Dental Radiology and Good Practice

The use of ionising radiation in dental practice is subject to the requirements of the Ionising Radiations Regulations 1999 (IRR99) and the Ionising Radiation (Medical Exposure) Regulations 2000 (IR(ME)R). IRR99 relates to the protection of the patient, and the basic requirements that patient exposure must be kept as low as reasonably practicable (ALARP). IR(ME)R relates to written procedures and protocols that demonstrate how this optimisation of dose is achieved.

Dental radiology is an important aspect of any practice. Under the law, the responsibilities for compliance with IRR99 and IR(ME)R largely rests with the ‘employer’. Often dentists working within a dental practice are treated as self employed for tax purposes, for example as associates. However, people working under the control and direction of others may nevertheless be treated as the employees for health and safety purposes. Within a dental practice what matters is that there is a clearly defined person or body corporate who takes legal responsibility for radiation safety. That person, or body is referred to as the legal person.

In order to comply with the relevant statutory requirements a Radiation Safety Policy may be made stating:

- The legal person and their responsibilities (usually the employer)
- A named person responsible for drafting, issuing and annually reviewing clinical procedures and protocols (possibly a practice manager)
- A named person responsible for health and safety arrangements
- A named person responsible for ensuring an effective quality assurance programme is maintained at the practice (possibly a head nurse)
- Who the Radiation Protection Adviser (RPA) is and their contact details (usually an external contact)
- Who the Radiation Supervisor is (usually an internal person at the practice, like a dentist)
- What a referrer, practitioner, operator is
- Notification details to the health and safety executive (HSE).

Radiology will not only affect the patient but each and every member of the practice, be it a nurse, clinician, therapist, receptionist etc. Certain protocols must be in place in order to maintain efficient and safe running of the practice. Below are a few of the criteria which will involve the whole dental team and a few tips on how to help with the management of radiology in your practice. Of course, the list is not exhaustive, and these are only a few examples.

Patient identification

When a patient is called into the dental examination room their identity should be confirmed prior to the dental examination starting, by the dentist or whoever is going to take the x-rays. If the operator (the person taking the x-ray) is not the same as the referrer (the person requesting the x-ray), then patient checks should be made prior to exposure such as, name, address and date of birth to confirm the correct patient.

Clinical evaluation

The objectives of a clinical evaluation are to ensure that every dental exposure undertaken within a particular practice has a recorded clinical evaluation. The operator who takes the radiographs is responsible for ensuring that a clinical evaluation is recorded in the patient’s dental records. The
operator could be a dentist, dental nurse, hygienist or therapist who is adequately qualified and trained to do so.

The evaluation of the whole image should include:

- The patient identity
- Signature or initials of the operator undertaking the evaluation
- Details of all the findings including charting of caries
- Findings relevant to the patient’s management/prognosis
- In the case of pre-extraction radiographs - it may be adequate to report either ‘root form simple’ or ‘nothing abnormal detected’.

A simple practice audit can be done by the nurses, at regular intervals, to ensure these criteria are being met. Indeed the audit may flag up areas of importance which could be managed at the next practice meeting.

Training and education

This will ensure all entitled practitioners and operators have received adequate qualifications (complying with IR(ME)R) and training for the duties they are undertaking, and that records of such training are maintained and reviewed annually. For example dentists (who can prescribe, refer, set up and take x-rays) must have an undergraduate degree and attendance at a formal course every 5 years to cover radiation protection and the requirements of IRMER. It is equally important that they also undertake continuing professional education and training after qualification including, in the case of clinical use of new techniques, training related to these techniques and the relevant radiation protection requirements. This currently amounts to the nature of any training which they have had and when it was completed, and for registration with the GDC, they currently require 5 hours in any 5 year period.

These checks can be made at the yearly appraisals of each staff member/operator. (Since it is the employer’s responsibility to ensure all the arrangements are in place to maintain an up to date list of qualifications and duties for each operator/practitioner).

On induction and with the implementation of any new radiation equipment or equipment software there must be associated training which must be documented within the duty holder’s training record. Their scope of practice should also be reassessed by an appropriate person (such as a Radiation Protection Advisor). It may also be useful to have the local rules at each x-ray unit so that the staff who are competent to use the machines are fully aware of what protocols are used in a particular practice. Again a staff meeting would be useful to ensure each operator is aware of how to use the machines in that practice, and each staff member is aware that such protocols should be followed in order to safely provide the exposure to the patient.

Incident reporting

The idea of an incident report is to ensure that incidents and near misses involving patient overexposures are properly investigated and recorded. These must be reported to the appropriate statutory authority promptly. It is important for the whole dental team to be aware of the protocol, if such incidences were to happen. The individual who identifies the error is responsible for recording the available data on the incident or near miss and for informing the Named person e.g. Radiation Protection Supervisor (RPS) or employer within one working day. The Named person is then responsible for carrying out an investigation of the incident and when necessary, liaising with the
Radiation Protection Adviser (RPA) or Medical Physics Expert (MPE) regarding the patient dose as soon as possible.

