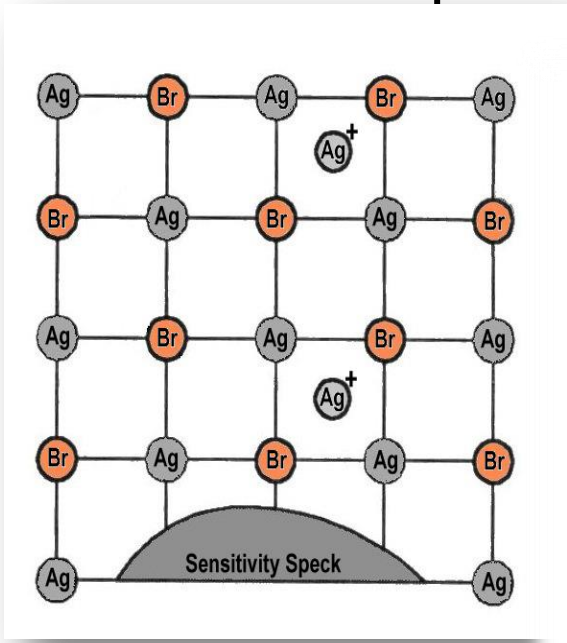
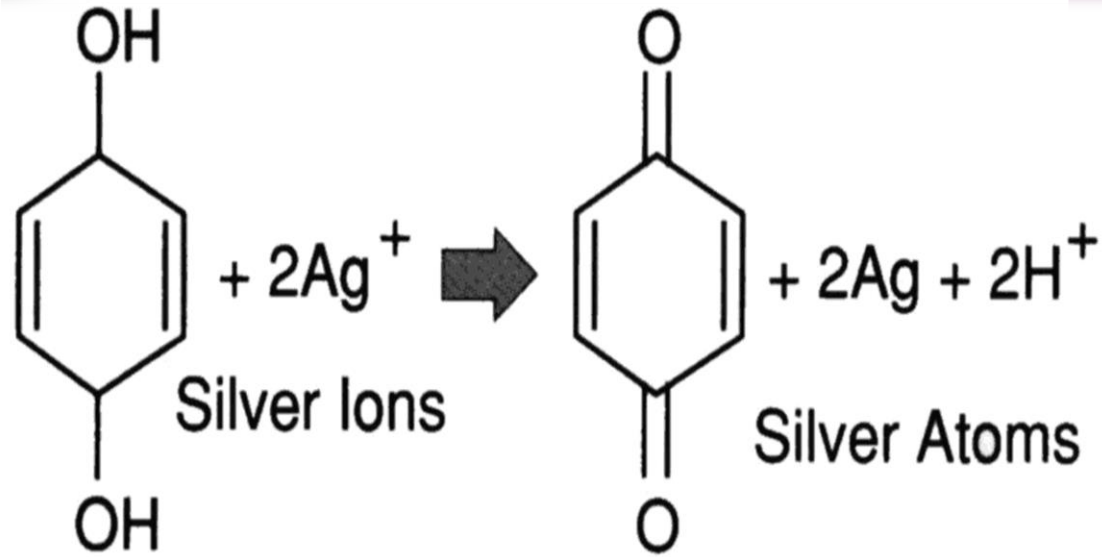
PROCESSING RADIOGRAPHS

INTRODUCTION

Film processing procedures have a direct effect on the quality of a radiograph.

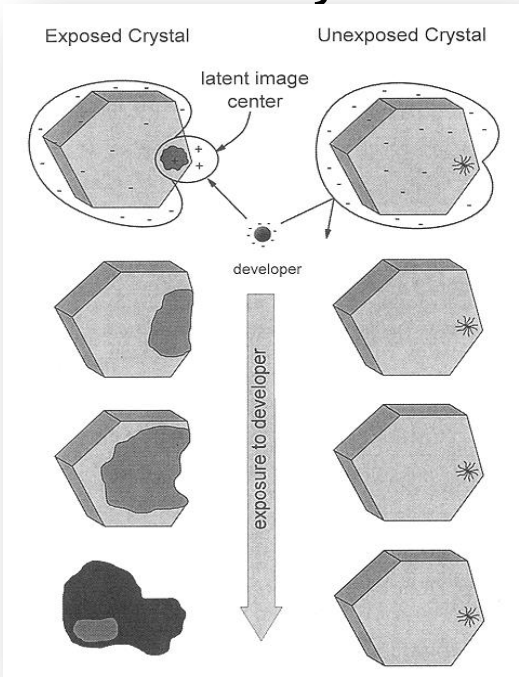




Developer

DENTAL X-RAY FILM PROCESSING

- Processing is a series of steps that changes the latent image on the exposed film into a radiograph by producing a visible image on the film.
- Proper processing is just as important as the exposure technique in producing diagnostic-quality radiographs.
- Radiographs that are nondiagnostic because of poor processing techniques must be retaken, and the patient will be exposed to unnecessary radiation.
- In many practices, intraoral films are processed in an automatic processor; however, it is still necessary to know how to process the film manually.



FIVE STEPS IN PROCESSING DENTAL RADIOGRAPHS

- Development
- Rinsing
- Fixation
- Washing
- Drying

DEVELOPING

- Developing is the first step in processing films.
- A chemical solution called the *developer* is used.
- The purpose of the developer is to chemically reduce the exposed silver halide crystals into black metallic silver.
- The developer solution also softens the film emulsion during this process.

RINSING

- *Rinsing* the films is necessary to remove the developer from the film so that the development process stops.
- Usually, agitating the film rack for 20 seconds is sufficient.
- This must be done under safelight conditions.

FIXING

- The acidic fixing solution removes the unexposed silver halide crystals from the film emulsion.
- The fixer also hardens the film emulsion during this process.
- For permanent fixation, the film is kept in the fixer for a minimum of 10 minutes.
- However, films may be removed from the fixing solution after 3 minutes for viewing.
- Films that are not properly fixed will fade and turn brown in a short time.
- Leaving films in the fixer for a long time (e.g., over a weekend) can remove the image from the film.

WASHING

- Following fixation, a water bath is used to wash the film.
- The washing step remove all excess chemicals from the emulsion.

FILM PROCESSING SOLUTIONS

- Obtained in following forms :

i) Powder

ii) Ready to use liquid

iii) Liquid concentrate

-Both powder and liquid concentrate forms must be mixed with distilled water.

-Liquide concentrate form is popular-easy to mix and occupies little storage space.

-Fresh chemical solutions produce the best radiographs.

To Maintain Freshness:

i)Solutions must be replenished daily.

ii)Must be changed after every 3-4weeks.

Two special chemical solutions are necessary for film processing:

i) Developer

ii) Fixer

PROCESSING METHODS

A.) Manual Processing: Three methods

- Time temperature method
- Modified time temperature method
- Visual method

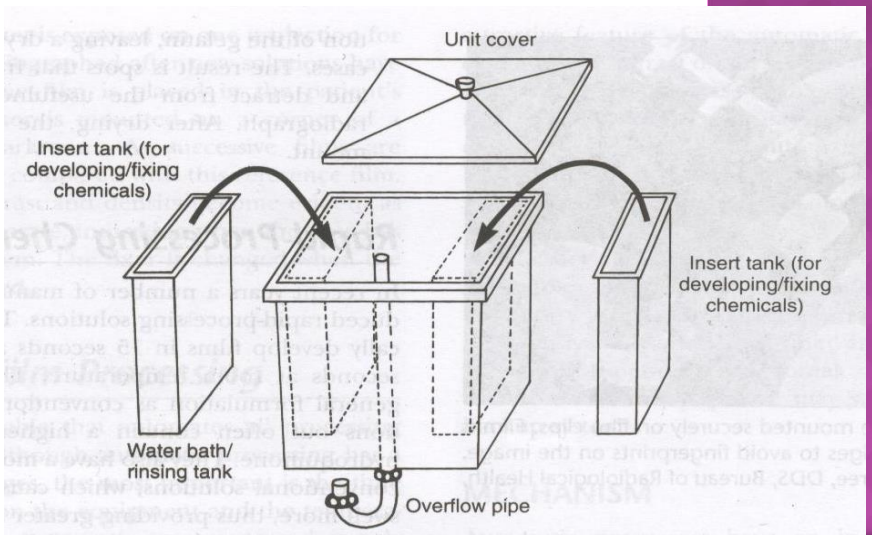
B.) Automatic Processing

C.) Day Light Processing

D.) Self Developing Films

***Time temperature method* :**

- Before processing check the levels of developer and fixer solution.
- If the solution level is low add fresh solution.
- Never add water to raise the level of the solution, as it dilutes the strength of chemicals.
- Stirring the processing solution with a stirring rod or paddle.
- Stirring the solution mixes the chemicals and regularizes the temperature of the solution.
- Check the temperature of the developer solution. The optimum temperature for developer is between 65^0 F to 75^0 F. If the temperature of the developer solution is outside this range circulating water tap must be regularized to adjust the tap and sufficient time must be allowed to reach the correct temperature.



