

Radiographs Clinical Guideline

Policy or objective

Evidence-based clinical guidelines are intended to provide guidance, and are not a standard of care, requirement, or regulation. However, the application of clinical guidelines in publicly-provided oral health services allows for consistency to occur across large patients cohorts with a variety of oral health clinicians.

Modern dentistry relies extensively on the use of ionizing radiation. It is used for diagnostic purposes and to assist clinicians to carry out their treatment plans more effectively.

Although individual doses in dental radiography are relatively low (Table 1), the number of radiographs taken is often high. Since exposure of living tissue to ionizing radiation results in a transient or permanent biological change at cellular level of that tissue, the decision to undertake each individual exposure must be justified. The benefit to the patient obtained from the diagnostic information should outweigh the possible detriment of the exposure. The exposure would be expected to provide new information to aid the patient's management. There is no justification for routine radiographs prior to a clinical examination. Radiology must not be used as a substitute for a clinical examination therefore radiographs are not to be undertaken until a clinical examination has been performed.

Guideline

This clinical guideline, as with all guidelines, is subject to the operator's clinical judgment; and in order to provide best practice for patients should also be read in conjunction with DHSV Radiation Safety Policy and Radiation Safety Procedure documents. Dental radiology is an adjunct to and not a substitute for a thorough clinical examination; therefore routine radiographic examinations are not acceptable and no radiographic examination must be performed until a clinical examination has occurred. It is the responsibility of the clinician following consultation with the patient to;

- Refer to any previous relevant radiographs of the patient.
- Determine and justify the most suitable type of radiographic examination for the patient.
- Note the type of radiographic examination prescribed for the patient
- Document the findings of the radiographic examination in the patient's file.

Each radiograph must be labeled with the following information

- Date of exposure
- Patient's name and dental record number.
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- Site of exposure e.g. teeth included on the radiograph (for all periapical, occlusal and bitewing radiographs)
- Exposure settings used if they differ from normal values

Radiation Safety

Whilst for most types of dental radiological examinations the risks to both patient and operator are low (Langlais et al, 2002), any exposure of living tissue to ionizing radiation does result in either a transient or permanent biological change at a cellular level. Therefore, after justification, and prior to the exposure the clinician must take into the account the A.L.A.R.A. principle, that is the obligation to keep the radiation dose **As Low As Reasonably Achievable**.

This is achieved via the following:

- Using the fastest image receptor speed available consistent with the degree of information required.

- Utilizing appropriate image processing methods.
- Minimizing the possibility of retakes by means of standardization of the radiographic and processing techniques
- Taking as few images as practical.

Use of Lead Protective Drapes (<http://www.arpana.gov.au/pubs/rps/rps10.pdf>)**Protective Drapes**

Protective drapes do not protect against radiation scattered internally within the body and only provide significant protection in cases where the X-ray beam is directed towards structures outside the dento-maxillofacial area. Even in the latter case the use of protective drape for gonadal protection could only be regarded as prudent for a small child or for a female patient who is, or may be, pregnant. Although it has been argued in the past that routine use of protective drapes for dental radiography could be justified to allay perceived patient anxiety, their routine use is unnecessary in view of the very low effective doses involved in properly conducted dental radiography. Protection of the thyroid may be relevant for some examinations (see section on children below).

Pregnancy

Radiation Protection Series Publication No. 1 (ARPANSA 2002) recommends that precautions be adopted in radiological procedures involving exposure to the lower abdomen and pelvic regions of women of reproductive capacity to ensure that the radiation dose received is as low as possible, and particular care should be taken to avoid the irradiation of the fetus whenever practicable. When radiography of an area remote from the fetus is needed, such as in dental radiography, this can be undertaken with negligible dose to the fetus at any time during pregnancy. Provision of a leaded drape is recommended when the X-ray beam is directed downwards towards the patient's trunk, for instance when taking occlusal views of the maxilla. There is no need on radiation protection grounds to defer dental radiography during pregnancy.

