

Projection geometry

Lecture 4

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What does projection geometry mean?

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

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Projection geometry

The main ideas in projection geometry includes:

- Sharpness and resolution.
- Size and shape distortion.
- Localization techniques.

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Image sharpness and resolution

- **Sharpness:** How well the boundaries of the bone is revealed on the radiograph.
- **Resolution:** The ability to demonstrate small objects that are close together.
- Both sharpness and resolution are influenced by the same geometric variables.

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Image sharpness and resolution

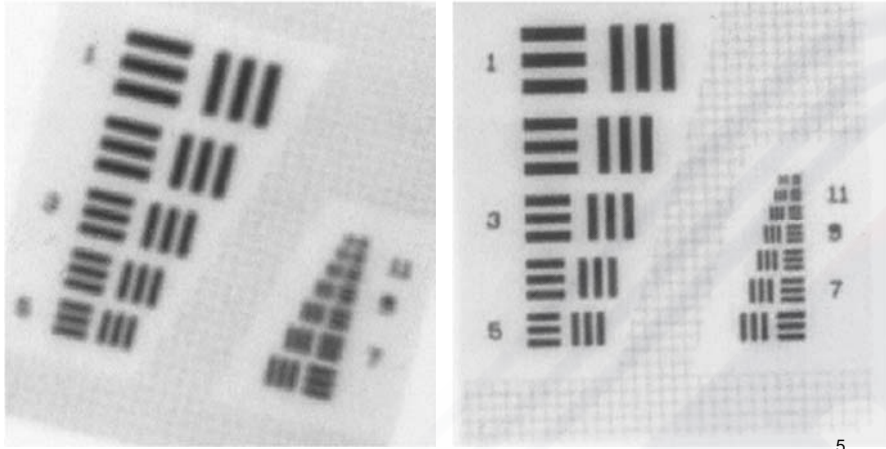


Image sharpness and resolution

- Image sharpness and resolution are increased through:

1- Use as small an effective focal spot as practical.

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Image sharpness and resolution

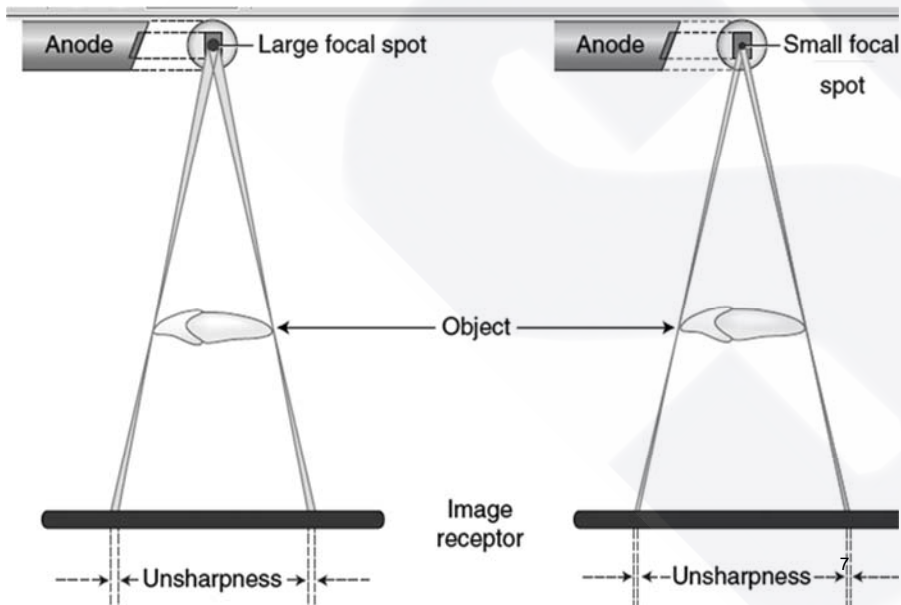


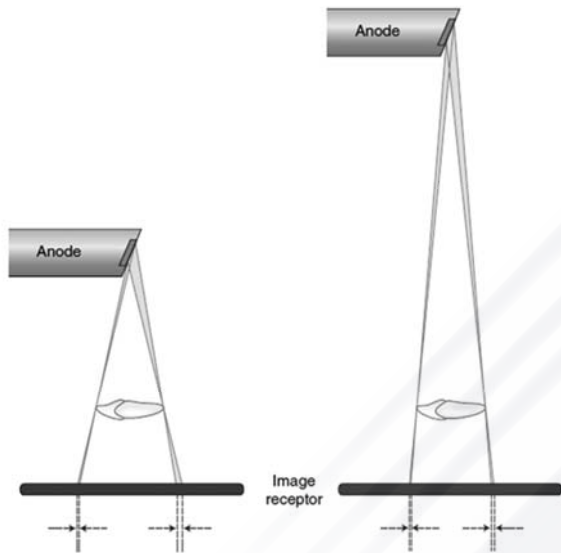
Image sharpness and resolution

- Image sharpness and resolution are increased through:

2- Increase the distance between the focal spot and the object (this will ensure using photons whose paths are almost parallel).

