Sri Aurobindo College of Dentistry

Indore, Madhya Pradesh

INDIA

MODULE PLAN

- TOPIC :PROJECTION GEOMETRY
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- PLATFORM: INSTITUTIONAL LMS
- PRESENTER: DR.VIHANG NAPHADE

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INTRODUCTION

- A radiograph is a two-dimensional representation of a three-dimensional object.

- To obtain the maximal value from a radiograph, a clinician must have a clear understanding of normal anatomy and then mentally reconstruct a three-dimensional image of the anatomic structures of interest from one or more of these two-dimensional views. Using high-quality radiographs greatly facilitates this task.

- The principles of projection geometry describe the effect of focal spot size and position (relative to the object and the film) on image clarity, magnification, and distortion.

- Clinicians use these principles to maximize image clarity, minimize distortion, and localize objects in the image field.

GEOMETRIC CHARACTERISTICS

- Sharpness and Resolution
- Magnification
- Distortion

- These geometric characteristics of the radiographic image influence the diagnostic quality of a dental radiograph.
- These geometric characteristics must be minimized to produce an accurate radiographic image.

SHARPNESS AND RESOLUTION

- Sharpness refers to the capability of the x-ray film to reproduce the distinct outlines of an object, or in other words, how well the smallest details of an object are reproduced on a dental radiograph. (Laura Jansen)
- Sharpness is the ability of a radiograph to define an edge precisely. (White & Pharoah)
- Resolution or resolving power is the ability of radiograph to record separate structures that are close together.
- The sharper the image, the easier it is to make a diagnosis concerning subtle changes in bone or tooth structure. The sharpness of an image is dependent on the size of the penumbra.

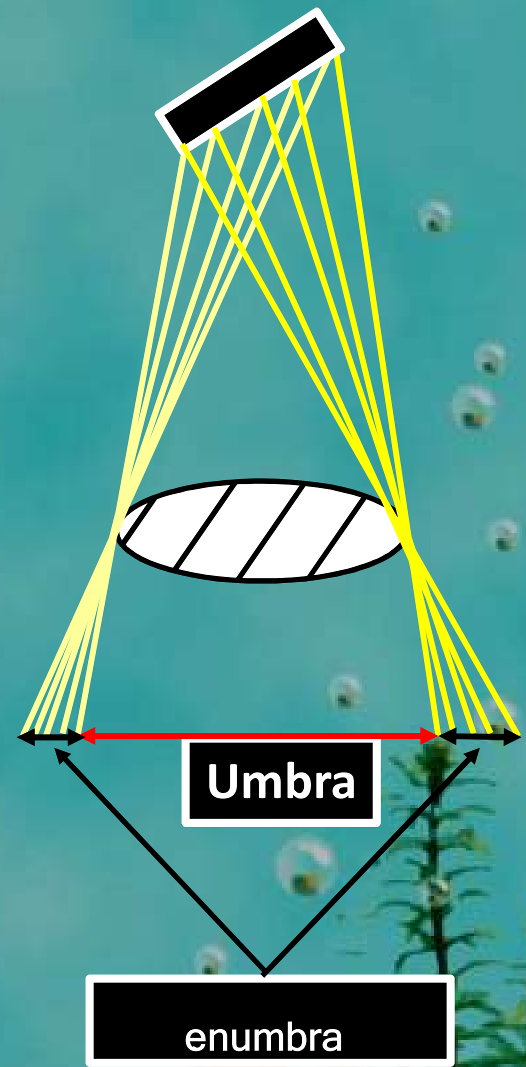
PENUMBRA

- The area on the film that represents the image of a tooth is called the umbra, or complete shadow or Umbra is defined as that part of the shadow where all light is absorbed, or area of total darkness.
- The area around the umbra is called the penumbra or partial shadow.
- The fuzzy, unclear area that surrounds a radiographic image is termed the penumbra.
- The term penumbra is derived from two Latin words, *pene, meaning almost, and umbra, meaning* shadow.

- Penumbra is that part of the shadow of an object which is larger than a point and yet represents a single point of the object.
- Penumbra is the unsharpness, or blurring, of the edges of a radiographic image.
- The penumbra is the zone of unsharpness along the edge of the image; the larger it is, the less sharp the image will be.

Penumbra

The penumbra is formed. X-rays from either extreme of the target, and from many points in between, pass through the edge of the object and contribute to the penumbra.



The various factors that control sharpness of an image on the X-ray film are:

A. Geometric unsharpness
   - Size of the Focal Spot.
   - Object Film Distance.
   - Target Film Distance.

B. Motion unsharpness
   - Patient.
   - Tube.
   - Film.

C. Film unsharpness
- Grain Size
- Single and Double Emulsion.
- Film Thickness.

D. Fog unsharpness
- Scattered Radiation.
- Unsafe, Safety Light in the Darkroom.
- Chemical Fog.

E. Intensifying screen unsharpness

- Crystal Size
- Back Screen Scatter
- Mottle

Geometric Unsharpness

- This type of unsharpness is due to criss-crossing of rays at the edges of the object. resulting in a fuzzy image border.
- Larger the focal spot size greater will be loss of image clarity.
- Three methods exist for minimizing this loss of image clarity and improving the quality of radiographs
  - Use as small an effective focal spot as practical
  - Increase the distance between the focal spot and the object by using a long, open-ended cylinder
  - Minimize the distance between the object and the film.

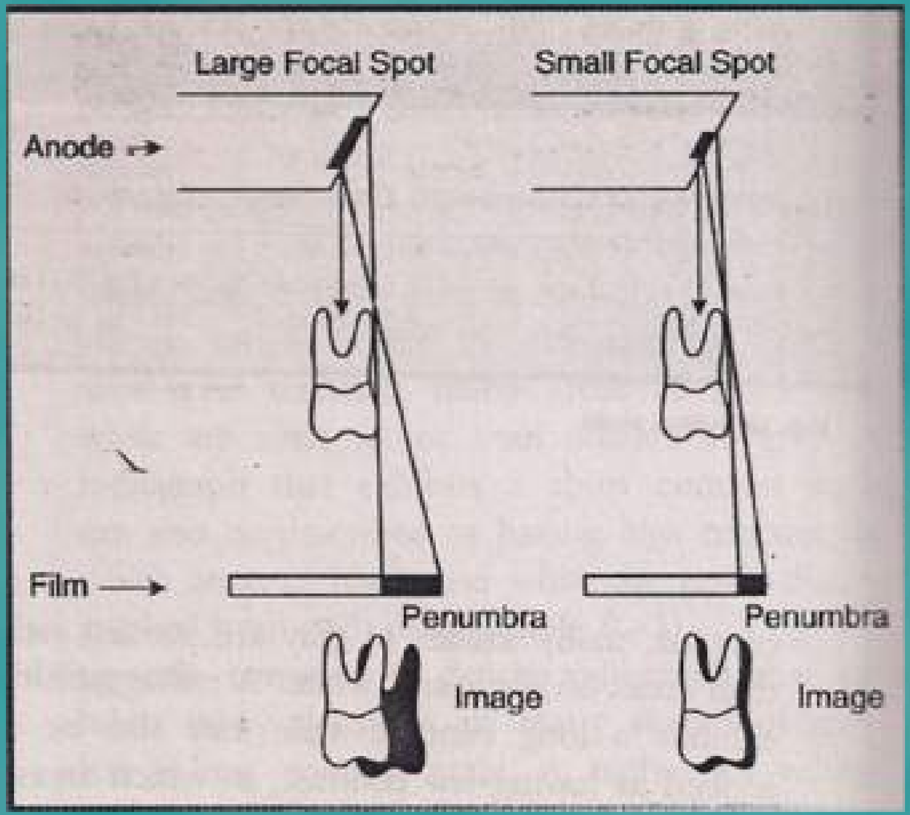
FOCAL SPOT SIZE

- The tungsten target of the anode serves as a focal spot this small area converts bombarding electrons into x-ray photons.
- The focal spot concentrates the electrons and creates an enormous amount of heat. To limit the amount of heat produced and to prevent damage to the x-ray tube, the size of the focal spot is limited.

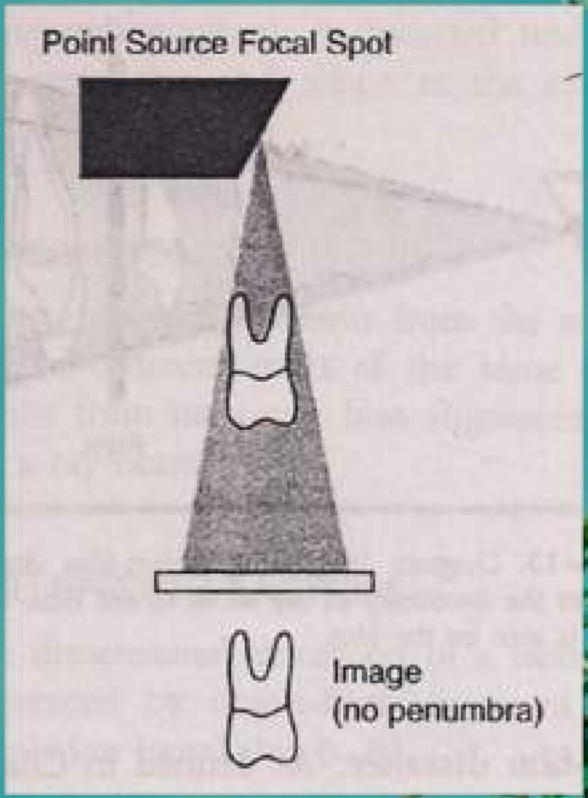
- Dental x-ray machines should have a nominal focal spot size of 1.0mm or less. Some tubes used in extraoral radiography have effective focal spots measuring 0.3 mm, which greatly adds to image clarity. X-ray tube manufacturers use as small an effective focal spot size as is consistent with the requirements for heat dissipation.
- The size of the effective focal spot is a function of the angle of the target with respect to the long axis of the electron beam.

