

DENTAL RADIOGRAPHY: RADIATION PROTECTION IN DENTAL PRACTICE

GLOSSARY

Absorbed dose (D) Quantity of energy imparted by ionising radiation to unit mass of matter such as tissue. Unit Gray, Symbol Gy. 1 Gy = 1 joule per kilogram

Absorption The reduction in intensity of a beam of radiation incident in the medium through which it is propagated

Acceptance test A regime of tests that must be carried out on X-ray equipment before it can be clinically used. The testing is designed to ensure the equipment meets an acceptable performance standard and to set baseline values to compare future routine tests against

Air-kerma Quantity of energy imparted by ionising radiation to unit mass of air. Unit Gray, Symbol Gy. Gy = 1 joule per kilogram

ALARP (as low as reasonably practicable) The ALARP principle is that the risk of radiation exposure shall be kept as low as reasonably practicable. In practice this means that the risk arising from the radiation exposure should be weighed against the trouble, time and money needed to control it.

Alternating current ('AC') An electric current that reverses direction in a circuit at regular intervals

Anatomical timer Where the exposure time is determined by the selection of an anatomical feature (a tooth or region of the jaw) and a particular size of patient to radiograph

Anterior The front (of the head or jaw)

Approved Code of Practice (ACoP) HSE document providing guidance on achieving compliance with IRR17

Approved dosimetry service (ADS) A laboratory specialising in the assessment of personal dosimeters and/or the keeping of personal dose records on behalf of employers, that has been approved for those purposes by HSE.

Artefact In relation to a radiograph, a defect in, or distortion of, the image produced by artificial means and resulting in a potentially misleading appearance

Automatic exposure control (AEC) A mechanism for automatically regulating the exposure parameters for individual patients, often achieved by means of an initial 'scout view' on dental CBCT equipment

Background radiation Ionising radiation in the environment to which we are all exposed. Examples include radon gas and cosmic rays

Beam-aiming device A device used to ensure an intra-oral X-ray tube is correctly aligned with the region of the teeth and jaws being investigated and the image receptor

Bicuspid A pre-molar tooth having two cusps (usually American terminology)

Bitewing A radiograph of the crowns of teeth on both the upper and lower jaw

Bremsstrahlung radiation X-rays covering a continuous energy range generated when high energy electrons (such as those generated in an X-ray tube) are slowed down in a medium. Also known as continuous or braking radiation.

Canine One of the pointed, conical teeth located between the incisors and the first bicuspid. Also called cuspid

Caries tooth decay

Cephalometric radiograph Imaging of the bony structure of the head using reproducible lateral and antero-posterior (AP) or postero-anterior (PA) radiographs

Certificate in dental radiography (CDR) A nationally-recognised qualification that provides the adequate training requirement for dental nurses to be able to take dental radiographs (other than dental CBCT images)

Characteristic radiation The generation of X-rays by the movement of an electron from a higher to lower energy state within an atom

Classified person An employee designated as classified under the Ionising Radiations Regulations, 2017, on the basis of the annual dose they are likely to receive. Must have their dose properly assessed, e.g. by personal dosimetry, annual health reviews and dose record keeping

Collimator A device used to limit the size of an X-ray field

Computed digital radiography (CR) Radiography using a image receptor device (usually a photostimulable phosphor plate) which is read in an automatic processor and the radiographic image then displayed on a computer monitor

Computed tomography (CT) Imaging whereby computer analysis of a series of cross-sectional scans is made using a fan-shaped X-ray beam rotating around and along a single axis of a bodily structure or tissue is used to construct a three-dimensional image of that structure

Cone-beam computed tomography (CBCT) A CT method where a series of images are acquired with a cone-shaped X-ray beam during a single rotation of the X-ray tubehead. Specialised CBCT systems have been developed for dental applications.

Contingency plans A set of written instructions specifying the actions to be taken following an incident to rectify the situation and make it safe. See **local rules**.