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Image sharpness and resolution



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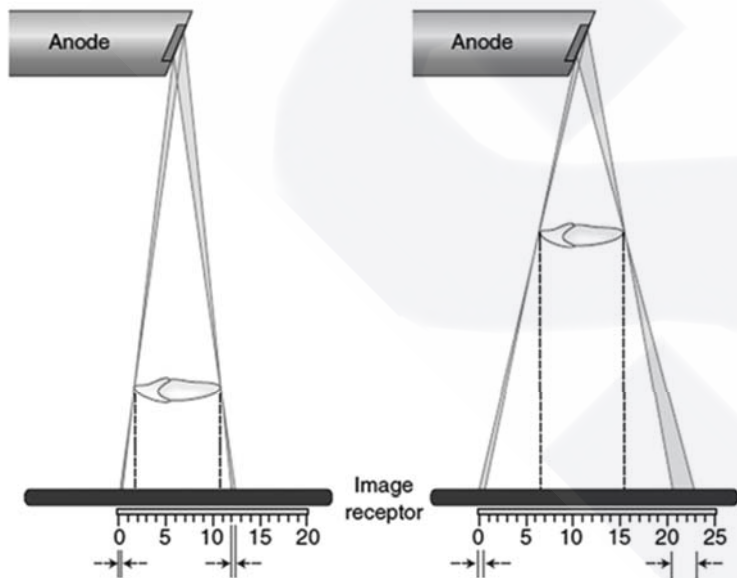
Image sharpness and resolution

- Image sharpness and resolution are increased through:

3- Minimize the distance between the object and the image receptor

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Image sharpness and resolution



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Image size distortion

- It is the increase in the size of the object (magnification).
- The cause
 - The divergent paths of photons in an x-ray beam cause enlargement of the image on a radiograph.

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Image size distortion

- Solution
 - Increasing the focal spot-to-image receptor distance (using long cone).
 - Decreasing the object-to-image receptor distance.

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Image shape distortion

- The cause
 - Unequal magnification of different parts of the same object.

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Image shape distortion

- Solutions
 - Position the image receptor parallel to the long axis of the object.

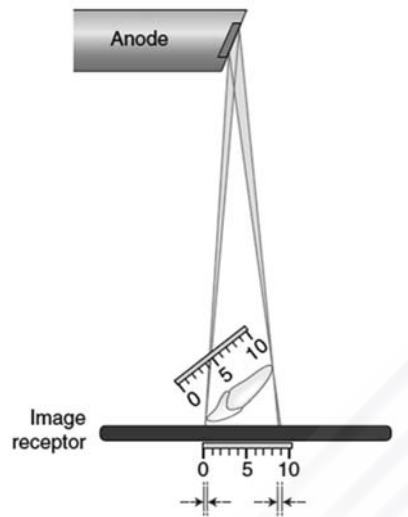
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Image shape distortion

- Solutions
 - Orient the central ray perpendicular to the object and image receptor.

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Image shape distortion



Foreshortening

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Image shape distortion



Elongation

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Image shape distortion



The unequal magnification of the buccal and lingual cusps.

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The principles of geometry on parallel and bisecting-angle techniques

- In bisecting-angle technique, the length of the radiographed tooth is correct, but the position of the alveolar bone is distorted.

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The principles of geometry on parallel and bisecting-angle techniques

- Parallel technique minimizes image distortion.
- There is a relatively long object-receptor distance, so, the parallel technique uses long cones to increase the focal spot-to-object distance.

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Object localization

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Object localization

- There are three methods to obtain three-dimensional information:
 - Two images projected at right angles to each other (occlusal radiography).
 - Tube-shift technique.
 - Using advanced imaging technique such as cone-beam CT (that allow 3D imaging) [not covered in this lecture].

