Radiography Quality Assurance

Core Subject

Aims: This article aims to give an overview on the importance of developing a Quality Assurance (QA) programme in respect to dental radiography in the dental practice.

Objectives: On completion of this verifiable CPD article the participant will be able to demonstrate, through completion of a questionnaire, the ability to:

- Identify the legislation relating to dental radiography
- Identify a definition of quality assurance in dental radiography
- Demonstrate an understanding of the main principle behind a quality assurance programme in dental radiography
- Demonstrate knowledge of some of the components of a quality assurance programme in dental radiography

Introduction

Dental radiography can be considered to be one of the dental clinicians’ most important diagnostic aids. However, radiography does come with a significant number of responsibilities to protect the patient, general public and workers. There are two sets of regulations in the UK governing the use of ionising radiation. Firstly, the Ionising Radiation Regulations 1999 (IRR99) which are enforced by the health and safety executive and are primarily concerned with the radiographic equipment, the workers and the public.\(^1\) Secondly, the Ionising Radiation (Medical Exposure) Regulations 2000 (IR(ME)R2000) which are governed by the Care Quality Commission and are primarily concerned with the protection of the patient.\(^2\) Both the IRR(99) and IR(ME)R 2000 place clear, but different responsibilities on the legal person to establish and maintain QA programmes in respect of dental radiography. Thus, the establishment of a quality assurance programme is a mandatory requirement for dental practices.

This article will define quality assurance in respect of dental radiography and outline the components of a quality assurance programme which are based on the 2001 Guidance Notes for Dental Practitioners on the Safe Use of X-ray Equipment.\(^3\)
What is Quality Assurance in Dental Radiography?

The World Health Organisation defines QA in radiography as:

"An organised effort by the staff operating a facility to ensure that the diagnostic images produced by the facility are sufficiently high quality so that they consistently provide adequate diagnostic information at the lowest possible cost and with the least possible exposure to radiation."

Therefore, the aims of a QA system are:

- To produce radiographs that are of a consistently high standard
- Reduce the number of repeat radiographs
- To highlight sources of error so that they can be rectified
- Reduce costs
- Increase efficiency
- To ensure that radiation doses to patients (and staff) are kept as low as reasonably practicable. (ALARP)

Employers deemed not to be keeping exposures as low as they reasonably can, could be at risk of prosecution.

The 2001 Guidance notes explain that a well designed quality QA programme should be simple and inexpensive to run. Once standards are checked, they should only require occasional verification or modification.

The basic principle of a QA programme is that within the overall QA programme all necessary procedures should be laid down in writing, such as:

- The implementation should be the responsibility of a named person- This is often a senior partner.
- The frequency of operations should be defined
- The content of the essential supporting records should be defined, as should the frequency for the formal checking of such records.

Essential Quality Control Procedures

Essential quality control procedures that relate to dental radiography are:

1) Image quality
2) Patient dose
3) Darkroom, films and processing
4) Training
5) Audits

1) Image Quality

One of the most important parts of the QA programme is to ensure that good quality images are produced that will aid the clinician in the treatment of the patient. It is therefore vital that images are monitored on a regular basis and that steps are taken to improve targets where applicable. Figures 1 and 2 show an example of good and poor quality radiographs respectively.

![Fig. 1](image1.jpg)  ![Fig. 2](image2.jpg)

The 2001 guidance notes recommend two alternative approaches to ensure that image quality is rated:

- A prospective evaluation which involves measuring radiographs as they are being viewed against image quality ratings. This should be followed with an analysis of results and it is recommended that the intervals between analysis do not exceed six months
- A retrospective evaluation whereby a representative sample of radiographs are drawn from clinical records at regular intervals, the image quality ratings are assigned and recorded, and the results analysed. It is recommended that this should be undertaken at intervals that do not exceed six months

Table 1 shows recommended targets that practices should aim to achieve within three years of the implementation of the QA programme. It also shows interim targets that should be regarded as the minimum acceptable standards in the short term.
### Quality assessment of radiographs

<table>
<thead>
<tr>
<th>Rating</th>
<th>Quality Criteria</th>
<th>Targets: percentage Of radiographs taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Excellent - no errors of exposure, positioning or processing</td>
<td>Not less than 70% (interim target not less than 50%)</td>
</tr>
<tr>
<td>2</td>
<td>Diagnostically acceptable - some errors of exposure, positioning or processing, but which do not detract from the diagnostic utility of the radiograph</td>
<td>Not greater than 20% (interim target not greater than 40%)</td>
</tr>
<tr>
<td>3</td>
<td>Unacceptable – errors of exposure, positioning or processing which render the radiograph diagnostically unacceptable</td>
<td>Not greater than 10% (interim target not greater than 10%)</td>
</tr>
</tbody>
</table>

Table 1: Image quality targets

Fig. 3 shows an example of a simple capture sheet that can be used in the surgery to rate the image quality of radiographs retrospectively or prospectively.