Children

The various factors influencing the dose to adults also apply to children, but the shorter distances between the area irradiated and many of the organs in children will result in higher doses to those organs. This is particularly true for the gonads and the thyroid. In general, it must be remembered that tissues in growing children are more sensitive to radiation than those of mature persons. Therefore, the need for radiography should be carefully assessed and appropriate protective measures such as leaded drapes and thyroid collars should be considered, particularly during occlusal views of the maxilla where the X-ray beam is directed almost vertically downwards towards the patient's trunk. However, in the case of panoramic and cephalometric radiography the use of a thyroid collar is discouraged since it may physically interfere with the procedure and can often be detrimental to obtaining an adequate image.

Infection control

Operators are to wear gloves whilst inserting the image receptor, aligning the X-ray tube head and exposing the radiograph. Wherever possible intra oral image receptors should be barrier wrapped, many are pre wrapped by the Manufacturer. After radiation exposure the barrier wrap should be opened with gloved hands and the image receptor allowed to fall onto a clean receptacle, the contaminated barrier wrap should then be discarded in accordance with current infection control guidelines as follows:

- Image receptor holding devices should be autoclavable or single use and disposable.
- Position Indicating Device (PID) or tube head should be wiped over between patients using a pre moistened detergent wipe
- Equipment controls such as timer setting and exposure buttons which are covered by a smooth and intact surface should be wiped over between patients using a pre

moistened detergent wipe. When there is a risk that detergent liquid might reach the electric circuitry these controls need to be covered with a barrier.

Selection Criteria (Appendix 1)

Children

Bitewing radiography can be a useful tool to reveal early lesions for which preventive measures can be applied and to identify lesions requiring restoration at an earlier stage than is possible by visual inspection alone.

DHSV has generally applied this resource to best effect in the permanent or late-mixed dentition (10 to 14 year olds). This can facilitate a more appropriate continuum of care as the child patient are not left with undiagnosed lesions.

Recall patients with clinical caries and/or high risk factors may benefit from posterior bitewings at recall appointments until the situation has stabilised.

Extraction:

Prior to the extraction of a deciduous or permanent tooth/teeth either a periapical or panoramic radiograph must be obtained if no recent image is available. This radiograph will provide information to the operator regarding the following:

- Root morphology
- Apical pathology
- Integrity of the surrounding alveolus and periodontium
- Position and length of tooth/teeth root/roots.
- Integrity of furcation region,
- Location of tooth/teeth roots in relation to tuberosity of the maxilla, maxillary sinus, inferior alveolar nerve
- Presence of succedaneous teeth (in the case of deciduous teeth)
- Ankylosis
- Dilaceration

Trauma:

Following trauma to teeth or the alveolar area, an occlusal (and sometimes a periapical) radiograph as well as an orthopantomogram should be taken to gain as much information as possible about the affected/traumatized site.

Other Needs in Children

Disturbances in eruption patterns, trauma and developmental conditions may require individualised radiographic examination, such as panoramic radiographs, and if necessary, supplemented with periapical and/or occlusal radiographs.

Adults

Caries

The frequency of radiological examination in adults will depend on the clinician's assessment of the patient's past caries experience. Evidence suggests that adult caries progression in the proximal surfaces of posterior permanent teeth is a slow process. It usually takes longer than 30 months for caries to progress from the enamel surface to the dentino-enamel junction. However, discretion needs to be applied where there is a large number of existing restorations and a high risk of recurrent caries. Lifestyle factors and medical conditions may also influence this decision.

Periodontal Diagnosis

Correctly taken radiographs are essential to assess the quality and quantity of the remaining bony support. For correct assessment of the relation between the crests

of the interdental septum with adjacent teeth, the paralleling technique provides better results than the bisecting of the angle technique. The health of the bone in every radiograph should be assessed as a matter of routine and radiographs which have been taken for other purposes are often useful in assessing the presence of periodontal disease.

Other Needs in Adults

Radiographic examination is recognised as part of the diagnosis and treatment of developmental abnormalities, trauma, inflammation (either acute or chronic) and other pathological lesions and conditions. Radiographs form an essential part of orthodontic, endodontic, prosthetic (both removable and fixed), and surgical treatment as well as in exodontia.