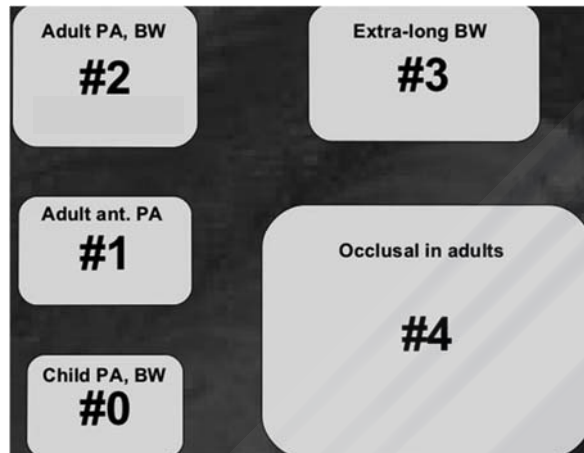
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Occlusal radiography

- One of the intraoral imaging techniques.
- There are three types of occlusal radiographs for each jaw.
- The clinician should feel free to modify these as per the patients' requirements.
- This technique is best for the mandible.

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Occlusal radiography



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Occlusal radiography

Head position

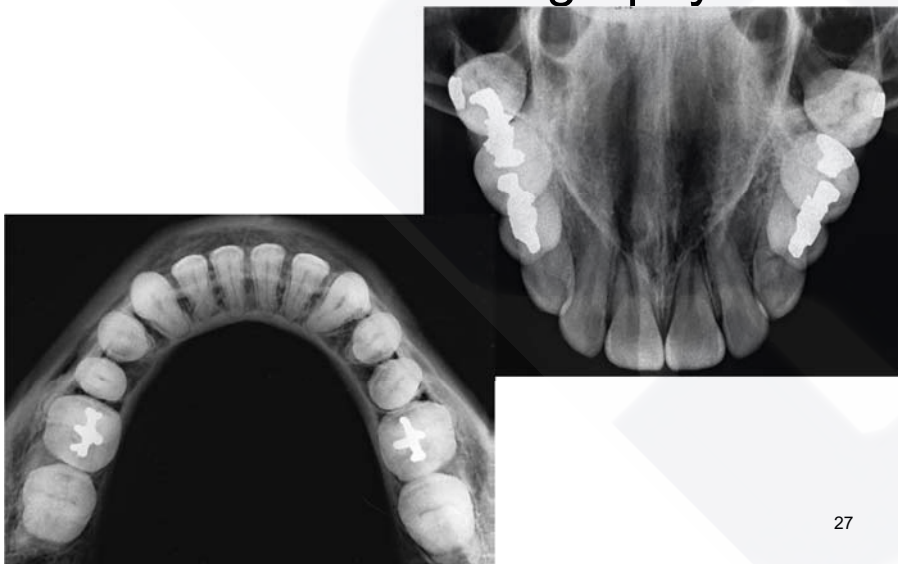
Maxilla: Parallel to floor.

Mandible: Perpendicular to floor.

Patient bites gently on film.

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Occlusal radiography



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Occlusal radiography

- Topographical maxillary occlusal projection



+65



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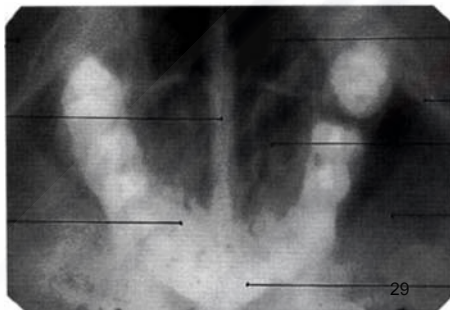
Occlusal radiography

- Topographical maxillary occlusal projection

[Other references]



+90

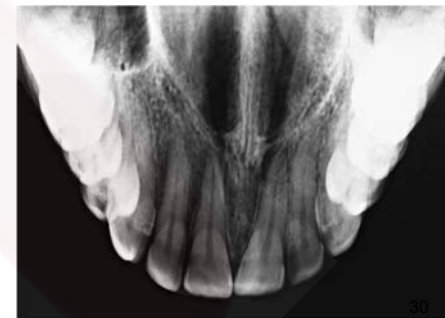


Occlusal radiography

- Anterior maxillary occlusal projection



+45



Occlusal radiography

- Lateral (right or left) maxillary occlusal projection.