- Close and lock the dark room turn off the overhead white light and turn on the safelight.
- Remove the exposed film from its lightproof packet, using only safe light illumination.
- Hold the film only from their edges.
- Clip the bare film to the hanger clip(1 film to a single clip).
- Based on the temperature of developer solution and the instruction of manufacture, set the timer. A time-temperature chart is used to determine the time.

Solution temperature	Developing time	Rinsing time	Fixing time	Washing time
65^0 F (18.5^0 C)	6	0.5	10-12	10
68^0 F (20^0C)	5	0.5	10	10
70^0 F (21^0C)	4.5	0.5	9-10	10
72^0 F (22^0C)	4.0	0.5	8-9	10
75^0 F (24^0C)	3.0	0.5	6-7	10
80^0 F (26.5^0 C)	2.5	0.5	5-6	10

- Immerse the film hangers with the films into developer solution.
- Film must not contact one another or the sides of the processing tanks during development.
- Gently agitate the film hanger up and down, Several times to prevent air bubbles from dinging to the film.
- Hang the film hanger on the edge of the insert tank and make serve that all the films immersed in the developer.
- Activate the timer and cover the processing tank.
- When the timer goes off, cover off the processing tank, remove the film hanger with film from the developer solution, and place it in the circulating water of the rinsing tank.

- Immerse the film hangers with films in fixer solution and gently agitate it for 5 seconds every 30 seconds. This eliminates air bubbles and brings fresh fixer in touch with emulsion.

- When the timer goes off uncover the processing tank and remove the films from the fixer and drain excess of fixer into the wash bath.

- The films are then placed in running water for atleast 10 min.

- Further surface moisture is removed by gently shaking off the excess water form the film and the hanger.

- Dry the film in circulating, moderately warm air.

- If a heated drying cabinet is used the temperature should not exceed 120^0 F.

- Remove the dry radiographs from the film hangers and use a view box to examine the radiographs and place then in an envelope labeled with patients name and date of exposure.

***Visual method* :**

- In this method the exposed x-ray film is immersed in developing solution. For about 10 sec and then removed and observed in the safe light.

- If adequate image have been obtained then it is put for rinsing, other wise re-inserted in the developing solution till adequate image is obtained.

Disadvantage : This method is highly objective in nature and doesn't give consistent quality.

AUTOMATIC PROCESSING

-Prepare darkroom, if daylight loader is not part of automatic processor.

-Close and lock the door of darkroom.

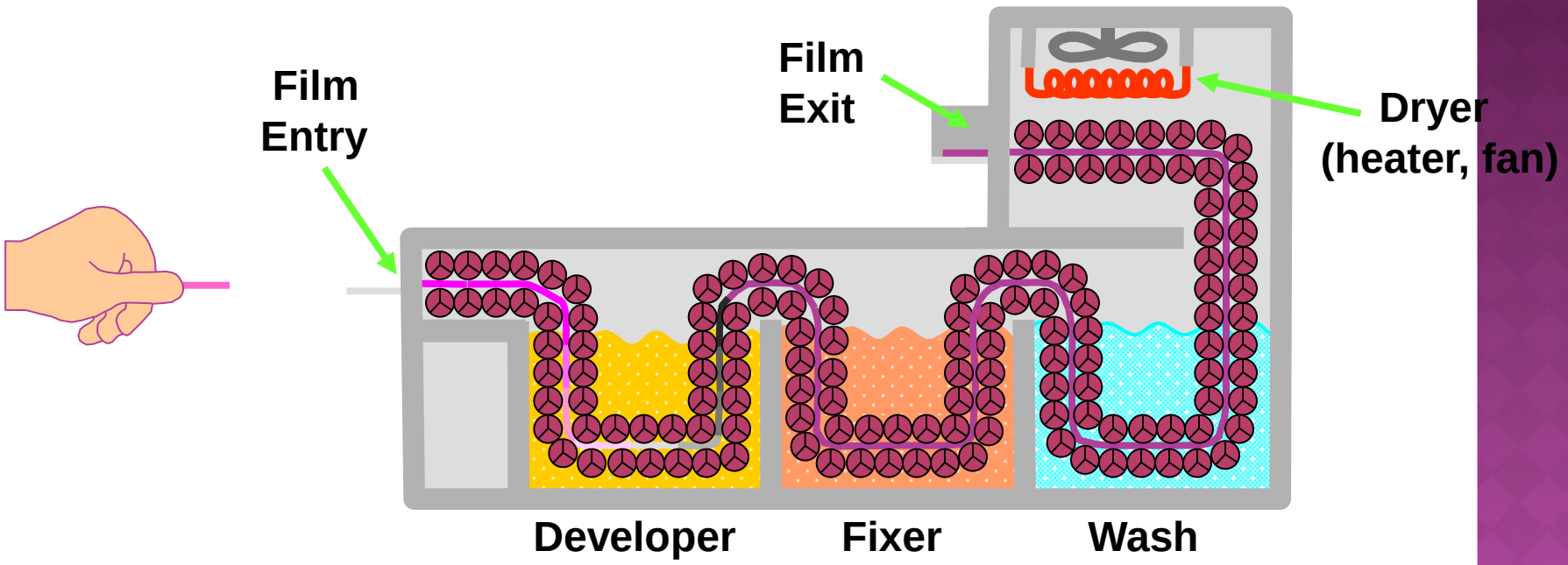
-Turn off the overhead white light, and turn on the safelight.

-For intraoral films, carefully unwrap each exposed film over a clean working surface.

-For extra-oral films carefully remove the film from the cassette.

-Handle all the films by the edges only.

Automatic Processor



The rollers “squeegees” the excess chemicals off of the film as it exits each solution; no rinse is needed between the developer and fixer.

-Insert each unwrapped film into the film feed slot of the processor, one at a time.

-Allow at-least 10 sec between the insertion of each film.