The MPE or RPA is responsible for making an assessment of the dose to the patient and for advising the Named person on whether an incident needs to be reported to the relevant statutory authority or if any other steps need to be taken. The Named person will inform the statutory authorities of any reportable incidents within 3 weeks of the incident occurring.

The dental practitioner must decide on whether to inform the patient or not. This must be documented in the patient’s dental/electronic records. The patient should be informed unless it is deemed not to be in their best interests. If the patient is not informed of the incident, the reasons why should also be documented.

The referrer, when they were not also acting as the practitioner and operator, will provide a written explanation of the reason for any incorrect referral, and the action they have taken to avoid similar errors in the future. If it is suspected that an unintended patient exposure, overexposure or near miss has occurred, the duty holder shall record on an incident form/other method of recording and provide it to the employer/RPS. The form should include:

- The age and demographic details of the patient
- The x-ray machine settings, dose area product (DAP), the kV and mAs (if known)
- Any other relevant information e.g. error codes, time for which the exposure appeared to continue, or unusual signals
- What happened and why
- Any other relevant information.

If it is suspected that the incident is due to an equipment malfunction, the equipment must be withdrawn from use and other staff notified. Warning signs must be placed on the faulty equipment. The equipment must not be reused until the reason for the incident has been clarified. Call the equipment service engineer or RPA for assistance if necessary.

The Named person shall investigate in order to assemble evidence to determine what events led to the near miss or incident and to allow the dose to be calculated in consultation with the MPE or RPA. The report from this investigation shall include details of what happened, the dose assessment, whether the patient has been informed, what actions have been taken to minimise the risk of a similar incident occurring in the future and any recommendations.

Regulations require that incidents involving an exposure of a patient to a radiation dose ‘much greater than intended’ are reported to the Health and Safety Executive (HSE) if they are due to an equipment fault (IRR99). A practice meeting on the above will make sure all team members are aware of the protocols involved. The Named person shall place copies of the incident report in the Radiation Protection file and the patient’s dental/electronic records. This report shall be retained for at least 2 years if it was not much greater than intended. For incidents reported to HSE a record must be kept for at least 50 years.

Any lessons arising or changes to practice following the investigation will be implemented to ensure that the risk is minimised in the future. Relevant staff will be informed of all incidents, any lessons arising from the investigation and any changes to practice by e-mail, staff meeting or handover book.

Reducing the probability and magnitude of unintentional exposures
The employer will ensure that an equipment inventory is kept on all radiation equipment and that the equipment is maintained in accordance with manufacturer’s instructions. This may be done every 3 years or so, but your Radiation Protection Adviser (RPA) will let you know when to do it. The employer must ensure that all duty holders shall comply with the employer’s procedures. Practitioners and operators shall ensure that the doses arising from an exposure are kept as low as reasonably practicable consistent with the intended purpose. A yearly log in your maintenance folder or radiation folder will help keep you up to date with this also.

The Practice may want to adopt the following protocols for their practices:

- Employer’s procedures and protocols will be in place and regularly reviewed to ensure they match local practice
- All equipment will regularly undergo quality assurance to ensure it is functioning correctly
- Additional equipment QA checks carried out if over 10% of images are deemed unacceptable
- Staff feedback given following incidents
- Training and competence assessments will be undertaken including when new equipment and procedures are introduced
- Induction programmes for new staff
- Grading and review of dental images
- Clinical audit
- Audit of procedures
- Good practice and technique applied
- Investigation of near miss incidents
- Peer review of images – looking at image quality to include positioning, collimation, density, sharpness and exposure
- Regular practice meetings.

Quality Assurance

The main objective of a QA programme is to ensure that radiation doses are kept as low as reasonably practicable. It is therefore necessary to monitor patient doses on a regular basis. Patient dose cannot be maintained as low as reasonably practicable unless the x-ray equipment complies with recommended standards. Dental x-ray equipment must be subject to the following tests:

- A critical examination by the installer, following installation
- An acceptance test before the equipment is put into clinical use
- Further routine tests at appropriate intervals and after any major maintenance procedure.

The recommendations are that such routine tests are carried out at intervals not exceeding 3 years. However annual testing is recommended. QA tests can be used to monitor the overall performance of film processing, and regular use of these tests can identify problems with film processing before they affect patient films. Checks can be made on the chemicals, cleaning procedures of the automatic chemical developers , dark rooms, developer temperatures, x-ray films (for out of date x-rays, storage etc), intensifying screen inspections, viewing facilities etc.

