QUALITY ASSURANCE IN DENTAL RADIOGRAPHY

Part of the Ionising Radiation Regulations

Section 4 (3) IR(ME)R 2000
Quality Assurance (QA)

• Ensure consistently adequate diagnostic information whilst keeping doses as low as practical.

• QA programme should be comprehensive, but inexpensive to operate and maintain.

• Much of QA is common sense.
Quality Assurance (QA)

• Many studies, including those of the DPB, have shown that up to 50% of dental radiographic images are of poor standard.

• Rushton & Horner
Quality Assurance (QA)

• Programme should be written down
• Must be implemented and made the responsibility of a named person
• Frequency of implementation should be defined
• Follow section 5 of guidance notes, page 32, (Dept of Health)

www. google.co.uk dental guidance notes
Quality Assurance (QA)

- Image quality
- X-ray equipment
- Darkroom, films, processing
- Training
- Audit
Subjective quality ratings of radiographs

• 1- Excellent- no errors of exposure, positioning or processing.  
  Not less than 70%.

• 2- Acceptable- some errors which do not detract from the diagnostic use.  
  Not greater than 20%.

• 3- Unacceptable- errors which render the radiograph diagnostically unacceptable.  
  Not greater than 10%. 
Dental X-ray Equipment

• Designed, constructed and installed to comply with European standards
• Meet requirements of Medical Devices Agency
• Manufacturers must provide adequate information on use, testing and maintenance
A newly bought set must have:

- A critical examination by the installer. A report is given. It includes:
  - a description of the set & its location
  - evaluation of warning signals
  - evaluation of exposure control
  - confirmation of radiation protection and safety features
  - confirmation of acceptable functioning of cut out switches etc.
QA Patient dose and equipment

• A newly bought set must also have an acceptance test before it can be used clinically.

• The ‘legal person’ is responsible for this test on receipt of an x-ray set.

  - The RPA usually undertakes this test as it requires a qualified physicist in ionising radiation
  - to determine that equipment is functioning correctly within agreed parameters
  - an assessment of a typical patient diagnostic reference level.
Routine tests are then carried out to monitor the performance of the equipment.

- In GDP, X-ray sets must be regularly checked for radiation safety at least once every 3 years.
- In hospitals it can be every year
  All X-ray equipment must be serviced according to the manufacturer’s specification. This is usually annually.
  Includes automatic processors.
Regulation 10 of IR(ME)R 2000

Information on X-ray sets:
• Name of manufacturer
• Model number
• Serial number
• Year of manufacture
• Year of installation
Image quality

• Image quality should be regularly monitored and film quality checked daily.

• A record should be kept of unacceptable (grade 3) films which is classified into a category to check for trends, e.g. Date, nature of deficiency, cause of deficiency and number of repeat radiographs.
QA for Radiographic Technique

• Appropriate training and instruction;
  Intra-oral technique:
  Use of film holders with beam aiming devices.

DPT:
  Use light beam diaphragms for correct patient positioning.
Bisecting angle technique
Bisecting angle technique

- This technique is only used when the paralleling technique cannot be used, e.g. A gagging or small mouthed patient.
- This is **not** the technique of choice.
- It relies on guess work and expertise.
- Images can be distorted and prone to foreshortening or elongation.
- However, it can be useful at times for occlusal radiography, or patients who have difficulty tolerating film holders.
Paralleling technique
Paralleling technique

- Film is parallel to the tooth, the holder must be far enough into the mouth to ensure that it is parallel to the tooth
- Beam aiming device must be used.
- No distortion –
- Reproducible –
  Provided the technique is performed correctly
Orthopantomogram (OPG)
Dental Panoramic Tomogram (DPT)

• Correct patient positioning:
  - Head straight
  - Shoulder clearance
  - Neck straight
  - Bite block position and central incisors

• Need 3 light beams for:
  - mid sagittal
  - frankfort
  - AP (canine line) position
OPG/DPT
Check for correct orientation of the cassette