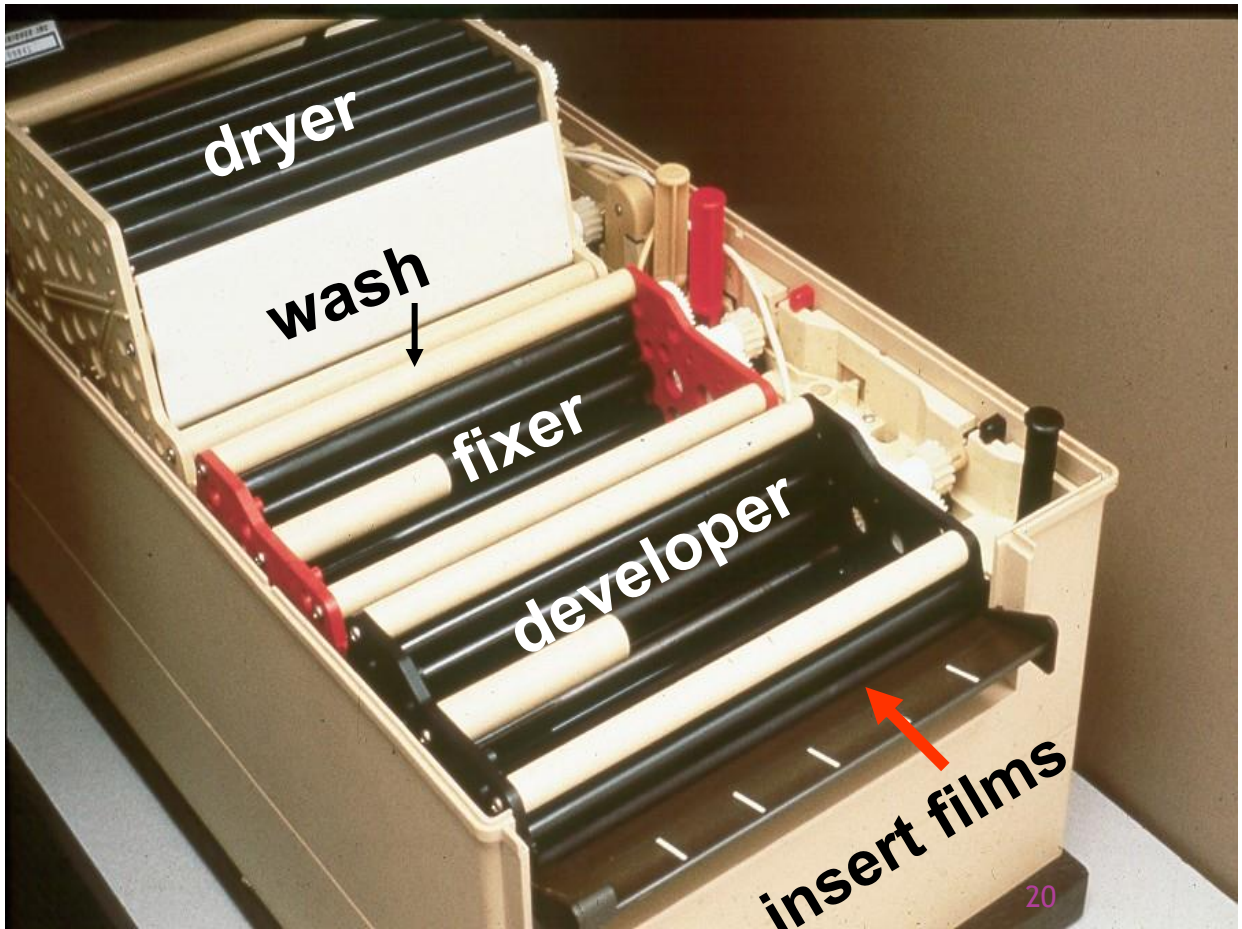
-Do not turned the films sideways or insert too quickly, they will overlap; overlapped films results in non diagnostic radiographs.

-After films are inserted, allow 4-6 min for automated processing to occur.

-Retrieve the processed radiographs from the film recovery slot on the outside of the automatic processor.

Automatic Processor

the insides of an automatic processor.
The wash section is located below the drying rack.



ADVANTAGES

- Time saving .
- Constant film quality is achieved, due to fixed processing cycles.
- Need for dark room is eliminated.
- Less floor space is required.
- Chemicals can be replenished automatically by machine.
- Large number of films can be processed continuously.

DISADVANTAGES

- Equipment is relatively expensive.
- Strict maintenance and regular change is required, dirty rollers produce marked films.
- Films may get lost in the tank

Day Light Processing Method

-Any processing method that doesn't need a dark room is called as daylight processing method.

-Both manual and automatic processing can be executed in this manner.

-Manual day light processing involves stripping the film inside a *light proof pouch*.

-Then processing steps are carried out manually as usual but in daylight.

-If an automatic processor has a daylight-loading chamber and since the entire assembly is enclosed in a light proof contains, it also can be called as daylight processing method.

-Elimination of need for a darkroom is the only advantage in this method.

SELF DEVELOPING FILMS

-Self-developing films are an alternative.

-The x-ray film is presented in a special sachet, containing developer and fixer.

-Following exposure the developer tab is pulled, unveiling developer solution, which is milked down towards the film and massaged around it gently.

- After about 15 seconds, the fixer tab is pulled to release fixer solution, which is similarly milked down to the film.

-After fixing the used chemicals are discarded and the film is rinsed thoroughly under running water about 10 minutes.

Advantages :

- No dark room or processing facilities are needed.
- Time saving.

Disadvantages :

- Poor over all image quality.
- Image detoriates rapidly over time.
- No lead foil inside the film hence less flexible and can be easily bent .
- These films are difficult to use in position holders.
- Relatively expensive

RAPID-PROCESSING SOLUTIONS

- develop films in 15 seconds
- and fix them in 15 seconds.
- contain a higher concentration of hydroquinone.
- more alkaline pH

- These solutions are especially advantageous in endodontics and in emergency situations,
- they often do not achieve the same degree of contrast as films processed conventionally,

- placed in conventional fixing solution for 4 minutes and washed for 10 minutes; this improves the contrast and helps keep them stable in storage.

PROCESSING ROOM REQUIREMENTS

A well planned dark room makes the processing easier, which should be of atleast 4 × 5 feet (1.2 × 1.5 m).

Characteristics of darkroom :

i) *Convenient location and adequate size*

ii) Ample working space with adequate storage

iii) Lighting

iv) Temperature and humidity controlled

v) Darkroom plumbing

vi) Miscellaneous

LIGHTING

-The room must be completely dark and must exclude all visible light.

-Any leaks of white light in the darkroom causes film fog.

- Two types of lighting are essential in darkroom.

i)Room lighting (white illumination) and

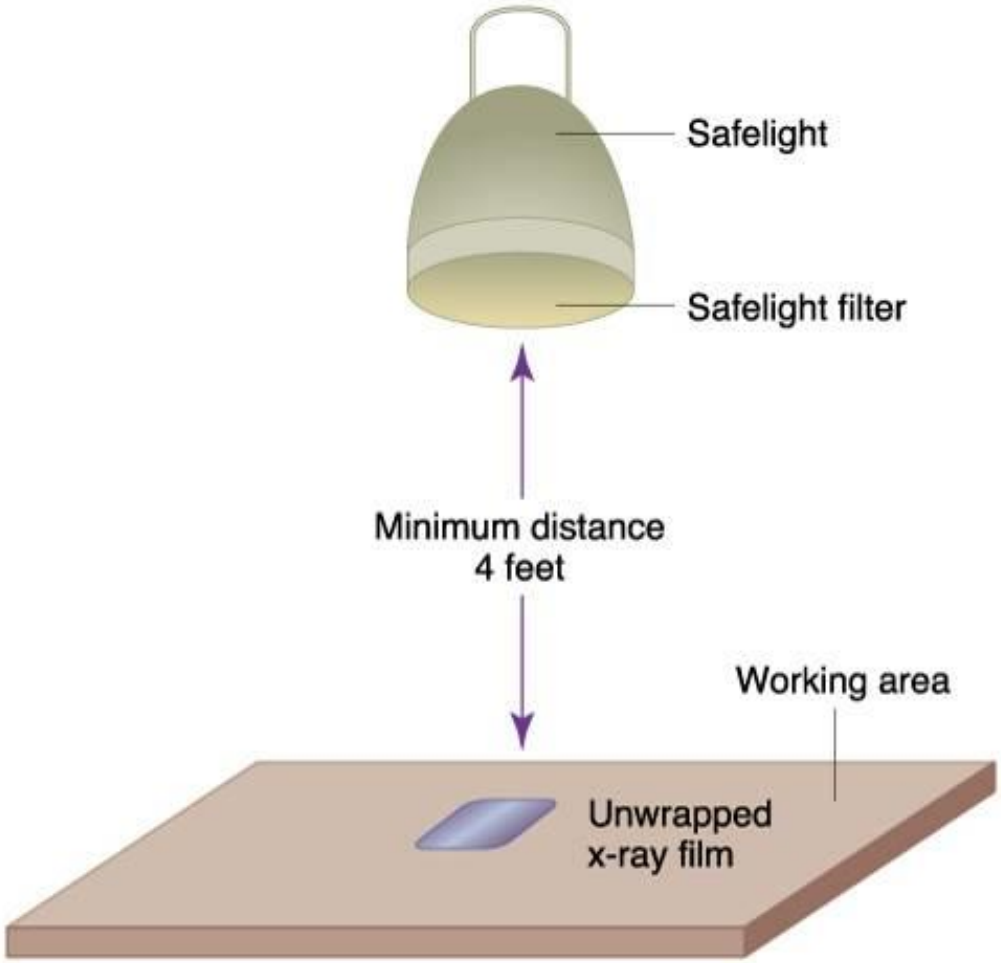
ii)Safe lighting.

