Dental Radiology - introduction

3.DM  Lect. 1
Introduction:

- X-ray department
- Equipment
- Films
- Darkroom
- Film processing
- Protection
Radiography and radiology

- **Radiography** – is the taking of radiographs (using the property of X-rays to cross materials to view inside objects)....radiographer, technician

- **Radiology** – interpretation of radiographs, the branch of medicine that deals with the study and application of imaging technology like x-ray and radiation to diagnosing and treating disease.
DENTAL X-RAY MACHINE

The standard structural parts include:

- **control panel**
- **tube head**, contains the dental x-ray tube;
- **flexible extension arm**
DENTAL X-RAY MACHINE

- The Control Panel - components are: switches, dials, gauges, and lights/indicators.
- The Extension Arm – provides horizontal and vertical movement, and attachment for the tube.
- The Tube Head. Inside the metal tube housing is the x-ray tube, which emits radiation in the form of x-rays. X-ray photons expose the film.
DENTAL RADIOGRAPHIC FILM

- supplied in various sizes and degrees of sensitivity
- each designed for a specific purpose
- should be stored in a cool, dry place free from chemical contamination
- use before the expiration date
DENTAL RADIOGRAPHIC FILM - construction

- Plastic covering – wrap – lightproof and waterproof, can be disinfected, contains embossed dot to identify right and left (dot on the right side)
- Protective black paper-from both sides
- Lead foil on the side distant to the exposure – protects the film from secondary radiation, shortens the exposure time – so each film has the seam side usually contains the name of the brand
- Emulsion with silver compound
- Adhesive
- Plastic foil – in the centre
Film Construction

- The base is made of cellulose and is a transparent plastic that is clear.
- The emulsion is a thin coating of a special gelatin with particles of a silver compound.
- When x-rays penetrate through soft tissue, such as the cheek or the gingiva, they also penetrate the emulsion easily, which causes the silver compound to stick to the cellulose base during processing. Therefore, the film is darker (this is known as **radiolucence** - greater transparency).
- When x-rays are directed to hard tissue (which is dense), such as bone, tooth enamel, and metal restorations, fewer x-rays reach the film. So, more of the silver compound is removed by processing. This results in lighter shades on the film (which is known as **radiopaque**).
DENTAL RADIOGRAPHIC FILM - types

- (1) Intraoral film. Periapical, bite-wing, and occlusal are three types of intraoral film used to reveal different dental structures.
- Periapical film is used primarily for radiographic examination of teeth and adjacent tissues to include the periapical region. 3x4cm, 2x3cm (pedo)
- Bite-wing film is used to obtain a radiograph of the coronal two-thirds of opposing teeth: 3x4cm, 3x5cm, 2x3.5cm
- Occlusal film in a size convenient for obtaining a view of the entire upper or lower arch or portions thereof: 4x5cm, 5x7cm, 6x8cm
DENTAL RADIOGRAPHIC FILM - types

- **(2) Extraoral film.** Extraoral film is used for radiographs of the jaws, facial bones, the temporomandibular joints, and other relatively large areas. This film has no embossed dot to identify right and left. 6x8cm, 13x18cm, 24x30cm

- **(3) Panoramic film.** Panoramic film, a type of extraoral film, is used in panoramic radiography. This film shows the entire dentition and surrounding bone structure. 30x15cm

- Before usage the film is placed into a cassette (rigid metal, plastic) - contains intensifying screens that magnify the x-ray beam, thus reducing exposure time.
Exposing Procedure.

1. Seat the patient and adjust the headrest to establish the proper position of his head.

2. Drape the patient with the lead apron and attach the cervical collar. Position the film packet.

3. Align the x-ray tube.

4. Select the proper exposure factor.

5. Make the exposure.

6. Place the film in a film safe until ready to process.
The processing procedure is performed in darkroom with a special "safe" light – red

1. Prepare the darkroom.
2. Stir the developing solution and note its temperature.
3. Open the film packet and attach it to the film hanger.
4. Set the timer and place the film in the developing solution.
5. Rinse the film in clear water.
6. Set the timer again and place the film in the fixing solution.
7. Wash the film.
8. Dry the film

**NOTE**: Each film must be labeled for proper identification.
Darkroom

- **lightproof** - walls should be painted black to absorb light, ceiling may be painted white for adequate illumination, should have an inside **lock** so that no one can accidentally enter while films are being processed
- supplied with both hot and cold **water**
- adequate **ventilation** must be provided.
- **clean** all equipment and only use for its intended purpose. Wash the thermometers and film holders thoroughly before transferring them to either the developing or fixing solutions
- **thermometer** - register the temperature of the solutions
- **timer** - the direct relationship between temperature and time in processing, the exact time of any given film is to be left in each solution.
- **safe light**
Darkroom

- **film holders** - frame type for extraoral films and the clip type for intraoral films
- **sink** - mixing solutions, washing hands, and disposing of used chemicals.
- **solutions** - types of processing solutions - for the automatic processor and another for the manual processor, may require several chemicals mixed with water or others may be used directly from the container.
Film processing - manual

- **time-temperature** method and small containers of the different processing solutions

- **Processing tank** - most commonly used in dental clinics has three compartments. The compartment to the left contains the developing solution, water is in the center compartment, and the fixing solution is on the right. In addition to the three compartments, a source of hot and cold water, a drain, an overflow valve, and a cover are needed. The water is adjusted to the proper temperature and is allowed to circulate in the middle compartment and pass from the tank by the overflow valve.