- There is a correct way to put the cassette in the machine.
- Tube side should be facing the patient (sometimes labelled)
- On the Planmeca machine in the department, there is an arrow on the back of the cassette, this needs to be orientated to align with the arrow on the machine.
- If the cassette is inserted upside down or back to front, the sides become reversed, so the right marker is on the left side and visa versa.
- Label the cassette if necessary with right and left markers.
Correct placement of Cassette
Exposure

- Input correct exposure parameters
- Have a standard exposure chart nearby for reference
- Always observe your patient during the exposure
- Observe infection control protocol
QA for Darkroom

• Safe light levels
  - GBX filter, low wattage bulbs e.g. <25 watts
  - no light leaks around the door
  - check light fogging with coin test

• Thermometer
• Timer
• Ventilation
• clean
Processing

• Development is very temperature and time sensitive
• Manual processing should not take place below 17 degrees c
• For each additional or lower degree c subtract or add 30 seconds
• Developer weakens even when not in use
• Thermostats in automatic processor may become inaccurate
QA for Processing

• Processor checks:
  - chemical change log, chemicals should be changed every 2 weeks
  - cleaning log
  - test object tests
  - temperature
  - cleaner film
Clinic Processors

• If a processor is used in a clinic situation, remember that the day light loader is a mini darkroom.

• Orange filter, on the processor window, is the safe light, so don’t put it under a bright light.

• Arm holes must be light proof.
Daylight Processor

Fig. 7.3A The AP200 automatic processor fitted with its daylight loading apparatus (arrowed). B The internal tanks and roller system of the AP200 processor.

Automatic processing cycle
Fig. 18.7  A simulated coin test result. The film, with seven coins on it, has been gradually uncovered every 30 seconds. The coin-covered part of the film remains white while the surrounding film is blackened or fogged. The longer the film is exposed to the safelight the darker it becomes. (Kindly provided by Mr N. Drage.)
Processing errors

Dark films may be due to:
- Over exposure
- Light fogging
- Over development

Pale films may be due to:
- Under exposure
- Under development
- Excessive fixation

- Temperature
- Concentration
- Timing excessive

These may give rise to category 3 films.
Processor test object

3. Process the film in fresh solutions to produce a standard reference film.

Fig. 18.9(i) A simple step-wedge phantom constructed using pieces of lead foil taped to a tongue spatula.

Fig. 18.9(ii) A The standard reference film of the step-wedge phantom on DAY ONE processed using newly made-up chemical solutions. B Test film processed in chemical solutions 1 week old — note the reduced amount of blackening of the second film owing to the weakened action of the developer.
Sensometric Strip

X-Ray Quality Control System

Entry Point for Vischeck Strip
LED Indicators

3b. Processed Vischeck Strip
Automatic Processor Check

• Daily: Run a cleaner film through each morning
• Weekly: Sensometric test, or test object film, check temperature at least once a week.
• Fortnightly: Change chemicals and wash transport mechanism and tanks.
• Yearly: Service machine.
QA for films

• Correct storage conditions
  - Cool
  - Dry
  - Radiation proof

• Check expiry date
  - Rotate stock
Film Storage

- Extra oral films, 18x24 and 15x30, should be stored, in their boxes, on its edge.
- Do not store film flat, as this causes pressure to be transferred to the lower films, and will cause film fogging.
- Be aware of expiry dates on the film boxes, and rotate the stock.
Cassette Care

• Clean cassettes with propriety cassette cleaner once a month, using cotton wool or a soft cloth.
• Check for scratches or marks.
• Check hinges.
• Check film/screen contact as poor contact will cause blurring of the image.
Correct Viewing Conditions

• Radiographs should be viewed correctly, on a viewing box.
• Ideally the room lights should be dimmed.
• Do not hold films up to a light or window.
Digital Radiography