Room lighting :Incandescent room lighting is required to perform task such as cleaning, stocking materials and mixing chemicals, this is not associated with the act of processing films.

Safe lighting :

- Special kind of lighting of relatively long wavelength and low intensity illumination that does not rapidly affect open film but permits one to see well enough to work in the area.
- To minimize the fogging effect of prolonged exposure, the safe light should have a 15 W bulb and a safe light filter(red GBX-2 filter).

FIG. 39-19 A MINIMUM DISTANCE OF 4 FEET MUST EXIST BETWEEN THE SAFELIGHT AND THE WORKING AREA.



TEMPERATURE AND HUMIDITY

-Should be controlled to prevent film damage.

-Room temp of 70 degree F is recommended ; if exceeds 90 degree F,film fog results.

-Humidity level of between 50 and 70 percent should be maintained; when too high, film emulsion does not dry; when too low, static electricity becomes a problem and causes film artifacts.

DARKROOM PLUMBING

Must include both hot and cold running water along with mixing valves to adjust the water temperature in the processing tanks with utility sink.

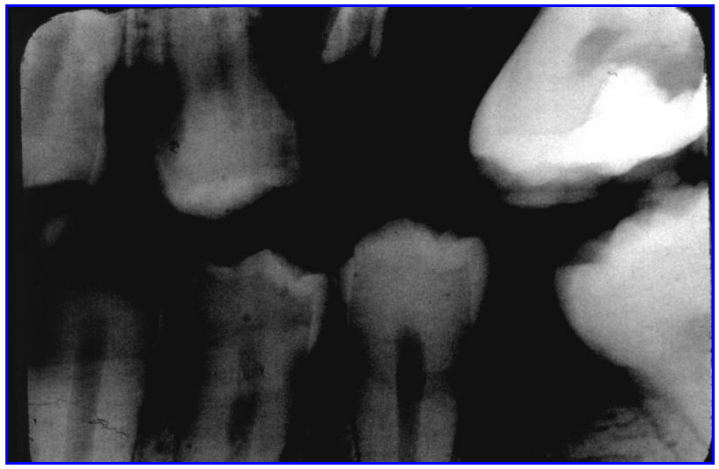
MISCELLANEOUS REQUIREMENTS:

i)Wastebasket for disposal of all film wrappings.

ii)x-ray view box used to examine radiographs.

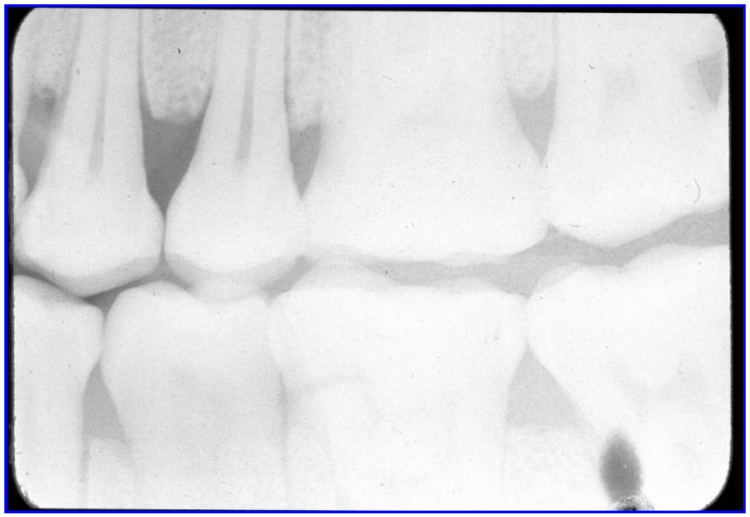
Chemical processing conditions

Studies have shown that poor processing conditions are responsible for a large percentage of radiographic re-takes. Thus, a reduction in the re-take rate can have a significant reduction in radiation exposure to patients.

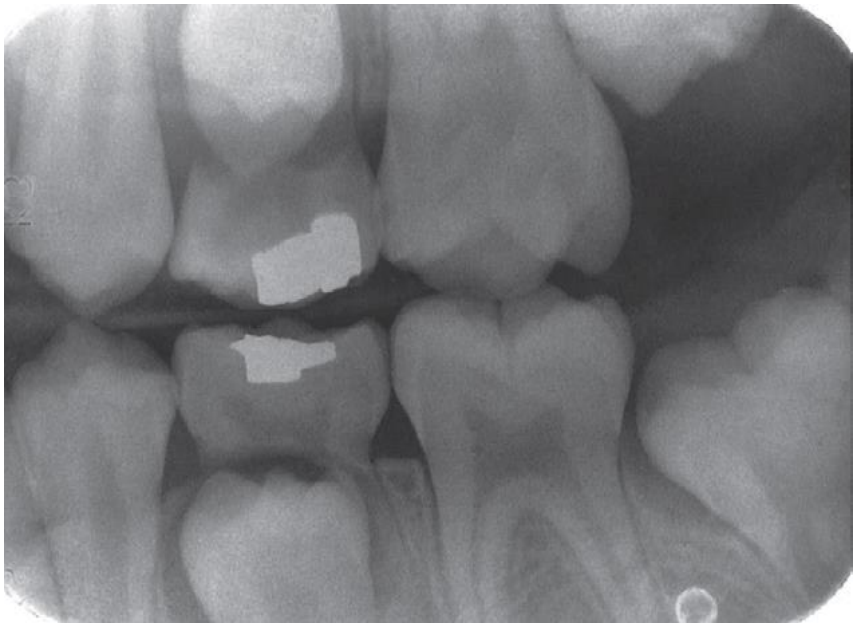


Dark images can result from high developer temperatures,

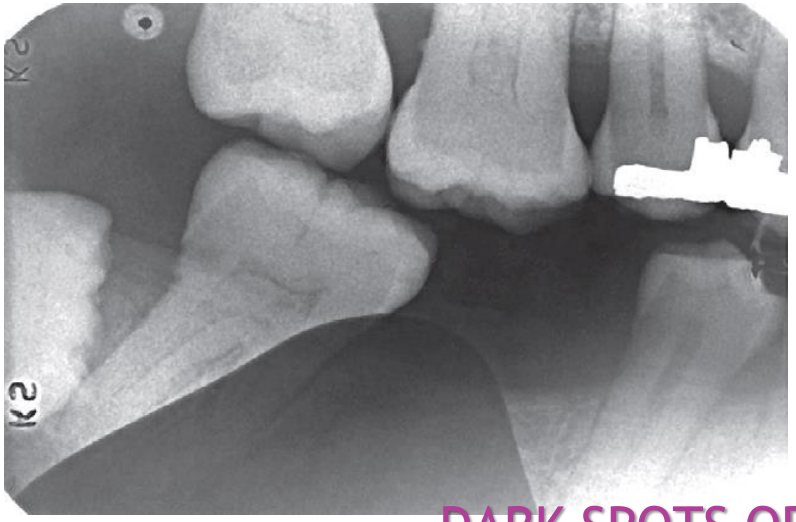
long development times or overactive developers. Check the thermostat, adjust it if necessary. Also, inspect the transport system for excessive wear of the gears and sprockets, and check the roller alignment and lubrication. Check the replenishing mechanism as the developer may be overactive. High water temperatures can also be responsible for dark films. Periodically check mixing valve adjustment and correct settings if appropriate.



Conversely, light films may occur if the developer or water temperature is too low, the development time is too short, or there is a decrease in developer activity. To assess developer activity, run a strip test and check for the possibility of contaminated or exhausted solutions.