The other dental recommendation is that a simple, subjective quality rating system is in place for the radiographs. This can easily be done by qualified nurses. Using the system below a regular analysis of image quality can be performed at the practice. Such an analysis can be undertaken prospectively, whereby image quality is assessed as each radiograph is viewed, or retrospectively,
where a representative sample of radiographs are drawn from the clinical records. The radiographs being assessed can be rated from 1-3 as defined below. The ratings should be recorded in a suitable log.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Quality</th>
<th>Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Excellent</td>
<td>No errors of patient preparation, exposure, positioning, processing or film handling</td>
</tr>
<tr>
<td>2</td>
<td>Diagnostically acceptable</td>
<td>Some errors of patient preparation, exposure, positioning, processing or film handling, but which do not detract from the diagnostic utility of the radiograph</td>
</tr>
<tr>
<td>3</td>
<td>Unacceptable</td>
<td>Errors of patient preparation, exposure, positioning, processing, or film handling which render the radiograph diagnostically unacceptable</td>
</tr>
</tbody>
</table>

There is a minimum recommended standard that quality ratings should meet (see below).

<table>
<thead>
<tr>
<th>Rating</th>
<th>% of Radiographs Taken</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>not greater than 10%</td>
<td>not greater than 10%</td>
</tr>
<tr>
<td>2</td>
<td>not greater than 20%</td>
<td>not greater than 40%</td>
</tr>
<tr>
<td>1</td>
<td>not less than 70%</td>
<td>not less than 50%</td>
</tr>
</tbody>
</table>

Practices should aim to achieve these within 3 years of implementing a QA programme.

Audit

Audits are very important tools used to ensure that the content of the written procedures are audited to ensure compliance by the duty holders. They can be carried out on several aspects of radiology for example the quality of radiographs taken by each operator/practitioner could be audited to ensure good diagnostic radiographs are consistently taken. The employer will ensure that annual audit is undertaken with a consistent approach and that the outcome of all audits will be fed back to relevant staff at practice managers.

An audit programme is in place which outlines the methods to be used to carry out each audit. The audit programme will describe the person responsible for carrying out each of the audits (nurse, practice manager, dentist), the standards, criteria, timescales and details of the audit process (probably at a practice meeting). These should be carefully stored in a safe place like your radiation protection file.

Risk assessment

This covers the application of the Ionising Radiations Regulation 1999 to work with dental x-ray equipment. The assessment concerns the exposure to radiation of employees and members of the public. The following persons are identified as being at risk:
• Operators directly involved with the radiography
• Other staff members outside of the radiography areas e.g. practice managers, receptionist etc
• Members of the public e.g. patients in the waiting rooms.

Special considerations may also be given to employees who are pregnant or under the age of 18.

This will involve the whole set up of how you take the x-rays for example:

• That no one is in the controlled area except the patient
• The distance the operator stands from the primary beam
• That the exposure switches are audible and a visible warning light shows that x-rays are taking place
• The positioning of the operator’s control panel so that the operator can always see the patient and the equipment warning lights during exposure
• Quick access to the isolation switches from the mains supply without having to enter the controlled area.

Cross infection control

During any dental radiography procedure, the radiographic equipment can become contaminated with the patient’s saliva and/or blood if aseptic techniques are not practiced. Dental health care professionals can also become at risk for occupational exposures to these contaminants as the microbes can survive on the equipment and developer and fixer solutions for a period of time. Cross infection must be strictly adhered to in order to prevent disease transmission between both the staff and the patients, thus helping to protect both. Simple procedures can be followed to help prevent contamination, these may included the following:

• The use of disposable and heat sterilisable x-ray accessories
• Immersion of heat sensitive items in liquid disinfectants
• Surface covers
• Disinfectant spray used on clinical contact areas
• The use of personal protective equipment (PPE) such as gloves and masks
• Training for anyone involved in helping to take the x-rays.

It may be easier to divide the clinical areas for a radiographic procedure into the following:

A. Tasks before the radiographic procedure:
   • This may include sterilisation of all intraoral x-ray equipment, and any disposable equipment set up.
   • Surface covers on any areas that may get clinical contact e.g. x-ray tube heads, x-ray control switches etc
     • All equipment required is set up
     • All staff involved in the procedure have PPE on
     • Label film mounts or envelopes or create the patient file if digital.

B. Tasks during the radiographic procedure may include:
   • Keep all PPE on
   • The x-ray film can have a protective /disposable pouch
   • Touch as few surfaces as possible
   • Remember clean and dirty zones.
C. Tasks after the radiographic procedure:
   • Place reusable film holders in a designated contamination area
   • Carefully remove the film packets from their protective pouches, allowing the films to gently fall out of their pouches
   • Remove all covers from the surfaces and discard
   • Disinfect uncovered contamination surfaces wearing gloves.

D. Tasks associated with the x-ray developing.
   • Transport the films in disposable containers e.g. a plastic cup
   • Process films
   Disinfect uncovered areas of the developer with new PPE.

Infection control for dental radiography employs the same materials, processes and techniques that you would use whilst treating a patient in the surgery. The protocols and procedures given in this article are generalised as every practice is individual with is staff and employers. Your Radiation Protection Advisor should help you ensure your set up is correct.

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