![Fig. 3 Example QA image log](image-url)
It is important that all the results are kept together. The important part of the analysis is the reasons for failure. A record of corrective actions taken should be recorded.

In addition to the formal analysis, it is recommended that day-to-day comparison of the quality of every radiograph is measured against a high quality radiograph which can be left on the viewing screen. Any significant deterioration of quality between the two images should be investigated.

2) Patient Dose and X-ray Equipment

As previously mentioned, one of the main aims of a quality assurance programme is to ensure doses to patients are kept **As Low As Reasonably Possible**. Patients doses should be monitored regularly to ensure they stay below the national diagnostic reference levels. In order to achieve this, it is important that X-ray equipment complies with current recommendations and is appropriately maintained.

The Health and Safety Executive (HSE) must be informed of the routine use of dental x-ray equipment. The HSE doesn’t need to be notified if equipment is upgraded; however, if there is a change of practice ownership or a move to a new premises, then the HSE must be informed of the change.

IR(ME)R 2000 requires that an up-to-date inventory is held for each piece of equipment which will contain:

- Name of manufacturer
- Model number
- Serial number
- Year of manufacturer
- Year of installation

All dental X-ray equipment should be maintained regularly and critically examined every three years. Routine surveillance should involve day to day checks of equipment. An equipment log should include a periodic record (6 months recommended) to confirm that the checks have been made. Further details can be found in the 2001 Guidance Notes which are available from the non verifiable section of the website.

3) Darkroom, films and processing

Despite digital x-rays, the majority of x-rays are still produced on film. Reports in the 1980’s and 90’s found that 90% of film faults were as a result of processing errors. Poor quality film handling and processing will negate any advantages from good
technique if it results in the image quality being compromised. The following should be implemented:

- Routine checks to ensure darkrooms and processing units remain light tight and that safelights do not produce fogging of films (checks should be made at least annually and results recorded)
- Processors must be regularly serviced and undergo regular cleaning of rollers and chemical tanks
- Solutions should be tested to ensure correct strength and changed when necessary
- Films should be stored in a cool, dry place and rotated to ensure that older stock is used first

The QA standards will be laid down by the suppliers of the films, processing solutions and processing equipment. Records should be kept detailing the procedures in place to control film stock; records to control and validate the chemical changes; and, cleaning procedures for automatic processors. This can be achieved through recording everything in a simple log book.

Overall performance of processing should also be monitored. Please see the non verifiable section of the website for further information on testing procedures including step wedge and coin tests.

**Working Procedures**

These include:

- Local Rules- Required in the UK under the IRR1999\(^1\)
- Employers' written procedures- Required in the UK under IR(ME)R2000\(^2\)
- Operational procedures or systems of work- Should be provided for all actions that indirectly affect radiation safety and diagnostic quality (ie actions not directly linked to use of x-ray equipment such as the correct preparation and use of processing chemicals)
- Procedures log- This should be used to record the existence of appropriate local rules, legal person’s procedures and operational procedures, together with a record of each occasion on which they are reviewed or modified (intervals not exceeding 12 months)\(^5\)

**4) Training**

IR(ME)R2000\(^2\) stipulates that all practitioners and operators involved in exposing patients to x-rays must be adequately trained and that Continuing Professional Development is undertaken. The QA programme should incorporate a register of all
staff involved in any aspect of radiography and should include the following information:

- Name
- Responsibility
- Date, nature and details of training received
- Recommended date of review for training needs

5) Audits

![Fig.4. The steps to a clinical audit](image)

Each procedure within the QA programme will include a requirement for the written records to be made by the responsible person at varying intervals. In addition, the person with overall responsibility of the programme should check the full programme at intervals not exceeding 12 months. This is an essential feature of demonstrating effective implementation of the programme.\(^5\)

The steps of an audit are detailed above in fig.4. It is important that the data is analysed and any changes identified are implemented in order to aim to improve current standards.

Any part of the QA programme may be audited such as:

- Mounting, labelling and filing of radiographs- Was it carried out correctly and were the x-rays available for the patient’s next appointment?
- Stock control- Is stock stored correctly? Is it in date?
- Reporting on the radiographs- Has this been completed and recorded in the patient’s clinical notes?
- Justification of radiographs- Was the justification for taking the radiograph clearly marked on the notes?
- Image quality. Are they correctly exposed and developed? Was it necessary to retake the radiograph and if so why?
Conclusion

Radiography can be considered to be an essential tool in clinical diagnosis and treatment planning. However, radiography does come with a significant number of responsibilities to protect the patient, general public and workers. Implementing an extensive QA programme with respect to dental radiography will help to ensure that any risk from ionising radiation is kept as Low As Reasonably Practicable.

Please refer to the following non verifiable CPD reading:

- Example audit in dental radiography
- Ionising Radiation Regulations 1999
- Ionising Radiation (Medical Exposure) Regulations 2000
- NRPB 2001 Guidance notes for dental practitioners on the safe use of X-Ray equipment
- Wedge and coin testing as part of QA system in Dental Radiography

Don’t forget to update your non verifiable CPD log

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References