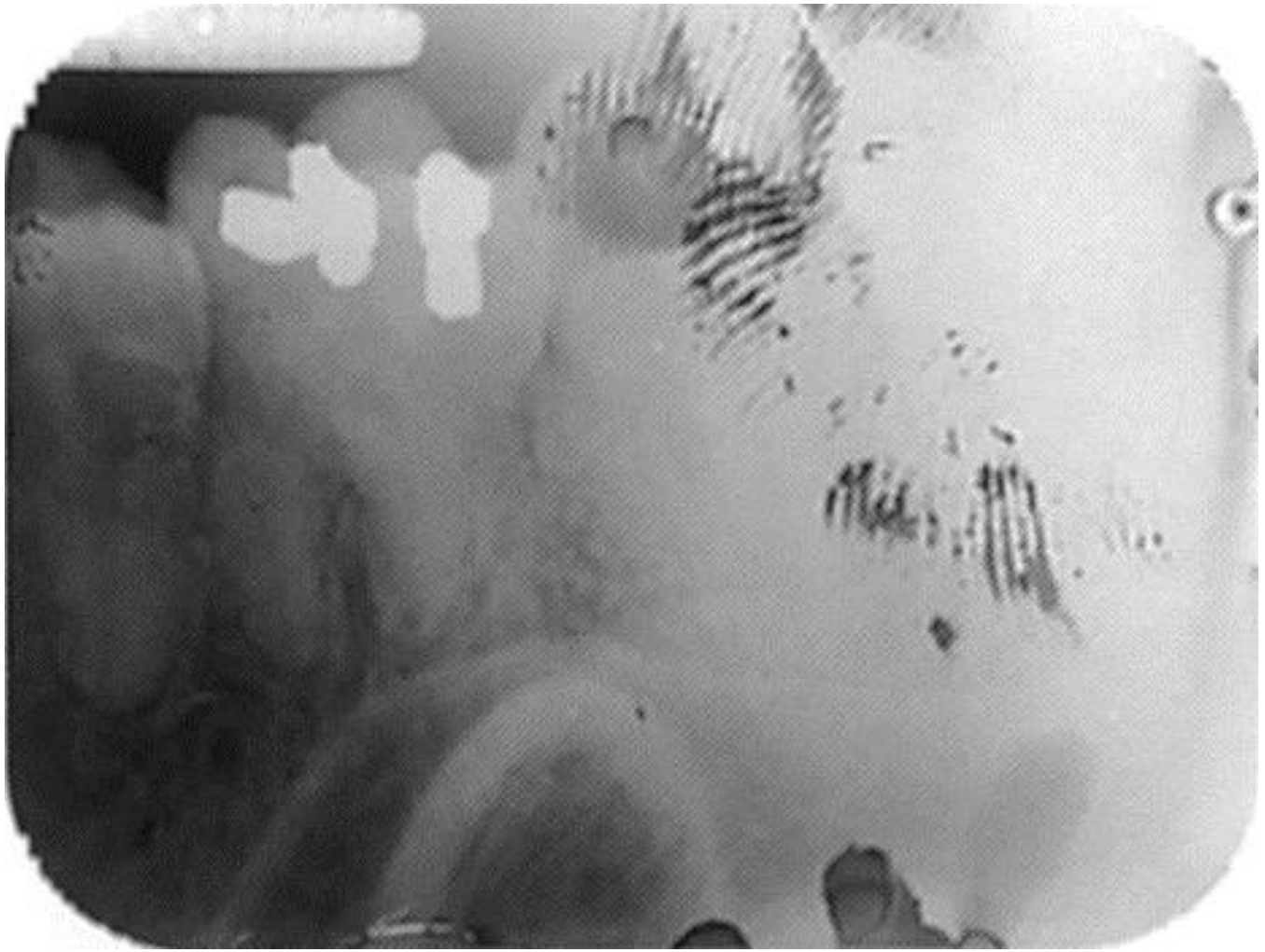
INSUFFICIENT CONTRAST
Underdevelopment
Underexposure
Excessive kVp
Excessive film fog

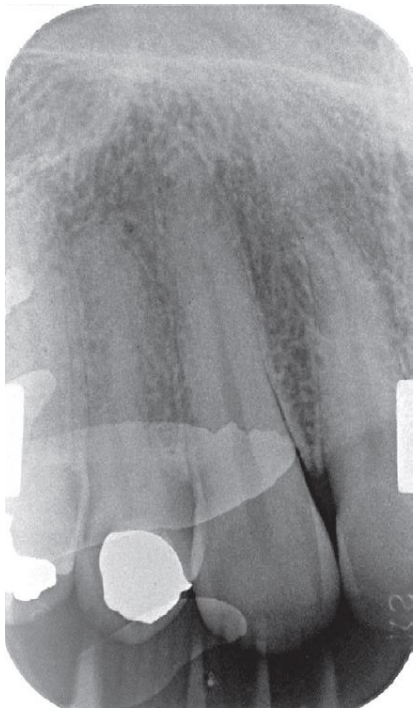


DARK SPOTS OR LINES

Fingerprint contamination
Protective wrapping paper sticking to film surface
Film in contact with tank or another film during fixation
Film contaminated with developer before processing
Excessive bending of film
Static discharge to film before processing
Excessive roller pressure during automatic processing
Dirty rollers in automatic processing

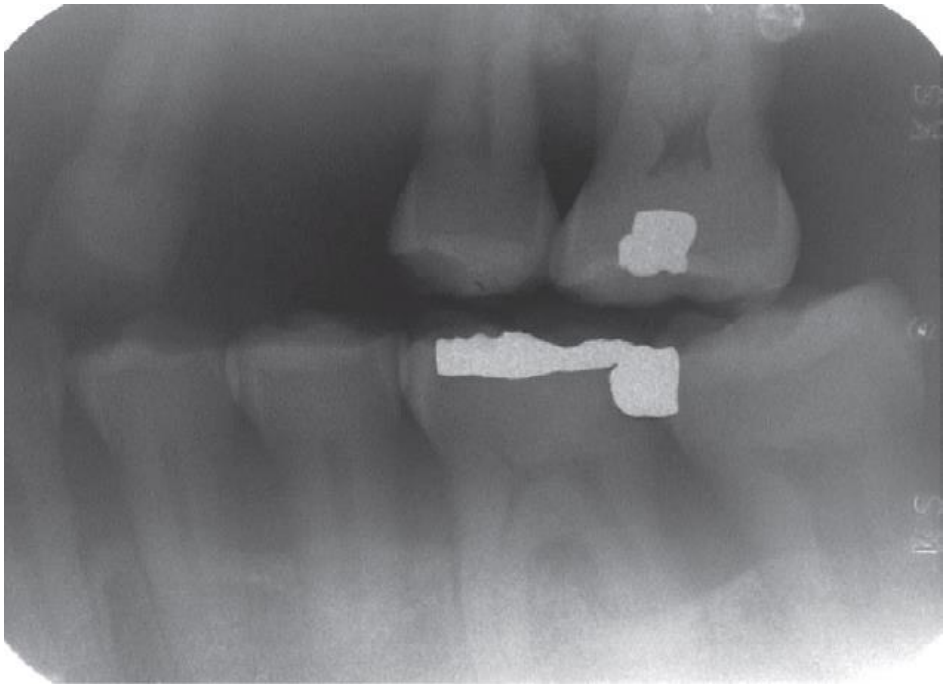
Fingerprints





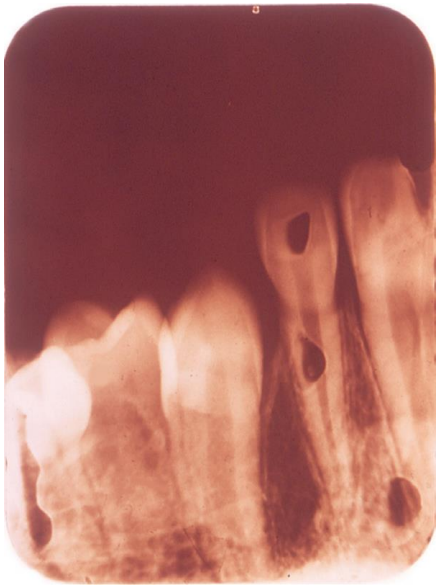
LIGHT SPOTS

Film contaminated with fixer before processing
Film in contact with tank or another film during development
Excessive bending of film