- A large angle distributes the electron beam over a larger surface and decreases the heat generated per unit of target area, thus prolonging tube life. However, this results in a larger effective focal spot and loss of image clarity.
- A small angle has a greater wearing effect on the target but results in a smaller effective focal spot, decreased unsharpness, and increased image sharpness and resolution.
- This angle of the target to the central x-ray beam is usually between 10 and 20 degrees.

- The smaller the focal spot area, the sharper the image appears the larger the focal spot area, the greater the loss of image sharpness.



- *If x-rays were produced from one spot or a single "point source," no unsharpness would be present. However, a single point source of x-ray production is impossible because of the limited capacity of the x-ray tube.*

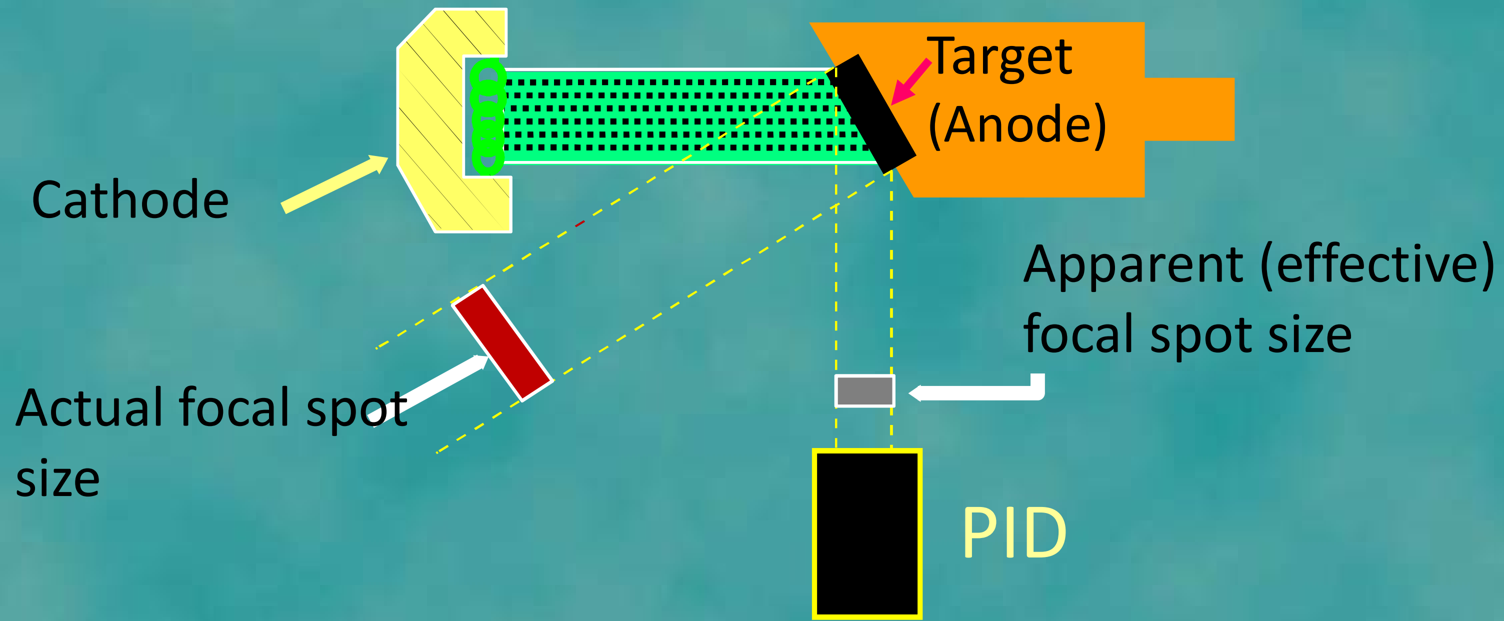


- When x rays are produced at the target in an x-ray tube, they originate from all points within the area of the focal spot. Because these rays originate from different points and travel in straight lines, their projections of a feature of an object do not occur at exactly the same location on a film.

The sharpness (detail) of images seen on a radiograph is influenced by the size of the focal spot (area in the target where x-rays are produced). The smaller the focal spot (target, source), the sharper the image of the teeth will be.

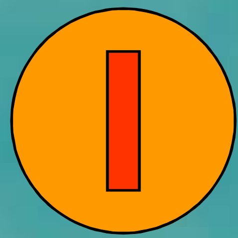
During x-ray production, a lot of heat is generated. If the target is too small, it will overheat and burn up. In order to get a small focal spot, while maintaining an adequately large target to withstand heat buildup , the line focus principle is used.

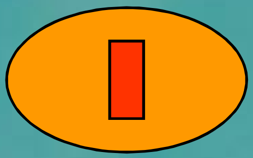
Line Focus Principle



The target is at an angle (not perpendicular) to the electron beam from the filament. Because of this angle, the x-rays that exit through the PID "appear" to come from a smaller focal spot. Even though the actual focal spot (target) size is larger (to withstand heat buildup), the smaller size of the apparent focal spot provides the sharper image needed for a proper diagnosis.

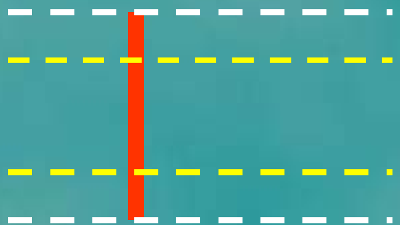
Line Focus Principle

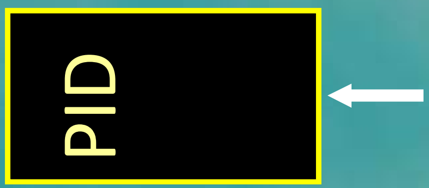




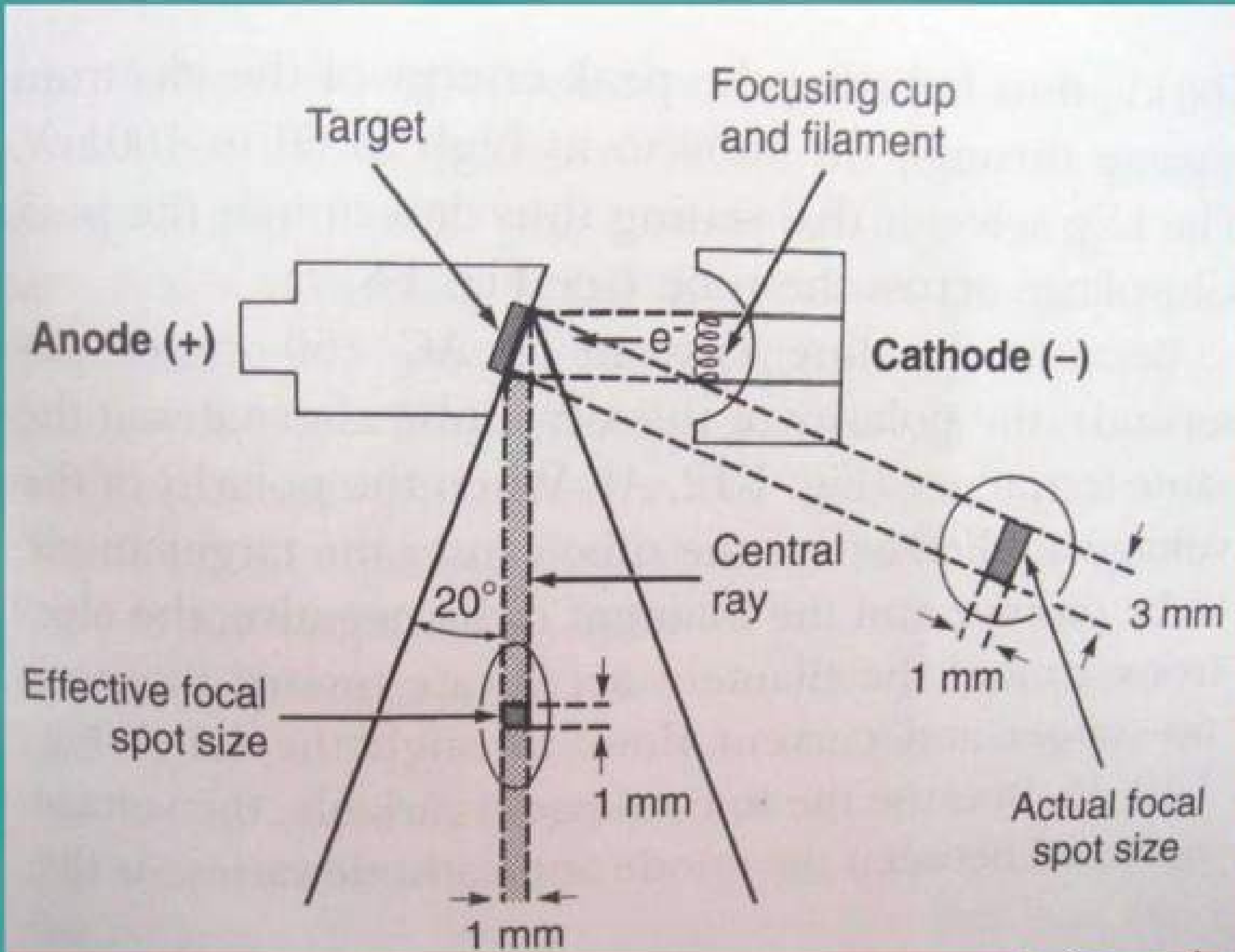
Actual focal spot size (looking perpendicular to the target surface

The target is at an angle to the electron beam.