Continuing professional development (CPD) A formal system of lifelong learning employed in a wide range of professions, including dentistry.

Controlled area An area designated in accordance with the Ionising Radiations Regulations 2017 where special procedures are followed to restrict exposure, or to prevent or minimise the effects of a radiation accident. Must be physically demarcated, have access to it restricted and be described in the local rules. Entry into the controlled area allowed for classified persons or non-classified persons who enter under written arrangements. See **classified person**

Cosmic rays High energy ionising radiations from space.

Critical examination A regime of tests that must be carried out on X-ray equipment before it can be clinically used. The testing is designed to ensure the equipment and location provide sufficient protection from radiation for all persons. Must be carried out in consultation with an RPA

Cusp A pointed or rounded projection on the chewing surface of a tooth

Cuspid See canine (usually American terminology)

Dentate having teeth

Diagnostic reference level (DRL) A level of patient dose that the employer must set for standard diagnostic examinations on average-sized patients, which should not normally be exceeded. Also called a 'local DRL' and should not normally exceed any current 'National DRL' or 'National Reference Dose'. (See also '**National DRL**').

DICOM (digital imaging and communications in medicine) An international standard related to the exchange, storage and communication of digital medical images and other related digital data.

Direct current ('DC') An electric current flowing in one direction only

Direct digital radiography (DR) Radiography using a device which directly captures radiographs and instantly display them on a computer monitor

Dose area product (DAP) The product of the absorbed dose and the area of the X-ray field measured at the same point (usually the image receptor) and perpendicular to the axis of the useful beam

Dose General term for quantity of radiation. See absorbed dose, equivalent dose, effective dose. Frequently used in place of effective dose

Dose constraint An upper level of individual dose set out at the planning stage of work. Dose constraints may be applied to outside workers, carers and comforters and members of the public

Dose investigation level (DIL) A level of total effective dose to employees in a calendar year above which an investigation must be carried out, in consultation with an RPA, to determine the cause of the exposure

Dose limit A level of total dose within a calendar year (or occasionally 5 year period) that is defined in legislation, above which no person should be exposed

Dose rate Rate at which a dose is received, usually measured in micro Sv per hour, ($\mu\text{Sv/h}$)

Effective dose (E) The quantity obtained by multiplying the equivalent doses to exposed tissues and organs by the tissue weighting factor appropriate to each and summing the products. Unit Sievert, symbol Sv. A measure of whole-body dose, frequently abbreviated to dose

Electromagnetic spectrum Electromagnetic radiations shown graphically in order of frequency or wavelength. The spectrum includes short wavelength radiations such as X-rays, visible radiation and longer wavelength radiations of microwaves, television and radio waves.

Electromagnetic radiation Radiation with both electric and magnetic field components which can be described as waves propagating at the speed of light. Examples are X-rays, gamma rays, ultraviolet radiation, light, infrared radiation, and radiofrequency radiation.

Employer The person or body legally responsible for the dental practice or company

Endodontics The study and treatment of tooth root, pulp and periapical tissues

Equivalent dose (H_T) The quantity obtained by multiplying the absorbed dose by a radiation weighting factor to allow for the different effectiveness of the various ionising radiations in causing harm to tissue. A measure of dose to a single organ or tissue. Unit Sievert, symbol Sv. The radiation weighting factor for X-rays is 1.0.

Erythema Reddening of the skin caused by dilation of blood vessels. A tissue reaction following radiation exposures exceeding about 2-3 Sv.

Extra oral radiograph Radiograph produced by placing an image receptor outside the oral cavity (e.g., such as during panoramic or cephalometric radiography or dental CBCT imaging).

Field of view (FOV) A term used to describe the extent of the imaged region of the patient, most often used with dental CBCT imaging

Film speed An indication of the amount of X-radiation needed to create an image of adequate diagnostic quality for a particular film. The faster the film the less radiation is required

Filtration The use of absorbers (usually aluminium) for the selective attenuation of lower energy radiation from a useful primary beam of X-radiation. If aluminium is used, the filtration is reported in 'mm Al equivalent'.