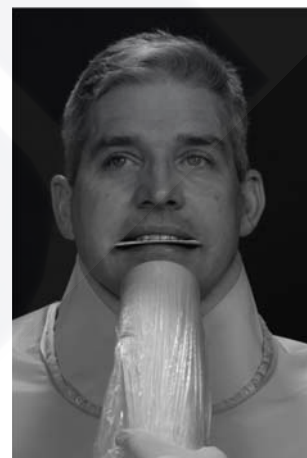


+60



Occlusal radiography

- Anterior mandibular occlusal projection



-55

-45



Occlusal radiography

- Topographical (cross-sectional) mandibular occlusal projection



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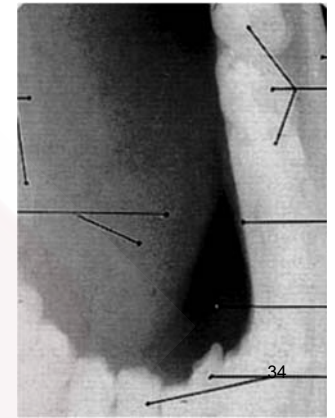


Occlusal radiography

- Lateral mandibular occlusal projection

+90

X

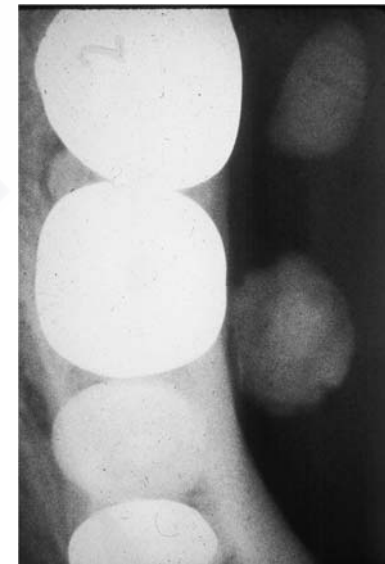


Occlusal radiography



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Occlusal radiography



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The uses of occlusal radiographs

- To locate impacted teeth (buccally or lingually).
- To localize foreign bodies in the jaws and stones in the ducts of sublingual and submandibular glands.
- To evaluate the outlines of the maxillary sinus.
- Patients who cannot open their mouth sufficiently.
- Fractures of the mandible and maxilla
- Large lesions (e.g., cysts, osteomyelitis, malignancies).

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Tube-Shift technique SLOB Rule

SLOB = Same Lingual Opposite Buccal

- If the image of an object moves **mesially** when the tubehead is moved **mesially** (same direction), the object is **located on the lingual**.
- If the image of the object moves **distally** when the tubehead moves **mesially** (opposite direction), the object is **located on the buccal**.

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Tube-Shift technique SLOB Rule

Horizontal Tube Shift: When the tubehead is moved mesially or distally.

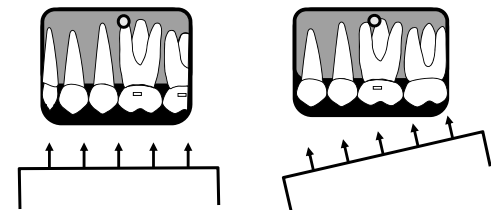
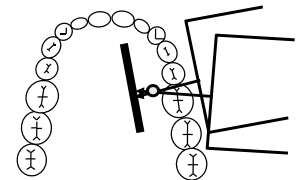
Vertical Tube Shift: Downward or upward movement of the tubehead.

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The tubehead is moved distally.

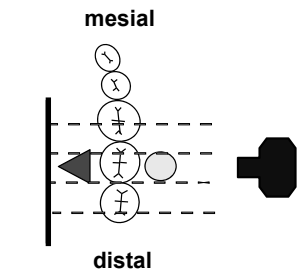
The object of interest moves distally (the same direction)

The object is located lingually.

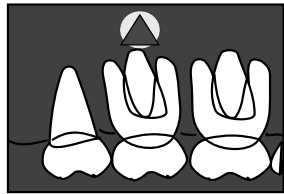


The tubehead is moved distally

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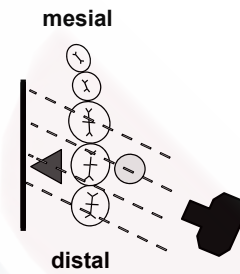


Horizontal movement



Both images (● ◀) are located above the second molar.