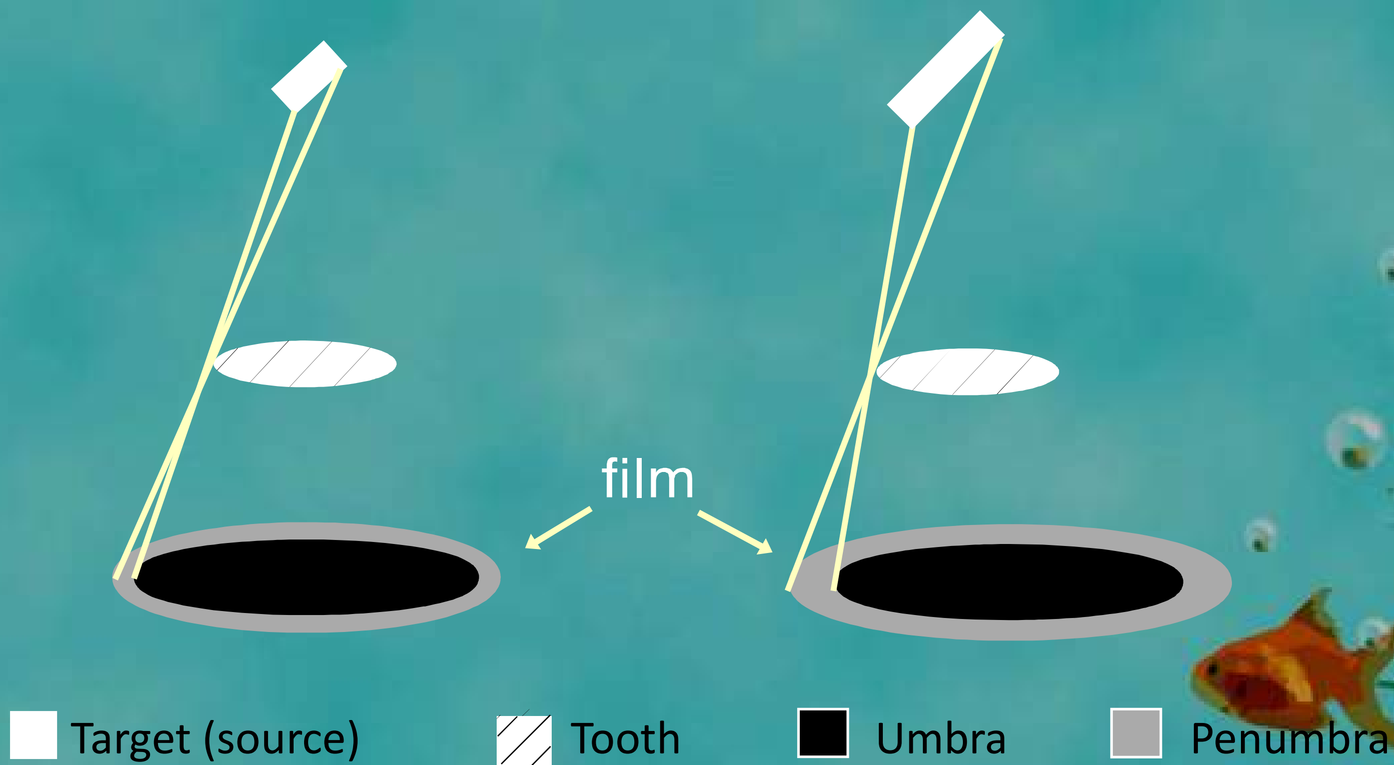


Looking up at target through open end of PID


Target
Focusing cup
and filament
Anode (+)
e⁻
Cathode (–)
Central
ray
20°
Effective focal
spot size
1 mm
3 mm
1 mm
Actual focal
spot size
1 mm

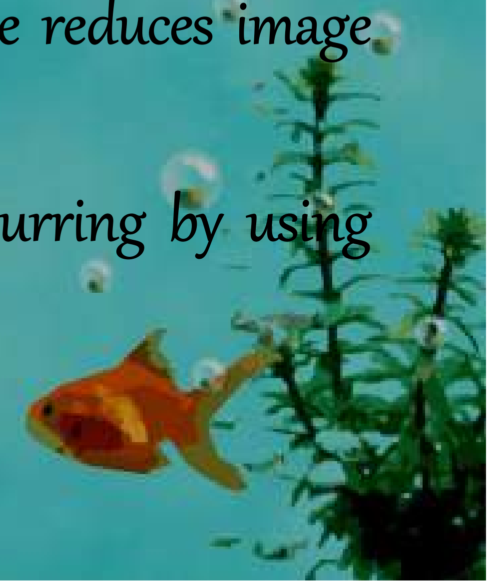
Decrease focal spot size, increase sharpness

The larger the target, the wider the area available from which x-rays can be generated. X-rays from opposite ends of the larger target pass through the edge of the tooth and create a larger penumbra around the image of the tooth on the film.

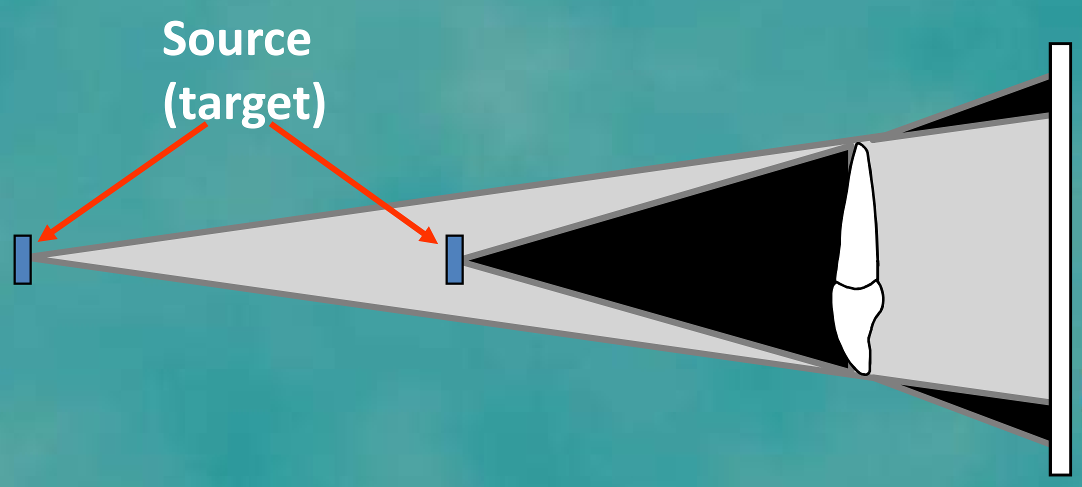


TARGET OBJECT DISTANCE

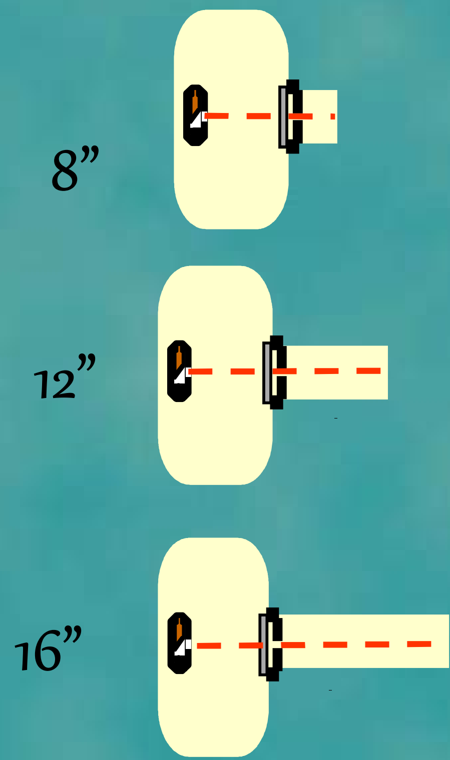
- The "source" refers to where the x-rays are produced, which is the target of the x-ray tube. This source, or target, is also referred to as the focal spot.
- Increase the distance between the focal spot and the object by using a long, open-ended cylinder
- Shows how increasing the focal spot-to-object distance reduces image blurring by reducing the divergence of the xray beam.
- The longer focal spot-to-object distance minimizes blurring by using photons whose paths are almost parallel.



Moving the source farther away from the teeth results in a sharper image that is less magnified.



