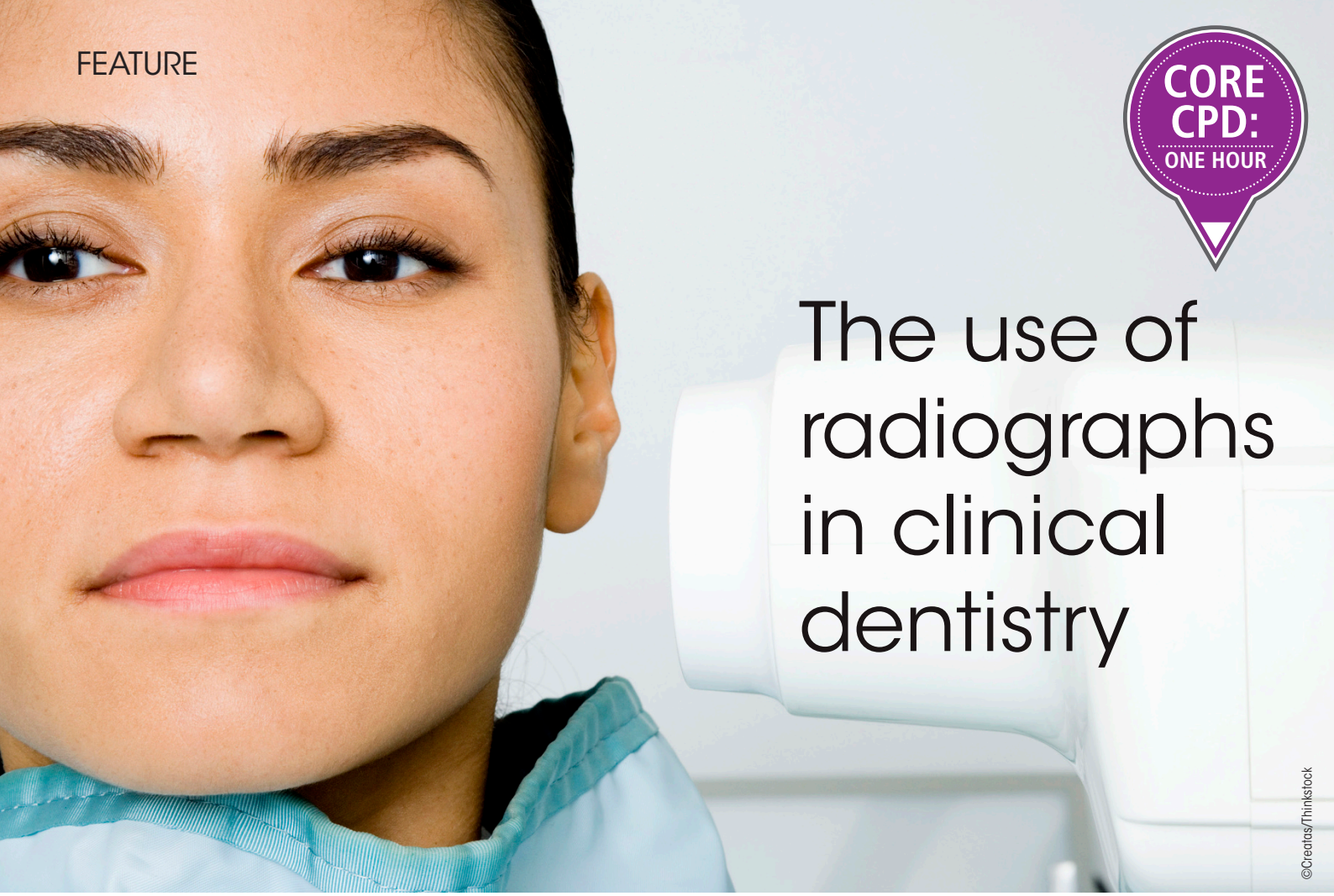

CORE CPD: ONE HOUR

The use of radiographs in clinical dentistry

By Jane Dalgarno, Dental Nurse Tutor, Community Dental Services, Bedford; jane.dalgarno@cds-cic.nhs.uk

Just about everything we carry out in our daily lives carries an element of risk and the use of X-rays within clinical dentistry is no exception.[1,2] For example, most individuals would regard activities involving a risk of below one in 1 million as exceptionally safe.[2] The radiation risks for simple X-ray examinations of the teeth are deemed to fall into this low risk category (less than one in 1 million risk).

The use of radiographs within clinical dentistry is controlled by the Ionising Radiation Regulations 1999 and the Ionising Radiation (Medical Exposure) Regulations 2000 (IRMER). These regulations necessitate the need for all radiographs to be justified, recorded in the patient's notes and a quality assurance programme established to improve the quality of radiographs produced.[3]

Quality assurance (QA) in radiography is a plan of action that ensures all radiographs conform to a consistently high standard while minimising the radiation exposure to patients and staff.[4] With appropriate training, this can be easily carried out by the dental nurse, the objective being to minimise the risk or to eradicate the risk completely. To achieve this involves assessing the quality of the films processed to establish the following key aspects:

- Is the film diagnostically acceptable?
- Is a fault present?
- What is the fault?
- How has it happened?
- How can it be prevented from happening again?
- Is re-exposure of the patient necessary?

