the current study on impacted third molars, we could not find significant differences in using 2D or CBCT images in surgical planning. When planning impacted canine surgery, the distinction between oral and vestibular position could better be made with CBCT than 2D images, which directly influenced the surgical approach and efficiency. Observers often shifted in their treatment opinion from extraction to conservative treatment when confronted with CBCT images after 2D images. In the study on sinus grafting procedures, it became clear that the volume to be grafted could be well-planned before the surgical intervention using CBCT, which in return provided more efficient surgery.

Work package 5 (http://www.sedentexct.eu/content/work-package-5-cost-effectiveness)

This Work package is exploring the difficult and challenging area of economic evaluation of Cone Beam CT and collaborating with team members with international expertise in health economics.

The collection of data in WP5 is coming to its end. During the last six months more observers have assessed radiographs of different clinical situations for us to be able to compare the assessments in CBCT images with assessments in conventional images, which are panoramic and intraoral radiographs. It is obvious that observers are more confident when assessing CBCT images compared to images from conventional radiographic examinations but for signs of clinical importance the differences are not obvious. Also clinicians have been involved to decide about treatment alternatives and how confident they are in their decisions when having access to CBCT images or not. The results are pointing in the same direction – there are differences in

treatment decisions and confidence but not agreement between observers irrespective of having access to CBCT images or not. The recent results have been reported at the Swedish Dental Association annual meeting in November 2010.

Work package 6 (http://www.sedentexct.eu/content/work-package-6-training-and-valorisation)

This element of the project deals with "Training and valorisation".

In this period we have been preparing 10 educational modules. Of the 10 modules prepared, five have Powerpoints with voice-overs made and are on the website. One module is complete with voiced Powerpoint, additional materials and assessment questionnaire. We hope to add more material to the CBCT information sections. Both this and the Forums are now "live" and open to the public for viewing. Those people who have expressed an interest to be registered on the SedentexCT website have been sent registration details enabling them to edit the CBCT info section and forums.

We have made contact with those building the EADMFR website, and are planning collaborative action to take the project into the period after SedentexCT finishes in June. There is a 3D anatomy viewer available which scrolls through CBCT images in various planes and which provides annotations of various structures.

CBCT concerns raised in the USA


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The New York Times

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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

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Online article from 22 November 2010

The New York Times published an extensive article on dental CBCT on November 22 2010. The focus of the article was on the concerns over radiation exposure of children when using CBCT in orthodontics. Several US clinicians and oral radiologists were interviewed and their opinions reported, but the only non-US expert consulted by the journalists was Keith Horner, the SEDENTEXCT project Co-ordinator. Professor Horner says "apart from showing the recognition worldwide of the SEDENTEXCT project, I was delighted to see this article appearing at a time when the use of CBCT in the USA for orthodontic use seems to be drifting towards routine practice in the absence of any evidence of improved patient outcomes". This article can be accessed in full online at: http://www.nytimes.com/2010/11/23/us/23scan.html

SEDENTEXCT Workshop planned

On 31 March 2011, a one day SEDENTEXCT Workshop on dental CBCT will take place in Leeds, UK, hosted by the British Society of Dental and Maxillofacial Radiology (BSDMFR). The venue will be the Leeds City Museum. At this Workshop, titled "State of the Art" we bring scientists from the SEDENTEXCT project to present latest information on dental CBCT, including results from the project. The Workshop is suitable for dental radiologists, radiographers, medical physicists and for dentists who have CBCT equipment in their practice.

The content of the day will include: Dosimetry of CBCT, Optimization and Quality Control, Diagnostic efficacy, Justification of CBCT and Guidelines for clinical use. Health Economics of CBCT and Professional Education in CBCT, reflecting the Work packages in the project. There will be opportunities for debate and audience participation through the day. The Workshop is CPD approved.

Work package leads will present each topic; these are Dr. Ria Bogaerts, Associate Professor, Experimental Radiotherapy Section, Katholieke Universiteit Leuven, Belgium, Prof. Hugh Devlin, School of Dentistry, University of Manchester, United Kingdom, Prof. Keith Horner, School of Dentistry, University of Manchester, United Kingdom, Prof. Reinhilde Jacobs, Oral Imaging Centre, Dept. of Dentistry, Oral Pathology and Maxillofacial Surgery, Katholieke Universiteit Leuven, Belgium, Prof. Christina Lindh, Department of Oral Radiology, Faculty of Odontology, Malmö University, Sweden, Dr. Vivian Rushton, School of Dentistry, University of Manchester, United Kingdom and Prof. Kostas Tsiklakis, Dental School, National and Kapodistrian University of Athens, Greece.

Leeds City Museum: Workshop venue in the heart of Leeds.

The provisional programme is as follows:

Registration from 9.00 am.

10.00 Opening remarks: Prof. Keith Horner, Co-ordinator of the SEDENTEXCT Project.

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

Enquiries regarding the Workshop and registration can be sent to alison.menhinick@nhs.net (Hon. Secretary, BSDMFR) or by phone on +44 (0)1382 425770.

The SEDENTEXCT project (2008-2011) is supported by the The Seventh Framework Programme of the European Atomic Energy Community (Euratom) for nuclear research and training activities (2007 to 2011)

http://cordis.europa.eu/fp7/euratom/ .

Join us at the Workshop on dental CBCT in Leeds

31 March, 2011

Further details available at the project website:

http://www.sedentexct.eu

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EURATOM

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