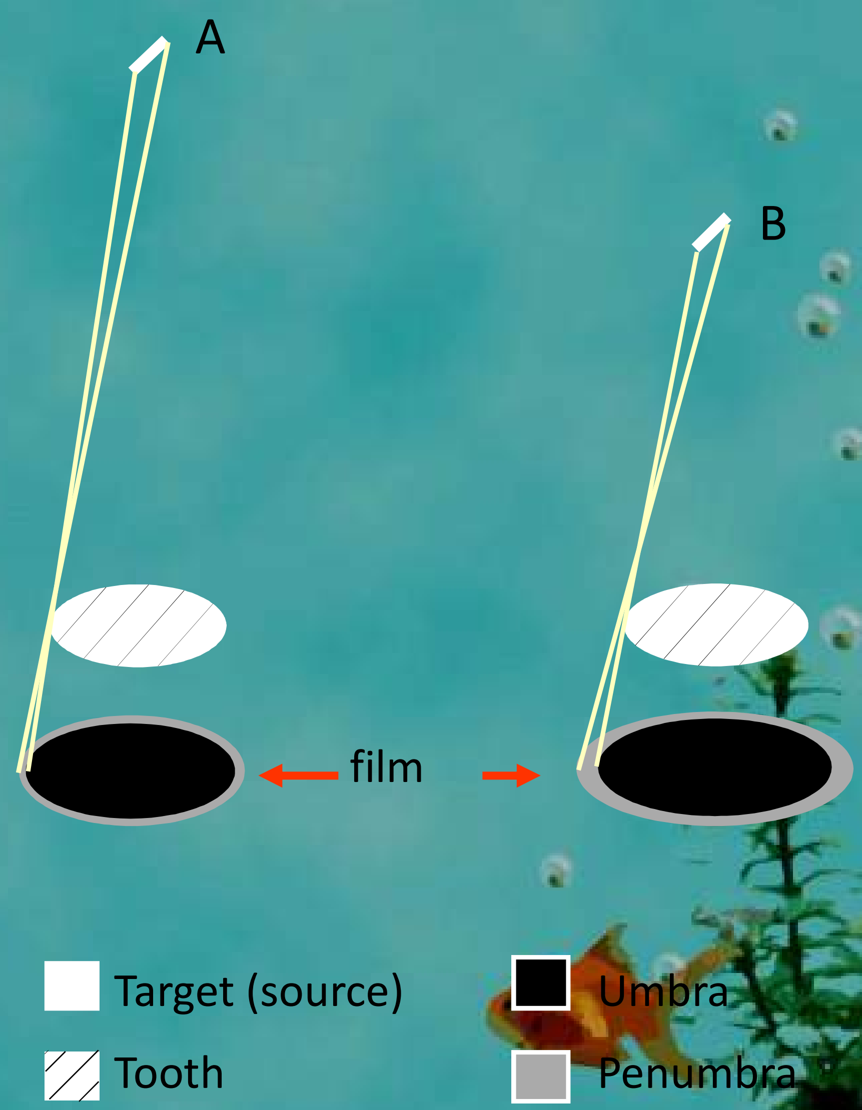
The most common way to increase the source-tooth distance is to increase the length of the PID.



- Target object distance should be as large as possible, to get a sharper image.
- The width of the zone of Geometric Unsharpness or Penumbra can be illustrated by the following equation:
- $$Ug = F \times \frac{d}{D}$$
  - Where, Ug = Penumbra size
  - F = focal spot size
  - D = Source to object distance in inches.
  - d = Object to film distance in inches.

Increase source-tooth distance, increase sharpness

When the target is closer to the tooth, the penumbra is larger. If the target is moved farther from the tooth, the penumbra surrounding the tooth image is smaller, creating a sharper image. The distance from the tooth to the film is unchanged.

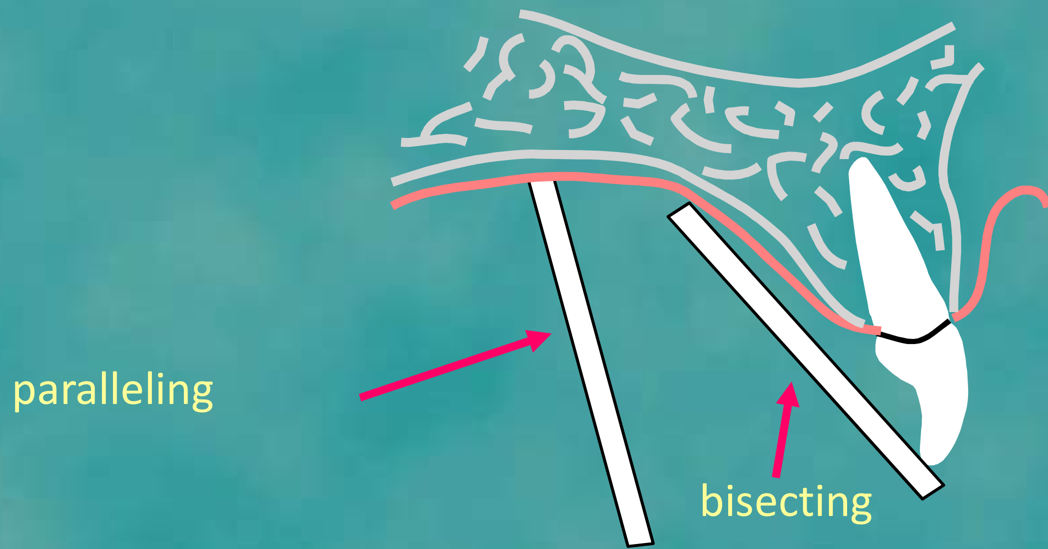


OBJECT FILM DISTANCE

Minimize the distance between the object and the film.

- Shows that as the object-to-film distance is reduced, the unsharpness decreases, resulting in enhanced image clarity.
- This is the result of minimizing the divergence of the x-ray photons.

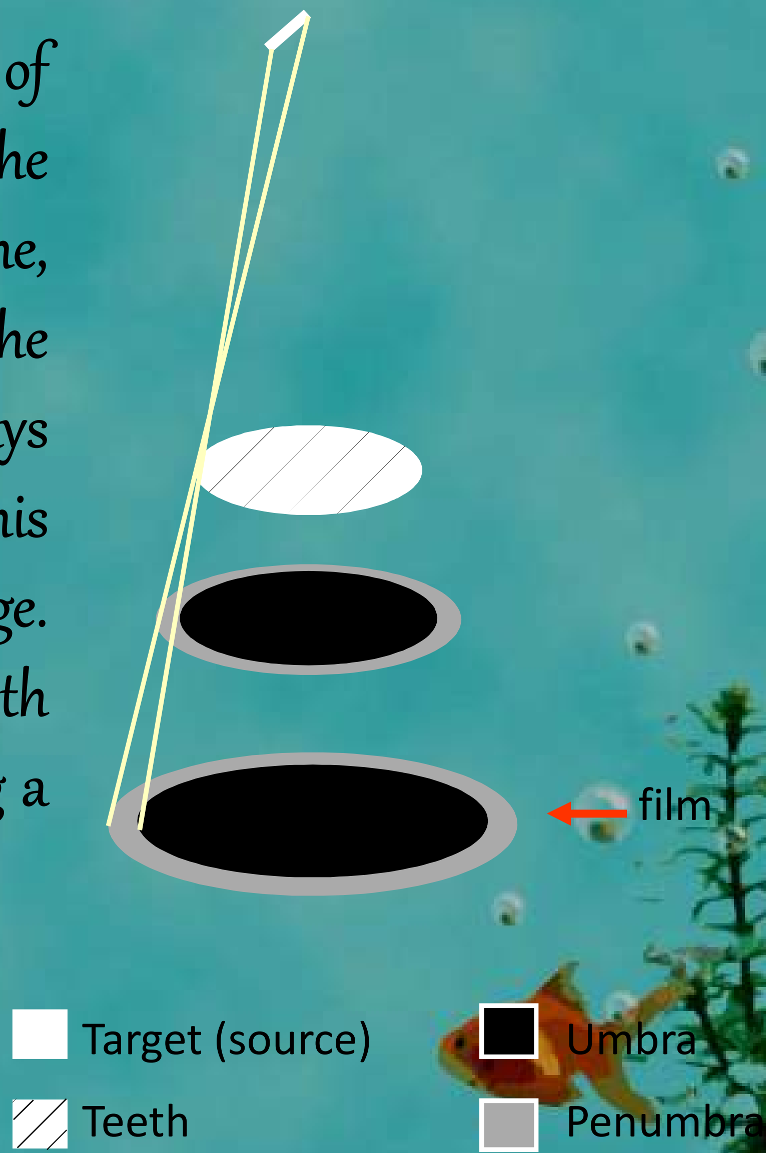
Tooth-film distance small



To achieve the sharpest image with the least magnification, the film should be as close to the teeth as possible. In general, the film can be placed closer to the teeth using the bisecting angle technique (with finger retention) than with the paralleling technique.

Decrease tooth-film distance, increase sharpness

As x-rays coming from opposite ends of the target pass through the edge of the tooth they continue in a straight line, diverging from each other. The farther the film is from the tooth, the more the x-rays diverge, creating a wider penumbra. This decreases the sharpness of the image. When the film is moved closer to the tooth (), the penumbra is smaller, creating a sharper image.



MOVEMENT
(MOTION UNSHARPNESS)

- Movement influences film sharpness. A loss of image sharpness occurs if either the film or the patient moves during x-ray exposure.
- Any movement of either the Patient, Tube or Film, results in unsharpness of the image produced.
- Movement of the x-ray source in effect enlarges the focal spot and diminishes image sharpness. Patient movement can be minimized by stabilizing the patient's head with the chair headrest during exposure.
- A decrease in the exposure time will give less time for movement thus helping to obtain more sharpness on the radiograph.