The number of exposures to be made in the examination should be the minimum necessary to obtain the required diagnostic information. The 'full mouth' periapical radiography is no longer considered as desirable as it was previously. A panoramic radiograph (OPG) supplemented with a limited number of periapical and/or occlusal radiographs will in many instances provide sufficient information and result in a lower radiation dose than a complete series of periapical radiographs (Table 1).

Radiographic Quality Assurance

Quality Assurance in radiography is an important tool to keep the radiation dose to the patient as low as possible and to achieve clinical excellence. A very simple but effective QA procedure is to keep an inventory of radiographs that needs to be re-taken. Information that needs to be recorded in this inventory is:

- Type of radiograph and area of interest
- The reason why the radiograph had to be repeated.
- The remedial action taken, if any.
- The operator (either by name or code)

After thirty repeats or after three months, whichever comes first, the results are analysed and sorted by the reasons why the radiographs had to be repeated. After some time a pattern will emerge of the most frequently occurring errors and remedial action can then be taken.

Quality Criteria for Intraoral Dental Radiographs

General

Repeat radiographs only when the diagnostic needs are not met, and not for aesthetic reasons.

1. Use paralleling technique whenever possible except:
 - When the angle between film and tooth exceeds 30° (for instance in patients with very shallow palates).
 - When the patient finds the holder uncomfortable
2. Keep a record of unsuccessful imaging outcomes, types of errors and causes of errors (as described above).

Criteria for periapical radiographs

1. Adequate density and contrast.
2. If a single tooth is examined, both the mesially and distally adjacent teeth (or areas that correspond with these teeth) should be entirely visible.

Exceptions:

- Wisdom teeth (no distal neighbour)
 - First premolar (at least the distal surface of the adjacent canine tooth must be visible).
3. Overlapping should not exceed the crest of the alveolar bone.

4. At least 2 mm of bone beyond the root of the apex should be visible.
5. The raised dot must be placed incisally/occlusally . (Not applicable to digital radiography.)
6. For Occlusal films the raised dot must be placed to the left side of the patient. (Not applicable to digital radiography.)

Criteria for Bitewings

1. Adequate density and contrast
2. Overlapping of the crowns should not exceed 50% of the width of the enamel caps.
3. 2mm of root beyond the cemento-enamel junction should be visible.
4. If there is a restoration, the apical margin should be completely visible.
5. The raised dot must be placed towards the distal of the teeth. (Not applicable to digital radiography.)

Full mouth surveys

With the advent of improved panoramic imaging, the need for “full mouth surveys” with periapical images has decreased substantially. In case comprehensive treatment is envisaged it is suggested to determine from an initial panoramic image what additional periapical or bitewing images might assist in further treatment planning.

Even in cases of selective treatment the panoramic image, when available, should be checked before deciding which additional images are indicated.

Full panoramic radiographs eg OPG, should not be repeated more often than once every 12 months. For follow-up of treatment sectional OPGs can be obtained.

Lost radiographs

Proper filing of radiographs is a simple and effective way to prevent unnecessary exposure of patients. Not returning borrowed radiographs is irresponsible.

If hard copies of digital images cannot be retrieved, patients do not have to be re-exposed; instead a duplicate can be ordered from the Radiology Department.

Transfer of Patients

Patients transferring from one practitioner to another may be exposed to unnecessary radiation if the relevant radiographs are not made available to the new practitioner. If digital images are used, a hard copy, electronic version or a written report should be made available. Patients must be advised that their radiographs are being provided to another practitioner with an explanation for the reason. This needs to be documented in the dental record.

Referral of patients

When patients are referred to the RDHM Radiology Department or radiology centres external to DHSV ensure that:

1. The reason for the request is clearly indicated. In many cases the reasons “Diagnosis” or “Treatment planning” are simply not good enough. Be as specific as you possibly can.
2. The patient is provided with relevant previous radiographs. This may assist the radiographer in producing a comparable radiograph.
3. An appointment is coordinated for complex referrals (special needs patients, multiple radiographs, tomograms, etc.).
4. When prescribing radiographs for a special needs patient or a very young child, ensure that the proposed examination is within the patient’s physical and mental capabilities.