FILM FOG

Improper safelighting (improper filter; excessive bulb wattage; inadequate distance between safelight and work surface; prolonged exposure to safelight)
Light leaks (cracked safelight filter; light from doors, vents, or other sources)
Overdevelopment
Contaminated solutions
Deteriorated film (stored at high temperature; stored at high humidity; exposed to radiation; outdated)



YELLOW OR BROWN STAINS

Depleted developer
Depleted fixer
Insufficient washing
Contaminated solutions

Exposure to light

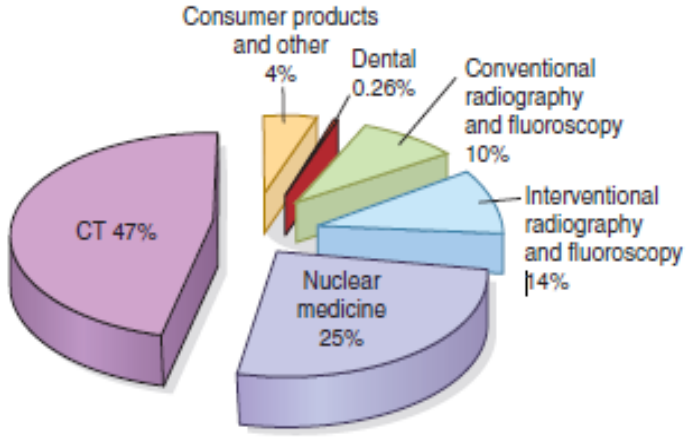
DENTAL RADIOGRAPHY SAFETY

RADIATION PROTECTION UPDATE

- Radiation in the Healing Arts is an invaluable tool with many obvious benefits.
- Although greatly beneficial, radiation can pose serious health risks to patients and equipment operators if not used properly.

RADIATION PROTECTION IN DENTAL RADIOLOGY

- Very frequent examination (about 25% of all the radiological examinations)
- Delivered doses may differ of a factor 2 or 10 or more (entrance doses between 0.5 and 150 mGy)
- Full mouth examination requires 20 exposures
- Image Quality often very low due to poor techniques and processing
- Organs at risk: parathyroid, thyroid, larynx, parotid glands



RADIATION IS RADIATION!

Although direct dosage is small, dental radiation can produce biological changes:

- Primary radiation: comes from tube itself
- Secondary radiation: "scatter radiation"
- Background radiation: from "normal" objects around us

THERE ARE THREE GUIDING PRINCIPLES IN RADIATION PROTECTION:

- 1. Justification
- 2. Optimization
- 3. Dose limitation

TABLE 16-2 American Dental Association Recommendations for Prescribing Dental Radiographs*

Type of Encounter	PATIENT AGE AND DENTAL DEVELOPMENTAL STAGE	
	Child with Primary Dentition (before Eruption of First Permanent Tooth)	Child with Transitional Dentition (after Eruption of First Permanent Tooth)
New patient* being evaluated for oral diseases	Individualized radiographic exam consisting of selected periapical/occlusal views and/or posterior bitewings if proximal surfaces cannot be visualized or probed. Patients without evidence of disease and with open proximal contacts may not require a radiographic examination at this time	Individualized radiographic exam consisting of posterior bitewings with panoramic exam or posterior bitewings and selected periapical images
Recall patient* with clinical caries or at increased risk for caries†	Posterior bitewing exam at 6- to 12-mo intervals if proximal surfaces cannot be examined visually or with a probe	
Recall patient* with no clinical caries and not at increased risk of developing caries†	Posterior bitewing examination at 12- to 24-mo intervals if proximal surfaces cannot be examined visually or with a probe	
Recall patient* with periodontal disease	Clinical judgment as to the need for and type of radiographic images for the evaluation of periodontal disease. Imaging may consist of, but is not limited to, selected bitewing and/or periapical images of areas in which periodontal disease (other than nonspecific gingivitis) can be demonstrated clinically	
Patient (new and recall) for monitoring of dentofacial growth and development and/or assessment of dental/skeletal relationships	Clinical judgment as to need for and type of radiographic images for evaluation and/or monitoring of dentofacial growth and development or assessment of dental and skeletal relationships	
Patient with other circumstances, including, but not limited to, proposed or existing implants, other dental and craniofacial pathosis, restorative/endodontic needs, treated periodontal disease, and caries remineralization	Clinical judgment as to need for and type of radiographic images for evaluation and/or monitoring of these conditions	

PATIENT AGE AND DENTAL DEVELOPMENTAL STAGE

Adolescent with Permanent Dentition (before Eruption of Third Molars)	Adult, Dentate or Partially Edentulous	Adult, Edentulous
Individualized radiographic exam consisting of posterior bitewings with panoramic exam or posterior bitewings and selected periapical images; full-mouth intraoral radiographic exam is preferred when patient has clinical evidence of generalized dental disease or a history of extensive dental treatment		Individualized radiographic exam, based on clinical signs and symptoms
Posterior bitewing exam at 6- to 12-mo intervals if proximal surfaces cannot be examined visually or with a probe	Posterior bitewing examination at 6- to 18-mo intervals	Not applicable
Posterior bitewing exam at 18- to 36-mo intervals	Posterior bitewing exam at 24- to 36-mo intervals	Not applicable
Clinical judgment as to the need for and type of radiographic images for the evaluation of periodontal disease. Imaging may consist of, but is not limited to, selected bitewing and/or periapical images of areas in which periodontal disease (other than nonspecific gingivitis) can be demonstrated clinically		Not applicable
Clinical judgment as to need for and type of radiographic images for evaluation and/or monitoring of dentofacial growth and development or assessment of dental and skeletal relationships. Panoramic or periapical exam to assess developing third molars	Usually not indicated for monitoring of growth and development. Clinical judgment as to the need for and type of radiographic images for evaluation of dental and skeletal relationships	

USE SELECTION CRITERIA TO ASSIST IN DETERMINING TYPE AND FREQUENCY OF RADIOGRAPHIC EXAMINATIONS

- Use E/F-speed film or digital sensors
- Use holders to support film or digital sensors intraorally
- Make exposures with 60 to 70 kVp
- Replace short pointed aiming tubes with open-ended aiming cylinders
- Use rectangular collimation for periapical and bitewing images
- Use thyroid collars
- Stand at least 6 feet (2 m) away from patient and away from the x-ray machine

- (preferably out of x-ray room) when making exposure
- With film, use time-temperature film processing rather than “sight” processing, or