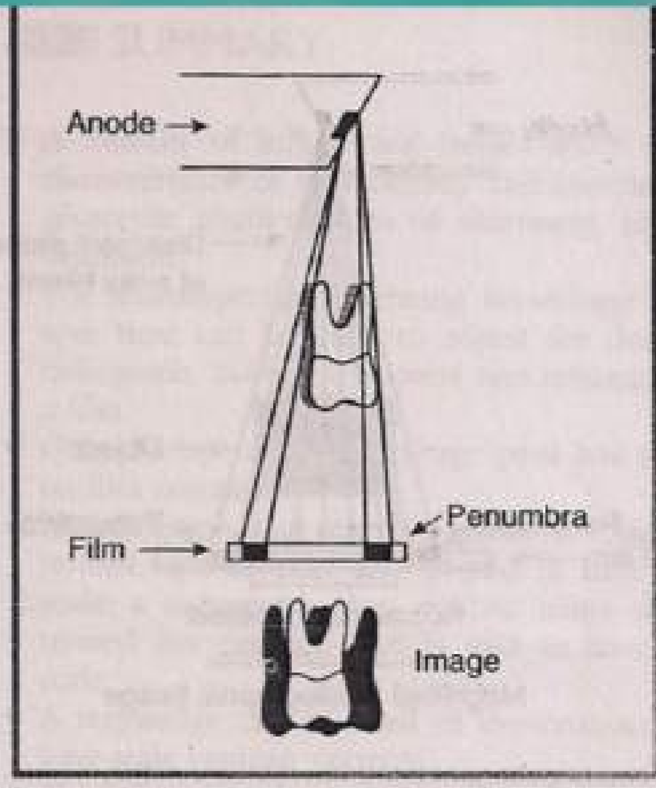


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FIGURE 8–9. Diagram illustrating the influence of motion on film sharpness. Notice that the image outline is blurred owing to penumbra formation.

Patient motion decreases sharpness

If the patient moves during the exposure of a film, the images will be blurred, or unsharp.

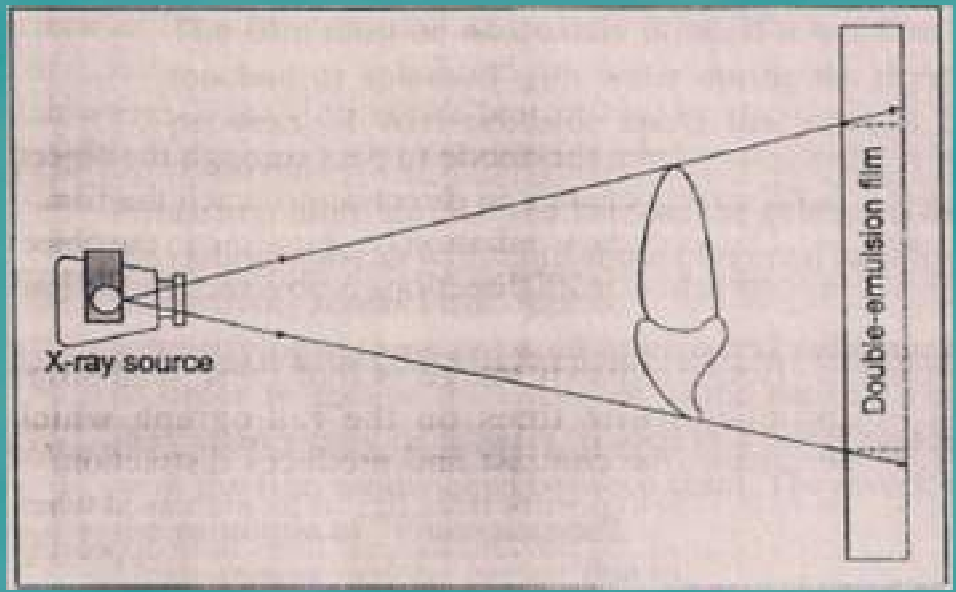
FILM UNSHARPNESS

– Grain Size

- The composition of the film emulsion influences the sharpness of the image produced, which is related to the grain size of the crystal.
- Faster the film speed bigger the grain size of the crystal, produces decreased image sharpness.
- This is because larger crystals do not produce image outlines as well demarcated as smaller crystals.

– *Single and double emulsion and film thickness*

- *Use of double coated films leads to increased thickness, which produces unsharpness due to parallax.*



- The presence of an image on each side of a double emulsion film also causes a loss of image sharpness through parallax . Parallax results from the apparent change in position or size of a subject when it is viewed from different perspectives. Because dental film has a double coating of emulsion and the x-ray beam is divergent, the images recorded on each emulsion vary slightly in size. In intraoral images, the effect of parallax on image sharpness is unimportant but is most apparent when wet films are viewed.

- *Under these conditions the emulsion is swollen with water and the loss of image sharpness caused by parallax is more evident. When intensifying screens are used, parallax distortion contributes to image unsharpness because light from one screen may cross the film base and reach the emulsion on the opposite side. This problem can be solved by incorporating dyes into the base that absorb the light emitted by the screens*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Nothing is Impossible
the word itself says
I'm Possible
_Audrey Hepburn
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CERVICAL BURN OUT

- Diffuse radiolucent areas with ill-defined borders may be apparent radiographically on the mesial or distal aspects of teeth in the cervical regions between the edge of the enamel cap and the crest of the alveolar ridg. This phenomenon, called cervical burnout

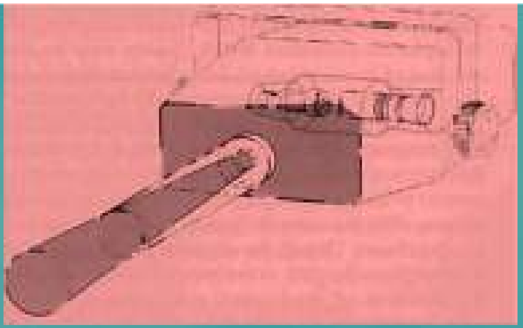
- It is caused by the normal configuration of the affected teeth, which results in decreased x-ray absorption in the areas . Furthermore, the perception of these radiolucent areas results from the contrast with the adjacent, relatively opaque enamel and alveolar bone. Such radiolucencies should be anticipated in almost all teeth and not be confused with root surface caries, which frequently have a similar appearance

FOG UNSHARPNESS

Scattered Radiation

- Scattered radiation results from photons that have interacted with the subject by Compton or coherent interactions. These interactions cause the emission of photons that travel in directions other than that of the primary beam.
- The consequent scattered radiation causes fogging of a radiograph, an overall darkening of the image that results in loss of radiographic contrast.

- Scattered, stray, leakage or any other radiation not belonging to the primary beam is undesirable as it produces film fog.
  - For intra oral films. filtration, collimation and film packets with lead backed sheets should be used to reduce scattered and secondary radiation.
  - For Extra oral films grids are used



Collimation

- Collimator is a device which collimates the Xray beam and reduces scattererd radiation.
- A collimator is a metallic barrier (lead) with an aperture in the middle used to reduce the size of the x-ray beam and therefore the volume of irradiated tissue within the patient.
- Use of collimation also improves image quality. When an x-ray beam is directed at a patient, the tissues absorb about 90% of the x-ray photons and 10% of the photons .pass through the patient and reach the film.

- Many of the absorbed photons generate scattered radiation within the exposed tissues by a process called Compton scattering
- These scattered photons travel in all directions, and result in film fog which degrade the image quality.
- Collimating the beam to reduce the exposure area and thus the number of scattered photons reaching the film can minimize the detrimental effect of scattered radiation on the images

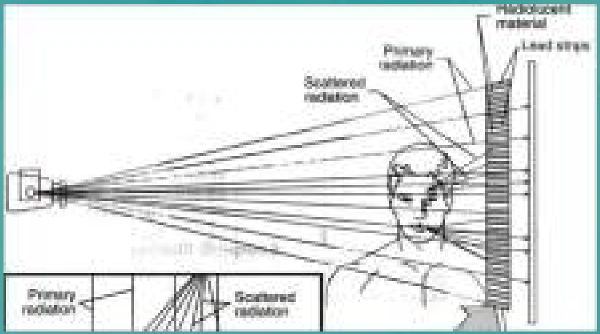
Filtration

- X ray beam emitted from the X ray tube consists of not only high energy (short wavelength) but also of low energy (long wavelength) photons.
- Low energy photons have little penetrating power and they are absorbed within the tissue contribute to patient exposure but do not have enough energy to reach the film.

- Consequently, to reduce patient dose, the less-penetrating photons should be removed. This can be accomplished, in part, by placing an aluminum filter in the path of the beam.
- Purpose of filtration is to remove low energy photons from x ray beam by placing an aluminium filter in the path of Xray beam and allow high energy photons to pass through which result in reduced patient exposure.

Film packets with lead sheets

- The foil is positioned in the film packet behind the film, away from the tube. This lead foil serves several purposes. It shields the film from backscatter (secondary) radiation, which fogs the film and reduces subject contrast (image quality). It also reduces patient exposure by absorbing some of the residual x-ray beam.



Grid

- A grid is a device which contains alternative strips of radiopaque and radiolucent material. It is placed between the object and the film to improve the quality of image by removal of scattered radiation that causes fog and reduces the film contrast.
- The secondary radiations originating in the object and travelling in all directions is absorbed by the lead strips.
- The disadvantage is that these lead strips produce white lines on the radiograph which decreases the contrast and produces distraction. Also the exposure time has to be increased when a grid is used. To prevent the grid lines from appearing on the radiograph, a moving grid called Potter Bucky.