Focal spot The specific area of the face of the target material in the X-ray tube that is bombarded by the focused electron stream when an X-ray tube is in action. It is usually an insert of tungsten

Focus to film distance (FFD) The distance from the X-ray source to the image receptor

Focus to skin distance (FSD) The distance from the X-ray source to the patient

Frequency The number of complete cycles of an electromagnetic wave in a second. Unit hertz, symbol Hz. 1Hz = 1 cycle per second.

Full-wave rectification Rectification in which output current flows in the same direction during both half cycles of the alternating input voltage

Genes The biological units of heredity. They are arranged along the length of chromosomes.

Gonads Ovaries and testes.

Gray See Absorbed dose

Half-wave rectification Rectification of the power supply to an X-ray machine so that the forward phase of the cycle can be utilized and in the reverse phase no current flows across the tube

Hounsfield unit (HU) The Hounsfield unit is named after Sir Godfrey Hounsfield, is a dimensionless quantity used for describing radiodensity, most usually in CT scans, where it is also referred to as the CT number. Dental CBCT images may not use the HU scale.

Inherent filtration An amount of filtration present in the X-ray beam due to the construction of the X-ray tube (e.g. glass, beryllium)

Intensity The amount of X-rays per unit area or volume

Intra oral radiograph Radiograph produced by placing a radiographic image receptor within the oral cavity

Ion Electrically charged atom or group of atoms

Ionisation The process by which a neutral atom or molecule acquires or loses an electric charge. The production of ions

Ionising radiation Radiation that produces ionisation in matter. Examples are alpha, beta, gamma and X-radiation and neutrons. When these radiations pass through the tissues of the body, they have sufficient energy to disrupt molecular structures via the ionisation process

IRMER17 The Ionising Radiation (Medical Exposure) Regulations 2017

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Justification As defined in IRMER17, the explanation (clinical reason) for carrying out a radiograph. This must take into account the benefit to the exposed individual or to society and the decision must be recorded for future reference

Late radiation effects Biological effects such as radiation-induced cancer which may occur sometime after a radiation exposure.

Lateral The side (eg, of the head)

Leakage radiation Radiation that is transmitted through the X-ray tube housing assembly other than in the main beam

Local rules Set of working procedures written in accordance with the Ionising Radiations Regulations, 2017, to enable work with ionising radiations to proceed safely, providing a good standard of protection for workers. Required for every **Controlled area**.

Mandible The lower jaw

Maxilla The upper jaw

Mean pixel value (MPV) The average of the pixel values in a region of an image displayed on a computer screen.

Medical physics expert (MPE) A person who holds a science degree or its equivalent, is experienced in the application of physics to the diagnostic and therapeutic uses of ionising radiation, and has been formally recognised as competent (eg, by being included in the list of MPEs maintained by RPA2000). The MPE provides advice on, among other issues, patient dosimetry and quality assurance

Molecule The smallest portion of a substance composed of more than one atom that can exist by itself and retain the properties of the substance.

Molar A tooth with a broad crown used to grind food, located behind the premolars

Mutation A chemical change in the DNA in the nucleus of a cell. Mutations in sperm or egg cells or their precursors may lead to inherited effects in children. Mutations in body cells may lead to effects in the individual

National Diagnostic Reference Level A level of patient dose for standard diagnostic examination on average-sized patients that has been formally announced by PHE on the gov.uk website, usually on the basis of national surveys of patient dose data (see also '**Diagnostic reference level**')

Non-ionising radiation Radiation that does not cause ionisation. Examples are ultraviolet radiation, light, infrared radiation, and radiofrequency radiation

Non-medical exposure An exposure where the benefit to the individual being examined may be financial rather than medical in nature, or may be to a third party

Nucleus The core of an atom, occupying little of the volume, containing most of the mass, and having positive electric charge

Nucleus of cell The controlling centre of the basic unit of tissue. Contains the important material DNA