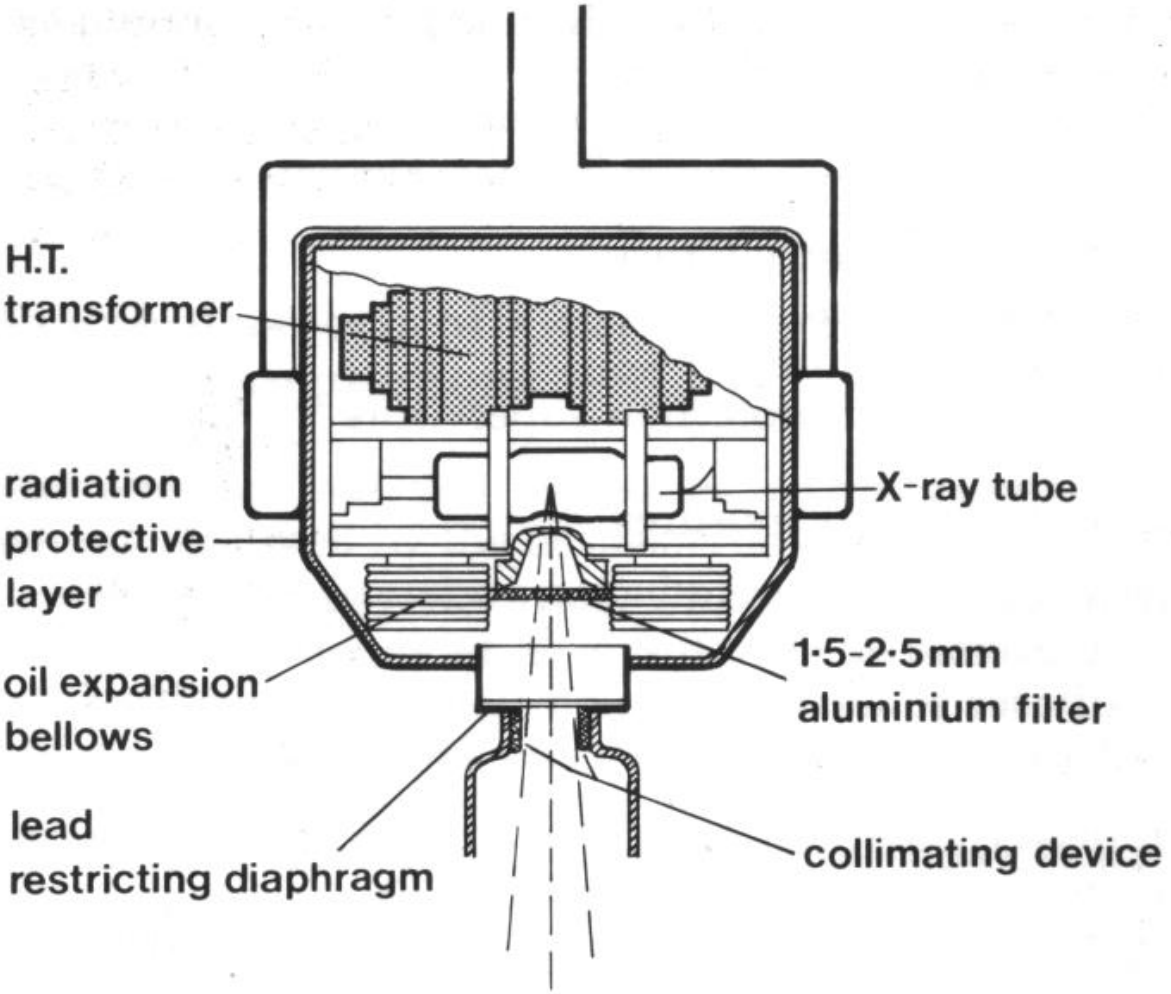
use an automatic processor

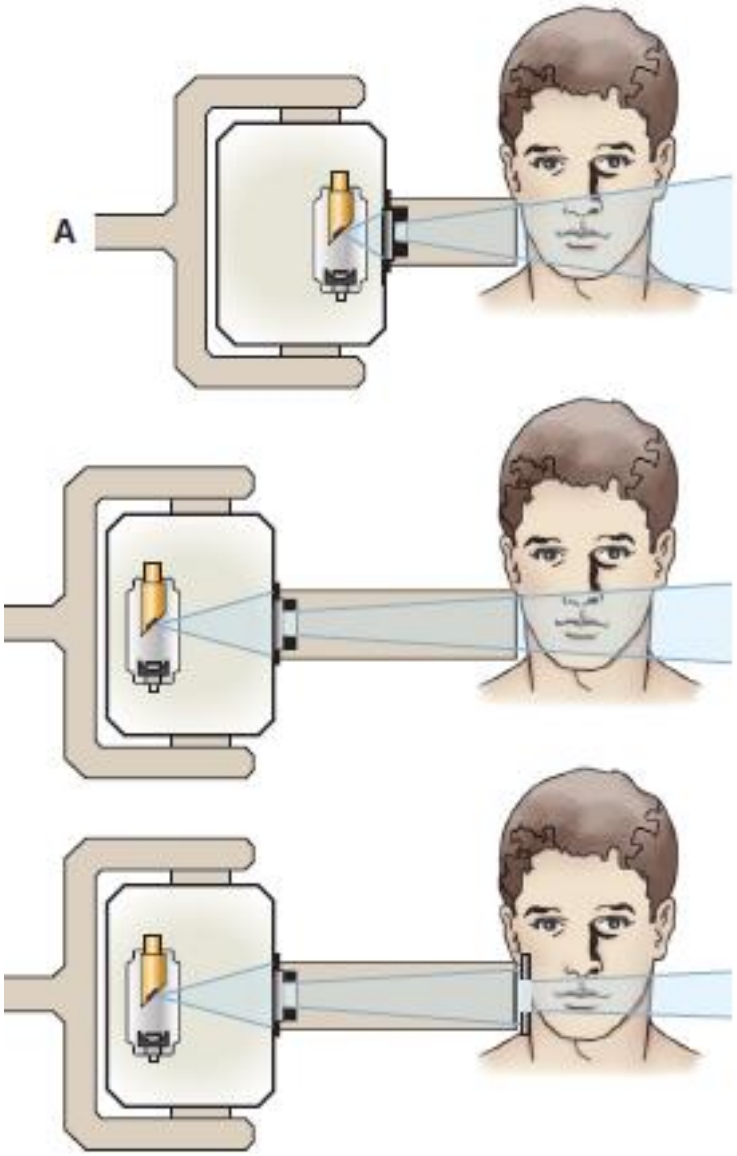
- Use rare-earth screens for panoramic and cephalometric film imaging or use digital

systems

- Reduce cone-beam CT beam field of view to region of interest

TUBE HEAD


H.T.
transformer
radiation
protective
layer
oil expansion
bellows
lead
restricting diaphragm
X-ray tube
1·5-2·5mm
aluminium filter
collimating device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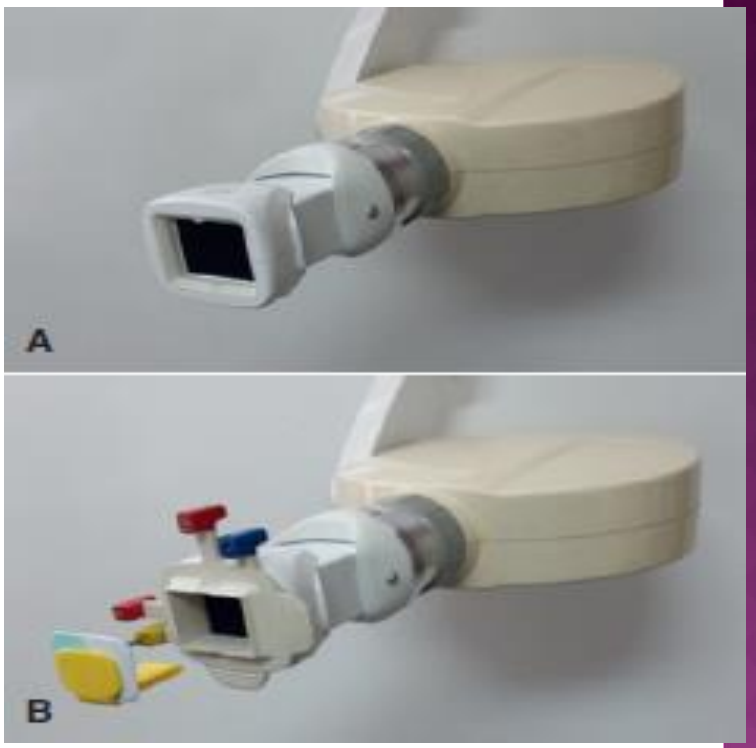

A
B

LEADED APRONS AND THYROID COLLARS

The NCRP 2003 recommendations referred to by the ADA are principally those already described—use of patient selection criteria, fast (E/F-speed film or digital sensors), and rectangular collimators.