- X-ray film is sensitive to light, pressure and any other type of ionizing radiation. The unexposed silver halide crystals slowly get converted to specks of silver. Therefore. it is important to safeguard the films from excessive temperature, humidity, exposure to chemicals and stray radiations. The films should be used preferably before their expiry date.

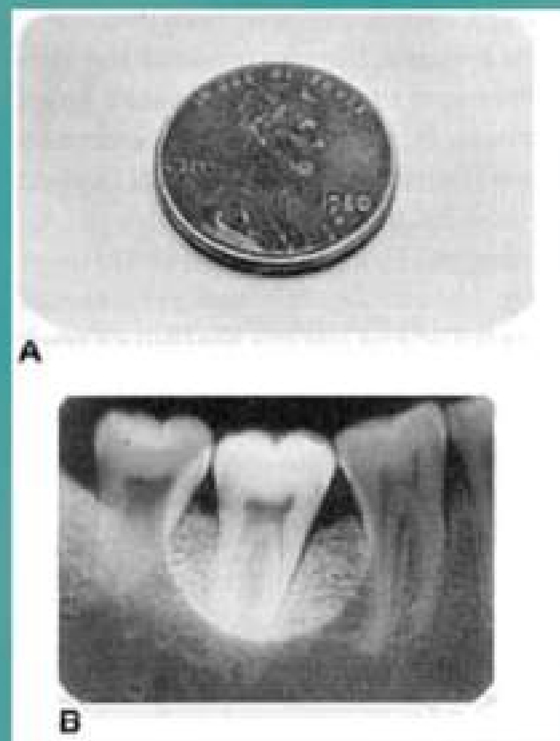
Unsafe, safety light in the darkroom

- Film becomes fogged in the darkroom because of inappropriate safelight filters, excessive exposure to safelights, and stray light from other sources. Such films are dark, show low contrast, and have a muddy gray appearance.
- Inspect the darkroom monthly to assess the integrity of the safelights (preferably GBX-2 filters with 15-watt bulbs).
- The glass filter should be intact, with no cracks.

- To check for light leaks in a darkroom, turn off all lights, allow your vision to accommodate to the dark, and check for light leaks, especially around doors and vents.
- Mark light leaks with chalk or masking tape. Weather stripping is useful for sealing light leaks under doors.
- Use of unsafe safe light produces fogging which can be verified by performing the "Coin Test“ or “Penny Test” in the dark room.

PENNY TEST

1. Open the packet of an exposed film and place the test film in the area where the films are usually unwrapped and clipped on the film hanger.
2. Place a penny on the film and leave it in this position for the approximate time required to unwrap and mount a full-mouth set of films, usually about 5 minutes.
3. Develop the test film as usual. If the image of the penny is visible on the resultant film, the room is not light-safe for the particular film tested. Each type of film used in the office should be tested to measure the integrity of the darkroom.


A
B

Chemical fog

- Is produced by prolonged development or development at high temperatures.
- Potassium Bromide or the restrainer prevents chemical fogging of the X-ray film by restraining the action of the developing agents on the unexposed silver halide crystals.
- If the radiograph is not adequately rinsed before putting it in the fixing solution, the alkaline developer will neutralize the acidic fixer and then the fixing and hardening action of the fixer solution is impaired, resulting in stains on the resultant radiograph.

- After fixing the radiograph should be thoroughly washed to remove all residual processing chemicals and silver salts from the film surface, as these may attack the silver image and/or certain products of fixation may decompose and produce a yellowish stain.
- If the temperature difference between the processing solution and the rinsing water is more than 15°F, an orange peel appearance (reticulations) will appear on the film.

- The film must be adequately dried. If a wet film is touched or splashed with water during the drying process, it will produce spots that cannot be removed.

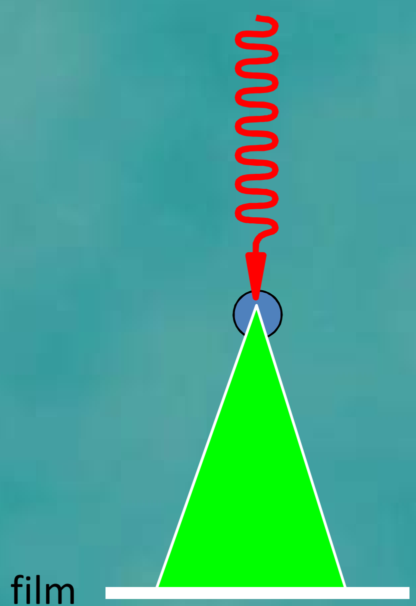
Potassium alum shrinks and hardens the gelatin so that the radiograph can withstand abuse of normal handling.

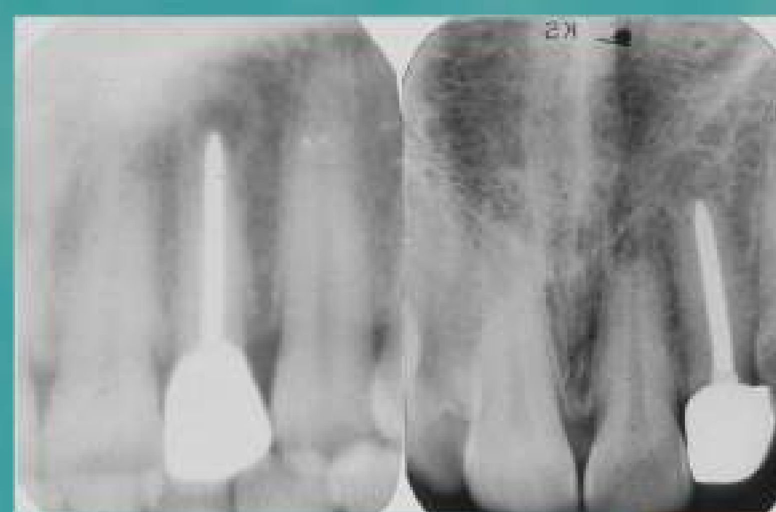
INTENSIFYING SCREEN UNSHARPNESS

- Intensifying screens are used in extraoral radiography in order to reduce the exposure to the patient.
- They are used in pairs, placed in a metal cassette with the film sandwiched between them. They work on the principle of "Fluorescence".

Intensifying screens decrease sharpness

Extraoral films use intensifying screens which contain special phosphor crystals that produce light when struck by x-rays ( ). This light in turn exposes the film. the light spreads out as it leaves the phosphor crystal. This results in a less sharp image. Compare the periapical film and the same area on a panoramic film. The periapical image is much sharper.





panoramic periapical

Unsharpness may be caused due to :

- When the X-rays strike the intensifying screen the fluorescent crystals emit light in all directions, producing stray radiations and thus causing unsharpness.
- Improper film contact with the screens. Clean all intensifying screens in panoramic and cephalometric film cassettes monthly. The presence of scratches or debris results in recurring light areas on the resultant images. The foam supporting the screens must be intact and capable of holding both screens closely against the film. If close contact between the film and screens is not maintained, the image loses sharpness.

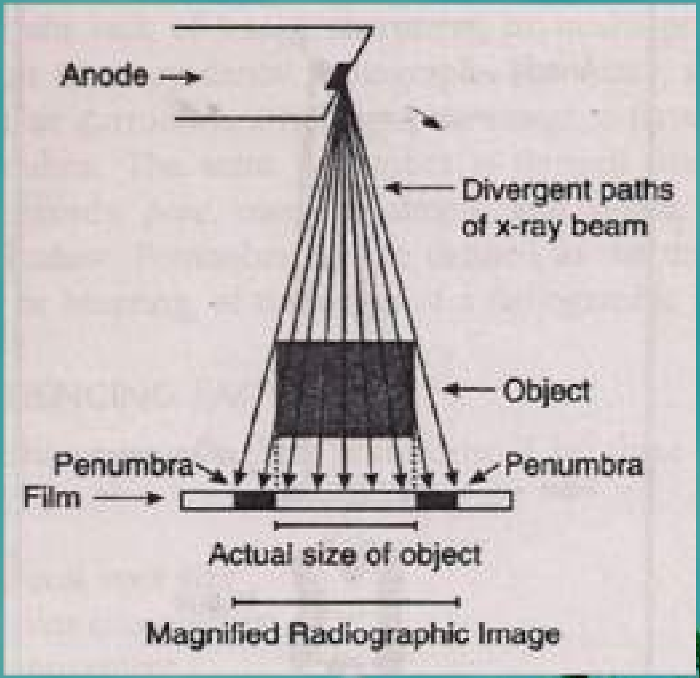
Screen Mottle and Quantum Mottle

- Radiographic mottle is uneven density resulting from the physical structure of the film or intensifying screens.
- On intraoral dental film, mottle may be seen as film graininess, which is caused by the visibility of silver grains in the film emulsion, especially when magnification is used to examine an image. Film graininess is most evident when high-temperature processing is used.
- Radiographic mottle is also evident when the film is used with fast intensifying screens. Two important causes of the phenomenon are quantum mottle and screen structure mottle.