Occlusal Contact of the lower and upper jaws

Operating potential See Peak Operating Potential

Operator A person undertaking any practical aspect of a radiographic exposure (e.g. pressing the exposure button, developing X-ray films or identifying patients prior to radiography)

Optimisation The process whereby radiation dose is minimised, but radiographic quality is not compromised

Orthodontics the study and treatment of cranio-facial development

Overexposure where a dose limit set under IRR17 has been exceeded

Panoramic A tomogram of the jaws, taken with a specialised machine designed to present a panoramic view of the full circumferential length of the jaws on a single image

Patient entrance dose The measure of radiation dose at the surface of the patient during intra oral radiography

Peak operating potential The X-ray tube peak voltage during an exposure. Also commonly referred to as just 'Operating Potential' or 'kilovoltage' (kVp)

Periapical Teeth plus surrounding bone and tissues

Photostimulable phosphor plate (PSP) A type of Computed Digital Radiography (CR) image receptor

Posterior The back (of the head or jaw)

Practitioner In the IRMER17 definition this is a person who can justify and authorise a radiographic exposure

Pre-molar One of eight bicuspid teeth located in pairs on each side of the upper and lower jaws behind the canines and in front of the molars

Primary beam The useful part of the X-ray beam that is directed from the X-ray source towards the patient and image receptor

Radiation protection adviser (RPA) Person or corporate body consulted in accordance with the Ionising Radiations Regulations, 2017, to give advice on radiation protection and compliance with IRR17

Radiation protection supervisor (RPS) Person appointed in accordance with the Ionising Radiations Regulations, 2017 who is responsible for day-to-day supervision of work with ionising radiation (e.g. ensuring that local rules are followed)

Radiation risk assessment Defined in the Ionising Radiations Regulations 2017, an assessment made by the employer to determine whether any further steps should be taken to restrict radiation exposures

Radiograph The image obtained by using an X-ray machine

Radiography The process by which radiographs are made

Radiology The profession of medical diagnosis or treatment planning using radiographs

Referrer A registered health care professional who is entitled in accordance with the employer's procedures to refer individuals for medical exposure to a practitioner

Routine test A test carried out at least every 3 years (or every year for hand-held X-ray units) to ensure the X-ray equipment still meets an acceptable performance standard

Scattered radiation radiation that is produced when the primary X-ray beam interacts with matter (eg the patient and image receptor, or the surgery wall)

Sievert See Effective dose

Set-time timer A timer, typically used for some intra-oral and cephalometric equipment, where the exposure time is manually selected.

Stochastic effect Biological effects whose probability of occurrence depends on the dose received, e.g. radiation induced cancer

Supervised area An area designated in accordance with the Ionising Radiations Regulations, 2017 where working conditions are kept under review. Supervised areas must be described in the local rules and routine radiation monitoring must be carried out

Temporomandibular joints (TMJ) the 'hinges' of the jaw bone

Tissue reactions Biological effect of acute, and high radiation exposure. Tissue reactions only occur when the dose exceeds a known threshold. Examples include radiation induced skin burn, hair loss and radiation sickness. Typically seen hours, days or weeks after the exposure

Tomography An X-ray technique that shows a single plane (slice) of the object under examination

Tube current the current flowing in the X-ray tube. It is directly proportional to the number of X-rays produced and reported as mA (milliamperes)

Wavelength The distance between successive crests of an electromagnetic wave passing through a given material. An indicator of radiation energy (higher wavelength = higher energy)
Unit metre, symbol m

Wisdom teeth The third molar teeth which generally appear during the ages of 17 - 25

Workload The number of radiographs that the X-ray set will take over a specific period of time

X-ray A discrete quantity of electromagnetic energy, without mass or charge. Generated in an X-ray tube (see X-ray tube) or resulting from changes in the position of the orbiting electrons around an atomic nucleus – also known as characteristic X-rays

X-ray tube Device that produces X-rays by accelerating electrons through an evacuated tube onto a dense metallic target