More recent research has shown that the risk of heritable effects from dental exposure is essentially insignificant . However, most states currently require the use of leaded aprons

EMBRYO/FETUS RADIATION EFFECTS

- Pregnant patients should have radiographs taken if needed for diagnosis
- Congenital defects negligible from gonadal exposures < 200 mSv *(Hiroshima survivor study)*
  - Single x-ray exposure < 0.001 mSv with leaded apron
- Probability of 1st generation defect from dental x-rays is 9 in one billion

Basic methods of protection against exposure to ionizing radiation

Three basic factors

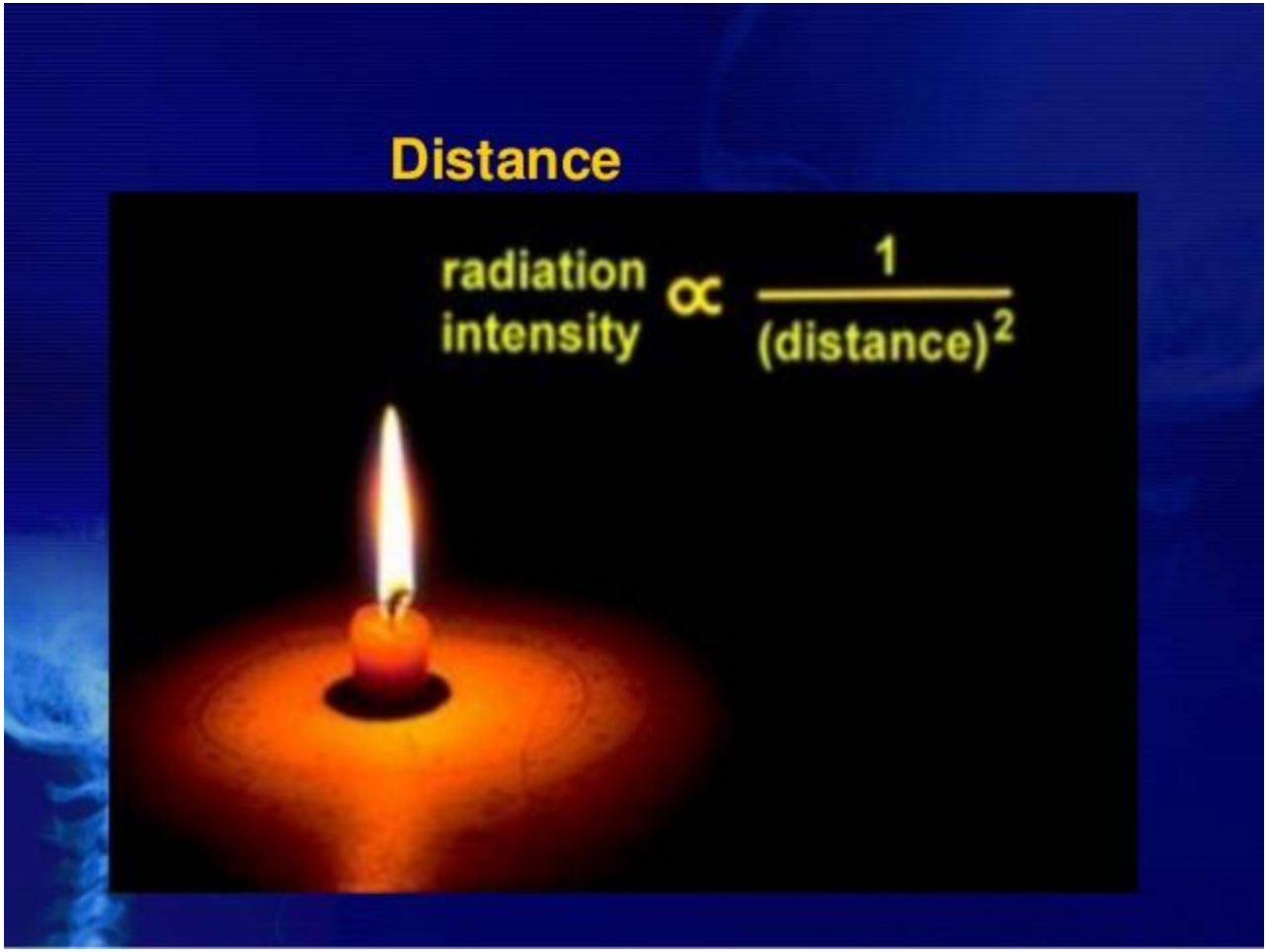
- time
- distance
- shielding

Time

Exposure rate =10mGy/h x **Time = Total dose**

1 hour = 10 mGy

2 hours = 20 mGy

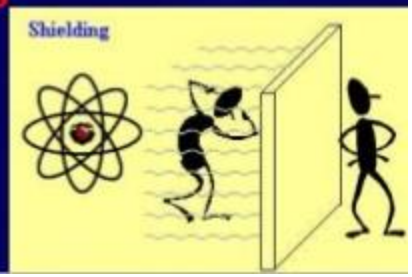

Distance
radiation intensity ∝ 1 / (distance)²

SHIELDING

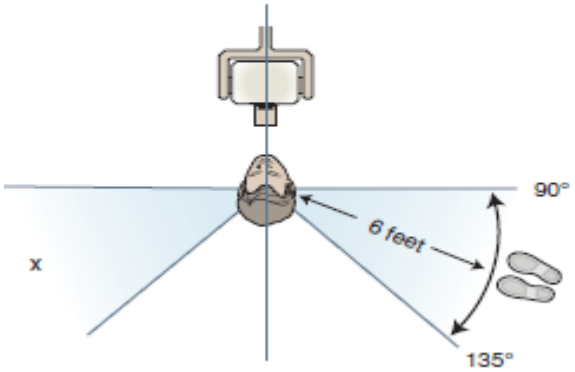
- Degree of exposure reduction depends on physical characteristics of material:

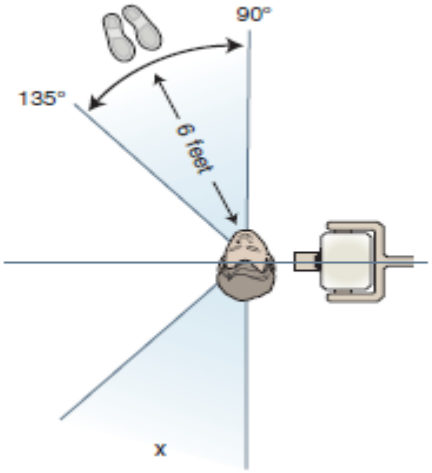
1. Atomic number
2. Density
3. Thickness

- For fixed X-ray imaging facilities most common materials are lead and concrete



PROTECTING PERSONNEL





SCHEDULE OF RADIOGRAPHIC QUALITY

- DAILY

- Check processing by comparing radiographs with reference film, step wedge, or

sensitometry and densitometry

- Enter causes of retakes in a log
- Replenish processing solutions
- Check temperature of processing solutions
- Run larger roller transport clean-up film through automatic processor

WEEKLY

- Replace processing solutions
- Clean processing equipment
- Clean viewboxes
- Review retake log

MONTHLY

- Examine photostimulable phosphor plates for scratches
- Check darkroom safelighting and for light leaks
- Clean intensifying screens
- Rotate film stock
- Check exposure charts
- Inspect leaded aprons and thyroid collars for damage such as cracks or tears

YEARLY

- Verify digital sensors with quality assurance apparatus
- Calibrate x-ray machine

RADIATION RISKS SUMMARY

- Dental radiology risks are small, but cannot be ignored
- Dental personnel need to be knowledgeable about radiation risks to answer patient concerns and protect themselves
- Radiation risks can be minimized by close attention to radiation safety and practicing good radiological techniques

INFECTION CONTROL IN DENTAL RADIOGRAPHY

KEY STEPS IN RADIOGRAPHIC

- Infection Control
- • Apply standard precautions
- • Wear gloves during all radiographic procedures
- • Disinfect and cover x-ray machine, working surfaces, chair, and apron
- • Sterilize nondisposable instruments
- • Use barrier-protected film (sensor) or disposable container
- • Prevent contamination of processing equipment

DISINFECT AND COVER CLINICAL CONTACT SURFACES

- x-ray machine and control panel, chair-side computer, beam alignment device, dental chair and headrest, leaded apron, thyroid
- collar, and surfaces on which film is placed. The CDC classifies these as noncritical items

- Good surface disinfectants include iodophors, chlorines, and synthetic phenolic compounds.
- the ADA suggest that when dentists use sterilization, the agent should be an Environmental Protection Agency (EPA)–registered hospital disinfectant of low to intermediate activity. The agent should also be tuberculocidal—an effective killer of tuberculosis—and capable of preventing other infectious diseases, including hepatitis B virus and HIV

STERILIZE NONDISPOSABLE INSTRUMENTS

- Film-holding instruments are classified by the CDC as semicritical items—instruments that are not used to penetrate soft tissue or bone but do come in contact with the oral mucous membrane. It is best to use film-holding instruments that are heat sterilizable.

USE BARRIERS WITH DIGITAL SENSORS

PREVENT CONTAMINATION OF PROCESSING EQUIPMENT

ممنون از توجه شما