- Quantum mottle is caused by a fluctuation in the number of photons per unit of the beam cross-sectional area absorbed by the intensifying screen.
- Quantum mottle is most evident when fast film-screen combinations are used. Under these conditions the relative non uniformity of the beam is highest.
- The longer exposures required by slower film-screen combinations tend to average out the beam pattern and thereby reduce quantum mottle. Screen structure mottle is graininess caused by screen phosphors. It is most evident when fast screens with large crystals are used

MAGNIFICATION

- Image size distortion (magnification) is the increase in size of the image on the radiograph compared with the actual size of the object.
- Magnification, or enlargement of a radiographic image, results because of divergent paths of the x-rays from focal spot.
- x-rays travel in divergent straight lines as they radiate from the focal spot. use of these diverging paths, some degree' of image magnification is present in. every dental radiograph.



- The use of a long, open-ended cylinder as an aiming device of an x-ray machine thus reduces the magnification of images on a periapical view.

- Factors which influence magnification of the image: are:
  - Target film distance
  - Object film distance
  - Use of intensifying screens

- The amount of magnification can be reduced by:

  1. Increasing the distance from the target to the film (source-film distance).

  2. Decrease the distance from the teeth to the film (object-film distance).

TARGET-FILM DISTANCE

- Target-film distance (also known as the source-to film distance) is the distance between the source of x-rays (focal spot on the tungsten target) and the film.
- Target-film distance determined in the intraoral machines by the length of the position indicating device (PID).
- Longer the PID, more parallel X-rays from the middle of the beam strike the object, rather than the diverging rays from the periphery of the beam. Therefore, there is less magnification.

- *Shorter the PID, less parallel X-rays from the middle of the beam strike the object, and more of the diverging rays from the periphery of the beam strike the object. Therefore, there is more magnification.*

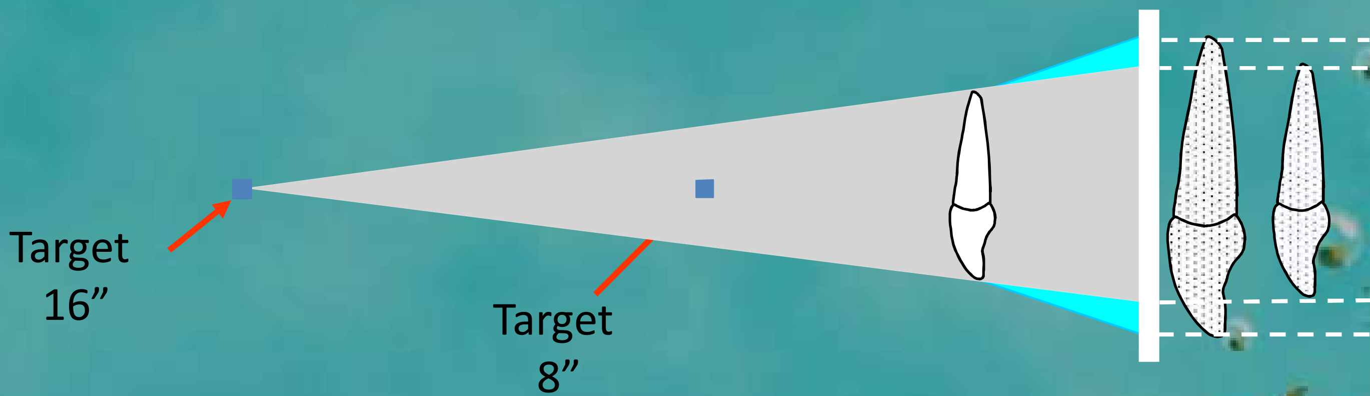
As a result, a longer PID and target-film distance result in less image magnification, and a shorter PID and target-film distance result ill more image magnification.

Magnification

Increase source-film distance, decrease magnification

When the target is moved farther from the teeth (from 8" to 16") the x-ray beam does not spread out as much and the magnification is decreased.

The closer the target is to the teeth, the more the x-rays spread out as they pass by the teeth, resulting in increased magnification.



OBJECT-FILM DISTANCE

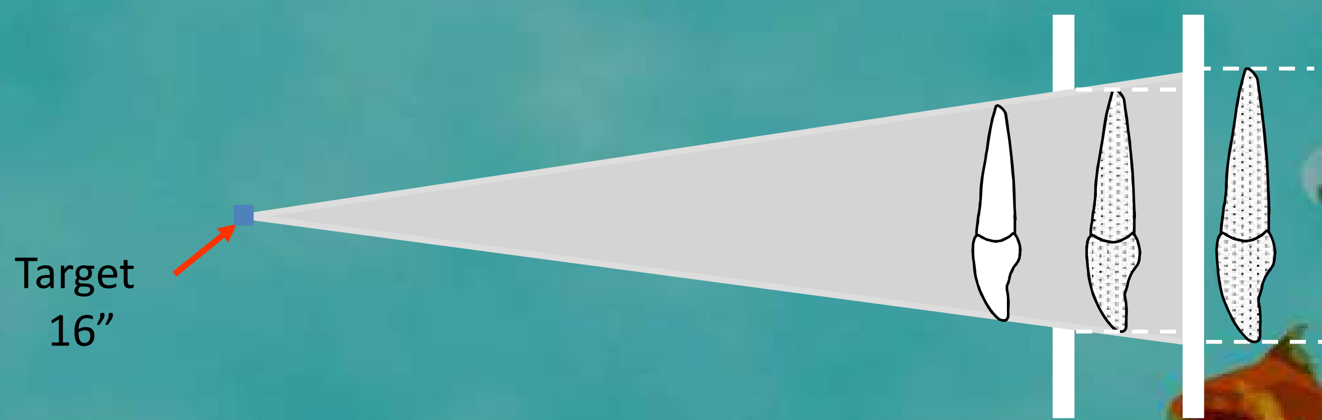
- Object-film distance is the distance between the object being radiographed (the tooth) and the dental x-ray film. The tooth and the x-ray film should always be placed as close together as possible.
- The closer the proximity of the tooth to the film, the less image enlargement there be on the film.
- A decrease in object-film distance results in a decrease in magnification and an increase in object-film distance results in an increase in image magnification .

Magnification

Decrease object-film distance, decrease magnification

When the film is placed closer to the tooth as seen below, the x-ray beam does not spread out as much and magnification is decreased.

When the film is placed farther from the tooth, the x-ray beam spreads out more and increases magnification.



USE OF INTENSIFYING SCREENS

- The use of these screens increases the film to object distance, which produces a certain amount of magnification.
- Rule for magnification: The actual size of the object is proportional to the size of the projected radiographic image of the object (tooth), as the S-O Distance is to the S-F Distance.

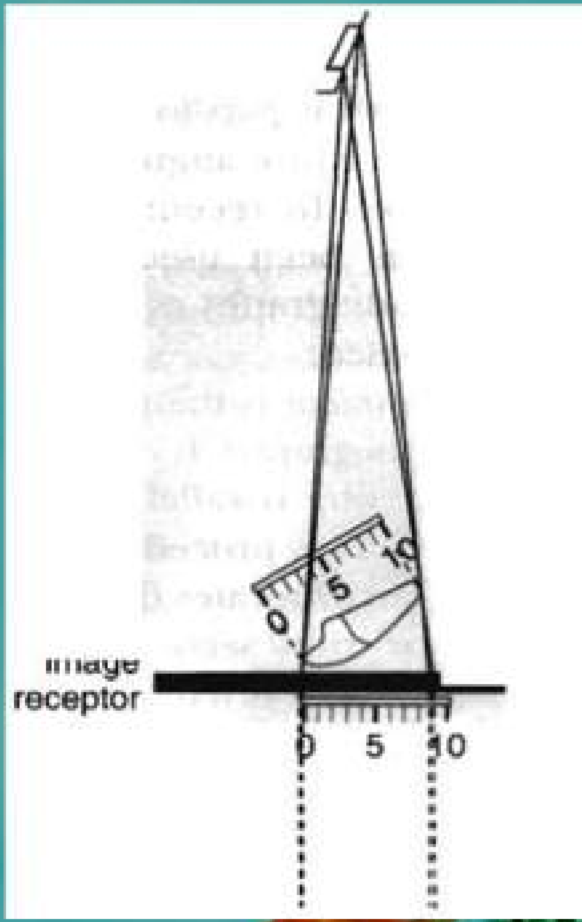
DISTORTION

- Image shape distortion is the unequal magnification of different parts of the same object. This situation arises when not all parts of an object are at the same focal-spot to object distance.
- Distortion is a change in the shape of an object or the relationship of that object with surrounding objects.
- Dimensional distortion of a radiographic image is a variation in the true size and shape of the object being radiographed.
- Distortion results from improper film alignment or angulation of the x-ray beam.

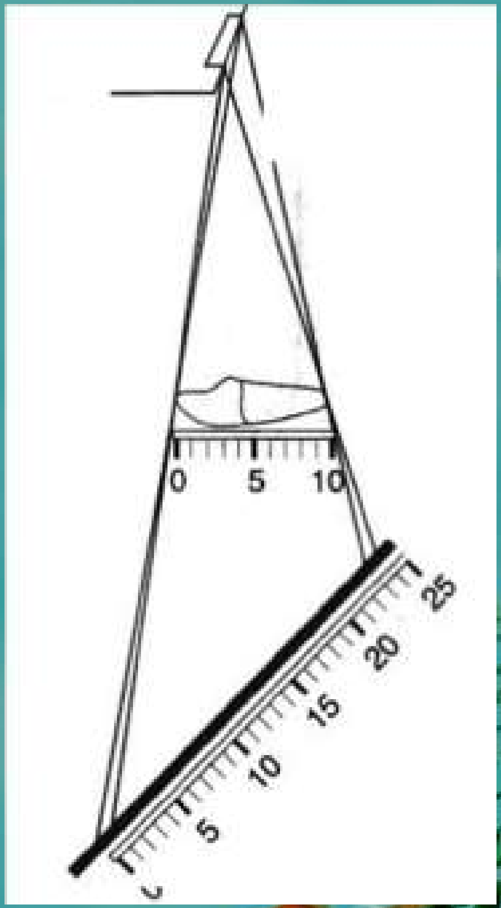
- To minimize shape distortion, make an effort to align the tube, object, and film carefully, using the following guidelines:

- Position the film parallel to the long axis of the object.
- Image shape distortion is minimized when the long axis of the film and tooth are parallel.