5. When prescribing radiographs for a special needs patient ensure that the request form contains as much clinical information as possible. This will assist the radiographer in modifying the examination if necessary.
6. When referring a pregnant patient ensure that the patient is comfortable with the proposed examination. This should not be left to the radiographer, as he/she will not have all the clinical information required to reassure the patient.

The Radiology Department should be contacted if substantial numbers of patients or difficult to manage patients will be referred. This will ensure adequate radiology facilities and staff are available.

Communication with patients regarding radiation dosages

Table 1 can assist clinicians explain to patients (family/carers) the level of the radiation exposure involved in dental radiography compared with the number of days exposure to natural environmental background radiation.

Digital radiography

The Radiology Department at the RDHM is equipped with the capacity to take some radiographs digitally. When electronic records are fully implemented within the RDHM, it is envisaged that radiographs will not be printed and placed in hard copy records, but be placed into the electronic patient record. At this time, it is expected that a review of procedures and clinical guidelines regarding radiographs will be required.

This guideline can be used for digital radiography systems (scanora) as implemented in community health agencies. It is advisable to purchase self developing film radiographs in the case of disrupted computer access.

Table 1

Typical doses from some dental and medical radiographic examinations and air travel. The doses for dental radiography are small when compared with the total amount of background radiation received during a patient's lifetime (estimated at 25 000 days).

Examination	Effective Dose (mSv)	Equivalent period of natural background radiation¹
2 bitewings, 70kV, 200 mm FSD ² , rectangular collimation, E- speed film	0.002	8.8 hours
2 bitewings, 70kV, 200 mm FSD ² , round collimation, E-speed film	0.004	17.5 hours
Dental panoramic, rare-earth intensifying screens	0.007	1.3 days
Dental panoramic, calcium-tungstate intensifying screens	0.014	2.6 days
Skull	0.1	2.6 weeks
Computed tomography: head	2	1 year
Chest	0.02	3.4 days
Air travel ³ :		
New York to Paris (7 hrs 25 min.)	0.05	9 days
Melbourne to Perth (4 hrs)	0.009	1.5 days

Digital radiography provides approximately half of the dose per one standard E-speed film. ie. exposure time of 0.16sec for digital radiography verses 0.30sec for film.

Footnote¹ - Natural background radiation is approximately 2 mSv per year in Australia

Footnote² - X-ray tube focus to skin distance.

Footnote³ - The radiation dose during air travel is due to increased exposure to cosmic radiation.

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Policy owner

Chief Oral health Advisor

Approved by

Clinical Leadership in Practice
Committee

Date approved

January 2018

Related documents

- Australian Dental Association -The Practical Guides 2000.
- British National Radiological Protection Board – Guidance Notes for Dental Practitioners on the Safe Use of X-ray Equipment 2001.
- Laland OE, Lenglais RP, Preece JW : Principles of Dental Imaging. 2nd Ed William and Wilkins 2002.
- New Zealand School Dental Service Guidelines – Use of Radiography
- National Health & Medical Research Council: Code of Practice for Radiation Protection in Dentistry (1987)
- Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) – (http://www.arpansa.gov.au/is_rad.htm) Radiation and Health Information
- <http://www.arpansa.gov.au/pubs/rps/rps10.pdf>
- http://www.ada.org/prof/resources/topics/topics_radiography_examinations.pdf
- http://www.ada.org/prof/resources/pubs/jada/reports/report_radiography.pdf

Appendix 1: Guidelines for prescribing radiographs:

TYPE OF ENCOUNTER	Child with Primary Dentition (prior to eruption of first permanent tooth)	Child with Mixed Dentition (after eruption of first permanent tooth)	Adolescent with Permanent Dentition (prior to eruption of third molars)	Adult Dentate and partially dentate	Adult Edentulous
New patient	Individualised radiographic exam consisting of selected periapical/occlusal views and/or posterior bitewings if proximal surfaces cannot be visualised or probed. Patients without evidence of disease and with open proximal contacts may not require a radiographic exam at this time.	Individualised radiographic exam consisting of posterior bitewings with panoramic exam or posterior bitewings and selected periapical images.	Individualised radiographic exam consisting of posterior bitewings with panoramic exam or posterior bitewings and selected periapical images.	See adolescent with permanent dentition.	Individualised radiographic exam, based on clinical signs and symptoms.
Recall patient with clinical caries or at increased risk for caries.	Posterior bitewing exam at 6-12 month intervals if proximal surfaces cannot be examined visually or with a probe.	Posterior bitewing exam at 6-12 month intervals if proximal surfaces cannot be examined visually or with a probe.	Posterior bitewing exam at 6-12 month intervals if proximal surfaces cannot be examined visually or with a probe.	Posterior bitewing exam at 6-18 month intervals	Not applicable
Recall patient with no clinical caries and not at increased risk for caries.	Posterior bitewing exam at 12-24 month intervals if proximal surfaces cannot be examined visually or with a probe.	Posterior bitewing exam at 12-24 month intervals if proximal surfaces cannot be examined visually or with a probe.	Posterior bitewing exam at 18-36 month intervals.	Posterior bitewing exam at 24-36 month intervals.	Not applicable
Recall patient with periodontal disease.	Clinical judgment as to the need / type of radiographic images for the evaluation of periodontal disease. Imaging may consist of, but not limited to, selected	Clinical judgment as to the need / type of radiographic images for the evaluation of periodontal disease.	Clinical judgment as to the need / type of radiographic images for the evaluation of periodontal disease.	Clinical judgment as to the need / type of radiographic	Not applicable.

	bitewing and/or periapical images of areas where periodontal disease (other than nonspecific gingivitis) can be identified clinically.	Imaging may consist of, but not limited to, selected bitewing and/or periapical images of areas where periodontal disease (other than nonspecific gingivitis) can be identified clinically.	Imaging may consist of, but not limited to, selected bitewing and/or periapical images of areas where periodontal disease (other than non specific gingivitis) can be identified clinically.	images for the evaluation of periodontal disease. Imaging may consist of, but not limited to, selected bitewing and/or periapical images of areas where periodontal disease (other than non specific gingivitis) can be identified clinically.	
Patient: monitoring of growth and development	Clinical judgment as to need / type of radiographic images for evaluation and/or monitoring of orofacial growth and development.	Clinical judgment as to need / type of radiographic images for evaluation and/or monitoring of orofacial growth and development.	Clinical judgment as to need /type of radiographic images for evaluation and/or monitoring of orofacial growth and development. Panoramic or periapical exam to assess developing third molars	Not applicable	Not applicable
Patient with other circumstances including, but not limited to, proposed or	Clinical judgment as to need / type of radiographic images for evaluation and/or monitoring in these circumstances.	Clinical judgment as to need / type of radiographic images for evaluation and/or monitoring in these	Clinical judgment as to need / type of radiographic images for evaluation and/or monitoring in these	Clinical judgment as to need for / images for evaluation	Clinical judgment as to need / type of radiographic

existing implants, pathology, restorative/endodontic needs		circumstances.	circumstances.	and/or monitoring in these circumstances.	images for evaluation and/or monitoring in these circumstances.
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The recommendations in this chart are subject to clinical judgement and may not apply to every patient. They are to be used by dentists only after reviewing the patient's health history and completing a clinical examination. /The use of lead aprons is recommended for children, women of childbearing age and pregnant women.



Clinical Guidelines

Answer the following questions about what you have just read.
1 Scientific CPD point is available on completion.

QUESTIONNAIRE

YourName:

Email Address:

Title of Clinical Guideline:

Question 1

List 3 key issues this Clinical Guideline reinforced for you?

Question 2

Were there areas of the Clinical Guideline you were previously unaware of? If yes, please list them.

Question 3

How will you share this information with your peers?

Click the button below to submit your answers for verification.