The overall aim of a QA programme should involve a scoring system that is explicit and followed by all staff. It should easily identify any areas of concern and generate solutions to the problems identified. Furthermore, it should limit the number of patient exposures to the minimum required for clinical need.[5]

A method outlined in clinical governance guidelines uses a simple scoring system and should include the following detail:

- Score 1 - excellent quality radiograph
- Score 2 - diagnostically acceptable quality, minimal errors present that do not prevent the radiograph from being used for diagnosis
- Score 3 - unacceptable quality, where errors present prevent the radiograph from being used for diagnosis, and will therefore require a retake.

Score 1 should be at a minimum of 70% of all exposures while score 3 should be at a maximum of 10%.[5,6] The outcomes need to be recorded following each exposure so that results can be analysed on an ongoing basis and any problems identified. Scores 2 and 3 should highlight any trends towards operator fault or equally poor processing, indicating a faulty machine or spent solutions.[5]

Careful processing carried out in accordance with the manufacturer's instructions eradicates one of the causes of repeat radiographs due to a faulty processing technique. Repeating the radiographic examination because of processing errors results in increased radiation exposure to dental staff and to the patient. A high standard of processing produces better quality films. To ensure radiographs are processed optimally it is important that you understand the two measures of X-ray quality, specifically density and contrast.[4]

Density

Density relates to the degree of blackening of the film following exposure and processing. The blacker the area the greater the density. Radiographs that have too little density will appear too light. Radiographs that have

too much density will appear too dark. It is difficult to interpret detail on a film that is either too dark or too light.[4]

Contrast

Contrast is the relative difference in density between the lightest and darkest parts of the radiograph. Contrast gives the operator the ability to distinguish the object seen in the radiograph.[4]

A dense image

A processing temperature that is too high or a developing time that is too long will produce a radiograph that is too dense.[4]

A light image

A processing temperature that is too low, a developing time that is too short or a processing solution that is too old or depleted will produce a radiograph that is too light.[4]

As X-rays cannot be seen or heard, it is easy to forget that they are potentially dangerous to health and, moreover, an overdose can give rise to serious health effects, thus the significance of avoiding retakes.[5] Although the risk associated with ionising radiation is real, we are all exposed to natural background radiation every day of our lives. This comes from the ground (16%) and building materials around us, the air we breathe, the food we eat (12%) and from cosmic rays (14%). In fact, in most of the United Kingdom the largest contribution is from radon gas (58%) which percolates out of the ground and accumulates in our houses.[2]

No person shall carry out a medical exposure unless it has been justified by a practitioner as demonstrating a net benefit.[6] However, as long as it is clearly necessary to help make the correct treatment decision for a patient, the benefits from an X-ray examination should usually outweigh these small radiation risks.[2]

Compliance with IRR 99

The preliminary act of compliance is to inform the Health and Safety Executive (HSE) whenever a dental workplace begins to use ionising radiation for the first time and with each change of ownership thereafter. Three recognised appointments must then be made by the employer.

The Employer (legal person) is responsible for providing the overall safety of the practice and for ensuring that staff and procedures conform to the regulations. In addition, the legal person must provide written procedures for medical exposures and is responsible for arranging a three-yearly assessment of radiation safety within the workplace. This involves organising an inspection with a competent authority such as the Health Protection Agency (formerly the National Radiological Protection Board).

The Radiation Protection Advisor (RPA) is a medical physicist who is appointed in writing by the dental workplace and is available to give advice on staff and public safety in relation to both sets of regulations.

The Radiation Protection Supervisor (RPS) is a designated individual within the workplace who can assess risks and ensure precautions are taken to minimise them in accordance with IRR99.

The legal person must draw up a set of local rules which have to be displayed at each X-ray machine, so that they can be referred to by all staff. The local rules must give all of the following information.

Local rules

- The name of the designated Radiation Protection Supervisor (RPS) and Radiation Protection Advisor (RPA)
- The identification of each controlled area
- Display the standard warning sign at each controlled area
- A summary of the correct working instructions for each controlled area
- A summary of the contingency plan to be followed in case of an equipment malfunction
- Details of the dose investigation level
- The use of a red light and audible buzzer to indicate the actual exposure time
- The arrangements in place for the safety of pregnant staff.

It is recommended that these written procedures and the local rules are kept together as a radiation protection file and that all staff are made aware of the contents.[1]

Radiation Protection Advisor

The role of the RPA is to give advice on the actions the workplace must take to comply with both sets of regulations and will include the following aspects:

- The implementation of controlled and supervised areas
- Installation of new or modified sources of ionising radiation
- The frequent use and calibration of radiation monitoring equipment, examination and testing of engineering controls, design and safety features, warning devices and regular checking of systems of work provided to restrict radiation exposure.[1,7]

Radiation Protection Supervisor:

The chief responsibilities of the RPS are to ensure that work is carried out in harmony with IRR99 and the local rules are observed.