- The central ray of the x-ray beam is perpendicular to the film, but the object is not parallel to the film.
- The resultant image is distorted because of the unequal distances of the various parts of the object from the film. This type of shape distortion is called foreshortening because it causes the radiographic image to be shorter than the object

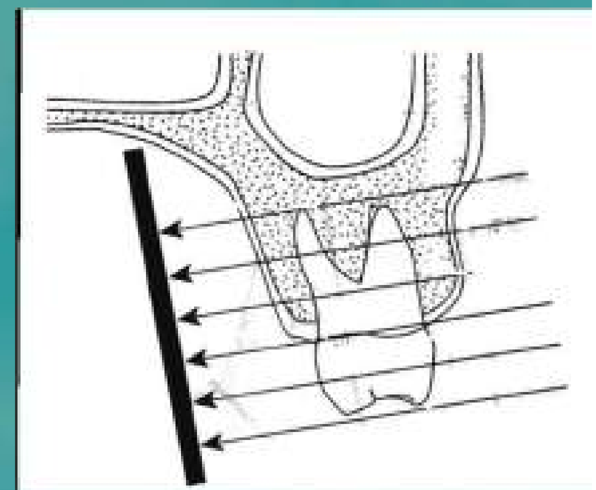


- When x-ray beam is oriented at right angles to the object but not to the film. This results in elongation with the object appearing longer on the film than its actual length.



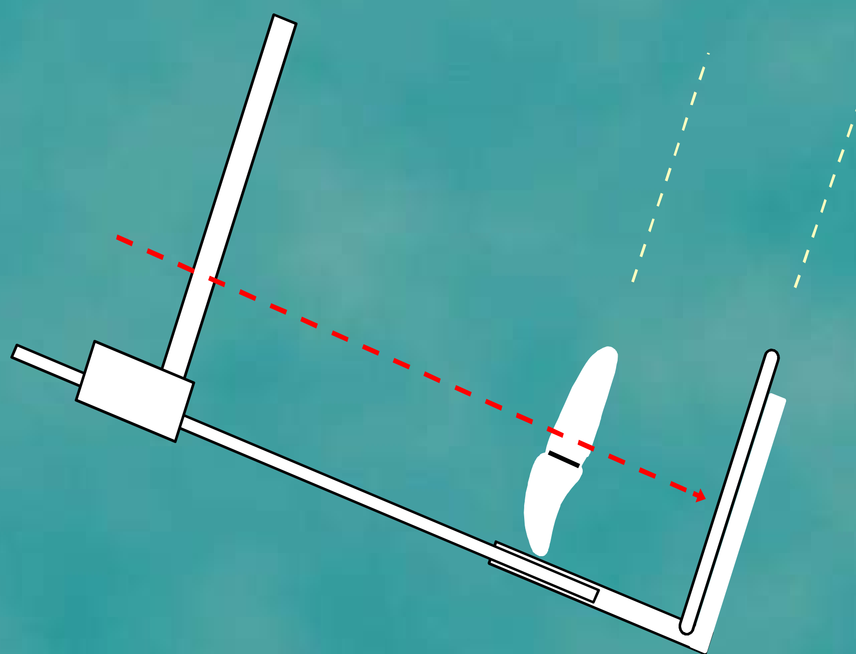
Central ray perpendicular to the object and film

- Image shape distortion occurs if the object and film are parallel but the central ray is not directed at right angles to each.
- This is most evident on maxillary molar projections.
- If the central ray is oriented with an excessive vertical angulation, the palatal roots appear disproportionately longer than the buccal roots.
- Distortion errors can be prevented by aligning the object and film parallel with each other and the central ray perpendicular to both.



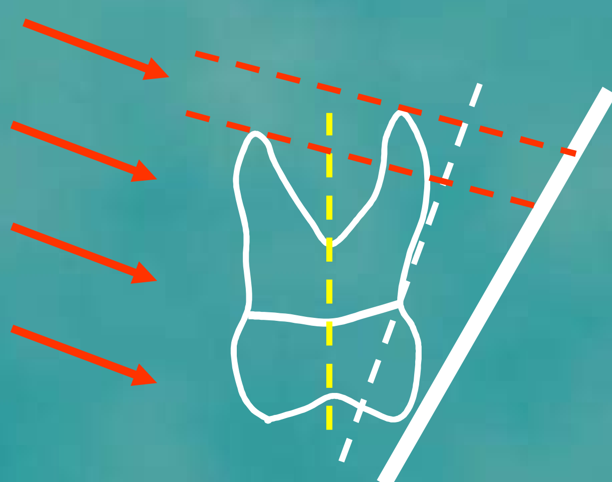
Teeth and film parallel
X-ray beam perpendicular to teeth/film

Having the teeth and film parallel to each other is accomplished using the paralleling technique. If the film and teeth are parallel, then the x-ray beam can be directed perpendicular to both the long axis of the teeth and the long axis of the film. This relationship will keep distortion of the image to a minimum.



Distortion

In the bisecting angle there is an angle between the teeth and film, dependent on the patient's oral anatomy, which influences film placement, and the technique used. (The bisecting angle radiograph of the maxillary molar,,shows the distortion of the relationship between the buccal and palatal roots.



- In this method the film is placed as close to the teeth as possible and direct the central ray perpendicular to an imaginary plane that bisects the angle between the teeth and the film.

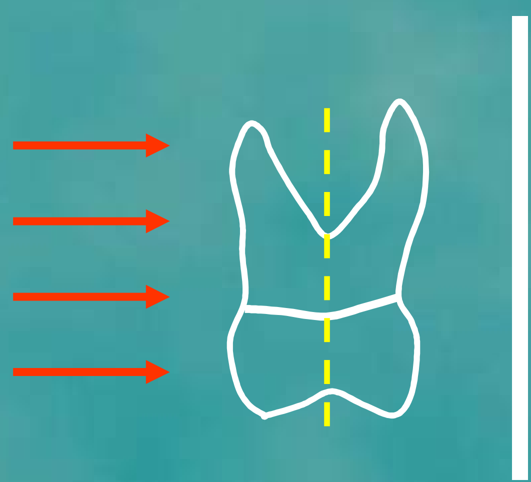
- However, when the film is in this position, it is not parallel to the long axes of the teeth. This arrangement inherently causes distortion.

- This angle between a tooth and the film is especially apparent when teeth are radiographed in the maxilla or anterior mandible. Even though the projected length of a tooth is correct, the image is still distorted because the film and object are not parallel and the x-ray beam is not directed at right angles to them.
- This distortion tends to increase along the image toward the apex.

- When the central ray is not perpendicular to the bisector plane, the length of the image of a projected tooth changes.
- If the central ray is directed at an angle that is more positive than perpendicular to the bisector, the image of the tooth is foreshortened.
- Likewise, if it is inclined with more negative angulation to the bisector the image is elongated.

Distortion

In the paralleling technique, the long axis of the film and the long axis of the tooth are parallel. The x-ray beam is directed perpendicular to both the long axis of the tooth and the long axis of the x-ray film. As a result, distortion is minimized or eliminated. In the radiograph of the maxillary first molar, the shape and relationship of the buccal and palatal roots are accurately imaged.



- The paralleling technique is the preferred method for making intraoral radiographs. It derives its name as the result of placing the film parallel with the long axis of the tooth. This procedure minimizes image distortion
- To achieve this parallel orientation , position the film toward the middle of the oral cavity, away from the teeth.
- Although this allows the teeth and film to be parallel, it results in some image magnification and loss of increasing unsharpness.
- As a consequence, the paralleling technique also uses a relatively long open-ended aiming cylinder ("cone") to increase the focal spot-to-object distance

- This directs only the most central and parallel rays of the beam to the film and teeth and reduces image magnification while increasing image sharpness and resolution.
- The paralleling technique has benefited from the development of fast-speed film emulsions, which allow relatively short exposure times in spite of an increased target-to-object distance.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RADIOGRAPHIC CONTRAST

- Radiographic contrast is a general term that describes the range of densities on a radiograph.
- It is defined as the difference in densities between light and dark regions on a radiograph. Thus an image that shows both light areas and dark areas has high contrast. This also is referred to as a short gray scale of contrast because few shades of gray are present between the black and white images on the film.

- A radiographic image composed only of light gray and dark gray zones has low contrast, also referred to as having a long gray scale of contrast. The radiographic contrast of an image is the result of the interplay of subject contrast, film contrast, and scattered radiation

FIG. 4-13 Radiograph of a dried mandible revealing low contrast (A) and high contrast (B).

Subject Contrast

- *Subject contrast is the range of characteristics of the subject that influences radiographic contrast.*
- *It is influenced largely by the subject's thickness, density, and atomic number.*
- *The dense regions of the bone and teeth absorb most of the incident radiation, whereas the less dense soft tissue facial profile transmits most of the radiation.*