• There are two types:
• Real time or corded where conventional film is replaced by either a CCD (charge couple device) or a CMOS (complementary metal oxide semiconductor sensor, which is connected to the computer via a cable or cord. The x-ray photons are converted to light which is picked up by CCD/CMOS, converted to electrical charge which when relayed to computer produces an instant image.
• Photostimulable phosphor imaging or cordless systems (PSPP), where re-usable PSPP plates are used instead of film. The phosphor layer absorbs and stores the x-ray energy, which is then read by a laser beam, digitised and sent to the monitor. This can take between approximately 1 to 5 minutes.
PSPP Digital imaging

Fig. 7.6 Examples of three phosphor plate readers. A Soredex’s Digora® Optime (intraoral), B Durr’s Vistascan and C Gendex® DenOptix®.
Phospher plates
PSPP Readers
CCD/CMOS Digital imaging

Fig. 6.14 Examples of modern solid-state sensors. A Planmeca dix²® and conventional film packets to show their comparative size, B Gendex Visualix® (kindly provided by Mr R. France), C Kodak RVG 6000.
CCD/CMOS Docking Station

Fig. 6.15  Examples of docking stations. A Planmeca Dixi® attached to an X-ray tubehead. Note the little holder for conveniently supporting the sensor (arrowed). B Gendex Visualix®. The sensor plugs into the arrowed port. The open arrowed cable connects to the computer (kindly provided by Mr R. France).
Digital QA

• PSPP sensors need to be cleaned and inspected every month for dirt, scratches, bends that would interfere with the image capture.
• CCD/CMOS sensors also need to be inspected monthly along with the cords/wires that link them to the monitor.
• There are test objects on the market which allow the digital image to be evaluated for geometric reliability.
Quality Assurance

A SUMMARY OF THE IMPORTANT POINTS
Why?

The law now requires that anything which can potentially lead to extra irradiation of either patient, staff or general public has to be meticulously monitored.
WHY?
(for ourselves)

1. Perfect results every time

2. Reduced radiation dose (to ourselves)

3. Improved diagnostic quality

4. Reduced costs
Quality Assurance Programme
(before taking radiographs)

1. Patient referral – is adequate clinical information available?

2. ID x 2 – do we have the correct patient?

3. Communication – do we understand each others objectives?
Quality Assurance Programme

4. Technique – are staff properly trained?

5. Processing – is equipment meticulously maintained?

6. Storage and retrieval – can we be sure the radiographs will not get lost?
Film Storage

1. Cool

2. Dry

3. Radiation proof

4. Rotate stock
Who is responsible?

1. Radiation Advisor – overall

2. Radiation Supervisor – locally

3. Quality Assurance Co-ordinator - specifically
Who is responsible

ALSO

4. Referrer, practitioner and operator

5. Darkroom staff

6. Clerical staff
Referral

1. Is radiograph necessary?

2. Has the patient been correctly identified by 2 means?

3. Check problem area with the patient

4. Can less films be taken to give same information?
Quality Control Tests

1. Dental x-ray set

2. Processor

3. Reject analysis
Daily maintenance (processor)

1. Top up chemicals

2. Wipe top rollers

3. Put cleaner film through processor
Daily maintenance

• 4. Visual external checks on equipment

• 5. Reject analysis
Weekly maintenance (processor)

- Change water in tank
- Step wedge/ normaliser film
Monthly maintenance (processor)

- Clean all tanks
- Change all chemicals – may be more frequent according to workload
Monthly maintenance Digital

- Check sensors, whether direct or indirect for any damage
- Check image produced using one of the recommended test objects available for distortion or loss of information
- Audit radiographic work produced using NRPB guidelines
6 Monthly maintenance

1. Visually check cassettes for defects
2. Visually check intensifying screens
3. Check darkroom is light tight
4. Check adequacy of safelights
5. Record results of reject analysis
Annual maintenance

1. Review local rules
2. Service x-ray sets
3. Service processors
4. X-ray equipment check
X-ray equipment check
annual/3 yearly for GDP’s
(Usually undertaken by RPA)

1. kV accuracy
2. Exposure time accuracy
3. Radiation output
4. Accuracy of collimation/beam size
5. Dose at end of collimator/dose width product
   Intraoral set DPT Equipment
6. Focal spot size
7. Mechanical safety
Thank you for listening