The RPS must be adequately trained, should be closely involved with the radiography and have the authority to satisfactorily implement their responsibilities.[1,7]

'AS X-RAYS CANNOT BE SEEN OR HEARD, IT IS EASY TO FORGET THAT THEY ARE POTENTIALLY DANGEROUS TO HEALTH AND AN OVERDOSE CAN GIVE RISE TO SERIOUS HEALTH EFFECTS, THUS THE SIGNIFICANCE OF AVOIDING RETAKES.'

Duties of the referrer, practitioner and operator

The Referrer: a registered dentist or dental care professional (DCP) who refers the patient for radiation exposure, either to themselves or to another dentist or specialist dental radiographer who can carry out that exposure.[1,5,8]

IR (ME) ER Practitioner: the dentist or DCP who takes responsibility for justifying the taking of the radiograph, by determining that the diagnostic benefits gained will outweigh the risks of the exposure to the patient.[1,5]

The Operator: the individual executing any practical aspect of the exposure. Practical features include:

- Patient identification
- Positioning the film, patient or X-ray tubehead
- Setting the exposure parameters
- Pressing the exposure switch to initiate the exposure
- Processing films
- Clinical evaluation of radiographs
- Exposing test objects as part of the quality assurance programme.[1]

Clinical audit

Requirements for clinical audit must be made and may include aspects of the QA programme. These may include the appropriateness of the radiographic requests and the clinical evaluation of radiographs.[1]

Training and continuing education

Following qualification operators and practitioners must undertake continuing education and training in all aspects of dental radiology and this should remain integral to their lifelong learning. It is suggested that practitioners attend a formal course every five years covering all aspects of radiation protection. Schedule 2 of IRMER lists the subjects that might be included in this training such as:

- Radiation doses and factors affecting doses in dental radiography
- Risks of ionising radiation
- Principles of radiation physics
- Principles of radiation protection
- Statutory requirements
- Quality assurance.[1,7]

For practitioners with a UK dental degree, this training requirement is met at undergraduate level; for non-UK graduates, the employer must establish whether the training is adequate to meet the standards required.

Operators who are not practitioners may also achieve a formal qualification. For example operators such as dental nurses who may be required to select exposure parameters and/or position the tube head can address this requirement by achieving a Certificate in Dental Radiography, which conforms to the syllabus laid down by the College of Radiographers.

Operators involved in film processing or QA checks must also receive training on how to undertake these tasks. This may be provided in-house, but evidence should be kept that instruction has taken place, for example in a training record.[7]

©iStockphoto/Thinkstock

'THE EMPLOYER MUST KEEP A RECORD OF ALL TRAINING UNDERTAKEN BY HIS/HER EMPLOYEES. THIS WOULD NORMALLY STIPULATE DATES AND CONTENT OF TRAINING AND MAY ALSO COMMENT ON ANY ADDITIONAL TRAINING NEEDS.'

Record keeping

The employer must keep a record of all training undertaken by his/her employees. This would normally stipulate dates and content of training and may also comment on any additional training needs. The record should also include evidence of in-house training provided.

Finally, operators and practitioners that are using Cone Beam Computed Tomography (CBCT) require additional training in this new technique. A core curriculum has been produced by the Health Protection Agency (HPA) and the British Society of Dental and Maxillofacial Radiology (BSDMFR) covering the training requirements for any individual undertaking the role of practitioner or operator.[7]

1. Whaites E. *Radiography and radiology for dental care professionals,* 2nd ed. London: Elsevier Limited, 2009.
2. National Radiological Protection Board. *X-rays, how safe are they?* Oxon: National Radiological Protection Board, 2001a.
3. Faculty of General Dental Practitioners (UK). *Clinical Examination and Record Keeping. Good Practice Guidelines.* London: Faculty of General Dental Practitioners, 2001.
4. The Dental Nurse Online. *Learner guide-assisting with dental radiography,* 1st ed. Australia: The Dental Nurse Online, 2011.
5. Hollins C. *Levison's textbook for dental nurses,* 11th ed. West Sussex: John Wiley and Sons Ltd, 2013.
6. National Radiological Protection Board. *Guidance notes for dental practitioners on the safe use of X-ray equipment.* Didcot: National Radiological Protection Board, 2001b.
7. Public Health England. *Radiation protection in dental practice.* Leeds: Public Health England: Radiation Protection Services, 2013.
8. Society of Radiographers. *IR(ME)R 2000 and IR(ME) Amendment Regulations 2006 & 2011.* Library Professional & Trade Union Titles, 2012. Available at: www.sor.org/learning/document-library/irmer-2000-and-irme-amendment-regulations-2006-2011 (accessed 4 February 2014).

*Radiography is a **CORE** CPD topic! Visit www.nature.com/bdjteamcpd to obtain one hour of verifiable CPD based on content in this article.*

bdjteam201426