- **Processing Procedure** for the film is sequenced as follows: developing, rinsing, fixing, washing, and drying.
Film processing - manual

[Diagram of film processing setup with labeled areas: Developer, Running, Rinse Water, Fixer, Overflow Valve]

[Sequential images of manual film processing steps]
Developing

1. Hands are clean and dry, prevent the appearance of finger marks on the developed film.
2. Remove the lightproof wrapper from the film. *Dispose of contaminated wrappers in accordance procedures.*
3. Place the film on the film holder.
4. Set the interval timer (clock) for the prescribed developing time. The recommended temp./time for the developing solution is 20°C /4.5min.
5. Immerse the film in the developing solution, moving the film holder up and down several times to break up air bubbles that may have formed on the surface of the film.
6. Remove the film at the expiration of the developing time. Hold the film rack in a tilted position for a few seconds to allow excess solution to drain into the developing section of the tank.
7. Rinse the film in clear water.
Rinsing

- film should remain in the rinse water at least 20 seconds to remove the developing solution. Be sure to tilt the film rack to allow excess water to drain back in - do not dilute the fixing solution.
Fixing

- By fixing unexposed silver crystals are removed from the film, clearing the film and making the image translucent.
- Hanger moved up and down several times to make sure the fixer contacts all surfaces.
- An average safe time for the film to remain in a fresh fixing solution is 10 minutes. This provides time for the emulsion to harden properly after the film has cleared.
- The film may be examined briefly after 1 minute in the fixer, but it must be returned to the solution to complete the hardening process.
Washing, Drying

- After fixation, the film should be immersed in fresh, cool, circulating water for at least 20 minutes to ensure complete removal of the fixing solution. If not washed properly, the radiograph will turn yellow and fade with time if any of the fixing chemical remains on its surface.

- Wet films must be handled carefully so that the emulsion is not touched or marred. After washing, the hanger should be hung carefully upon the drying rack.
primary radiation - technician should never receive primary radiation from a dental x-ray unit if safety precautions are observed - protective shield.

secondary radiation - is more difficult to avoid and is a serious danger to the technician/dentist. This type of radiation is produced by a scattering of the primary x-ray beam - a change of direction after interaction with an object.
PROTECTION

- Filtration and collimation of the x-ray beam are very important safety measures. The filter and collimator block the majority of the unwanted x-ray photons.
PROTECTION - **aluminum filter**

- placed in the path of the x-ray beam
- located at the base of the tube/cone, just inside the metal housing
- completely covers the opening where the x-ray beam emerges from the x-ray tube
- filter is to absorb the low energy, long wavelength x-rays and allow the high energy, short wavelength x-rays to pass through
PROTECTION - Collimator

- Is a lead diaphragm next to the filter
- restricts the x-ray beam to the desired size - only the area necessary for exposure receives the primary beam.
PROTECTIVE MEASURES

Technician Protection

- **(1) Radiation monitoring** - all x-ray technicians wear a dosimeter, which monitors radiation received by the technician, the results are recorded and kept permanently.

- **(2) Radiation standards.** For the technician operating a dental x-ray machine, the level of radiation must not exceed a maximum dose.

- **(3) Protective booth and shields** - rooms require a shielding thickness of 5mm barium sulphate which absorbs the radiation. The timer switch is mounted outside the protective shielding to prevent the operator from standing inside the booth during exposures. Leaded glass on the booth or shield provides a continuous view of the patient during the exposure. Holding of the film or tube head by the x-ray technician is strictly prohibited.
PROTECTIVE MEASURES

Patient Protection

- responsibility of the x-ray technician to use all available protective measures to reduce exposure to the patient
- only those radiographs requested by the dentist may be taken...or wise indication!
- a good quality x-ray should be produced each time as - wrong exposures, improper exposures, and faulty processing techniques result in retakes and unnecessary patient exposure
- the lead collar must be used for every exposure, lead apron for pregnant women – reduce the patient exposure
**Radiation Protection**

The International Commission on Radiological Protection have the following general principles:

- **Justification**: no exposure to be made unless there will be a positive net benefit to the patient.
- **Optimisation**: all exposures to be kept as low as reasonably practicable - the ALARP principle.
- **Limitation**: the dose equivalent to individuals shall not exceed the limits recommended by the Commission.
Radiation Protection

- During an exposure, a controlled area will exist around the X-ray set. This is defined as the area within the primary X-ray beam until it has been sufficiently attenuated by distance or shielding and within 1.5m of the X-ray tube and the patient. Normally, only the patient is allowed in this area.

- A Radiation Protection Supervisor must be appointed—usually a dentist in general practice—to ensure regulations are complied with.

- All areas using ionising radiation must have a written document—the Local Rules—which documents the radiation protection measures in place.
What is justification?

• Before an exposure can take place it must be justified—there must be a net benefit to the patient which outweighs the risk of the radiation exposure.

• The exposure must be assessed to ensure that it will lead to a change in the patient’s management and prognosis.

• Must be authorized by a practitioner.

• Every exposure should be justified after taking into account:
  1. Availability and findings of previous radiographs
  2. Total potential diagnostic benefit to the patient
  3. Relate the need for radiographs to the history and examination you have performed on the patient
  4. The radiation risk of the radiographic examination
  5. Are there any alternative techniques available?