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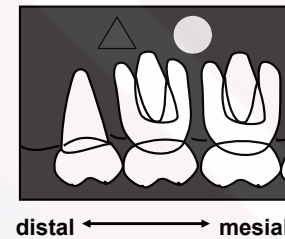


Horizontal movement

The tubehead is moved distally:

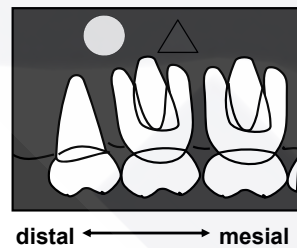
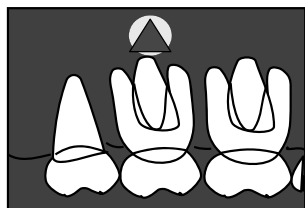
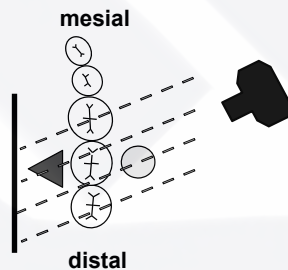
The buccal object (yellow) moves mesially (opposite to tubehead movement).

The lingual object of interest (red) moves distally (same direction as tubehead).

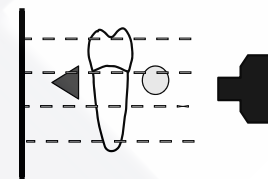


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Horizontal movement



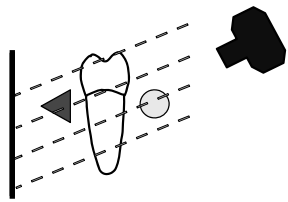
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Vertical movement

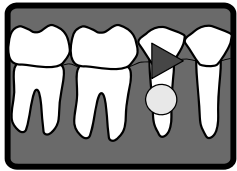


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Vertical movement
The tubehead is moved upward.

The buccal object of interest (yellow) moves down (opposite to tubehead movement).

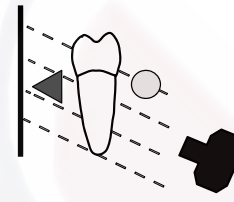


The lingual object of interest (red) moves up (same direction as tubehead).



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Vertical movement

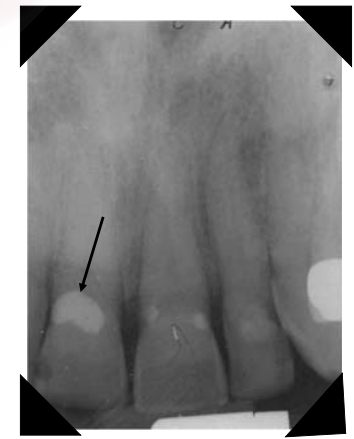
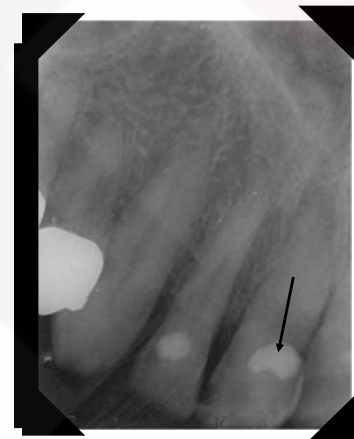


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Is the composite restoration (red arrow) located on the buccal or lingual?

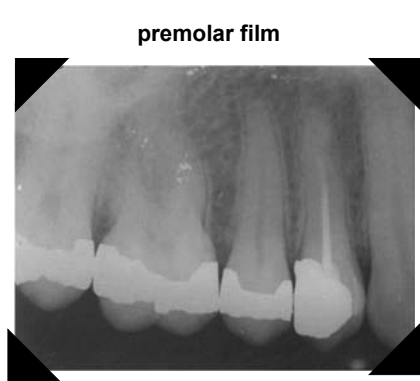
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tubehead ←
restoration →

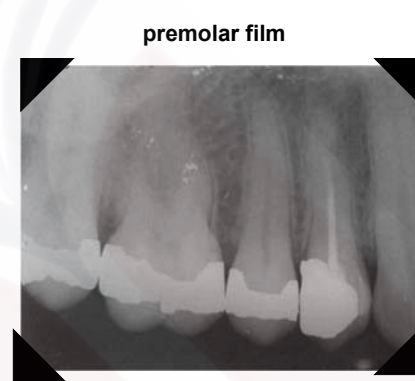
The restoration is located on the buccal.

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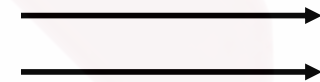


In which canal of the maxillary first premolar this red arrow indicates?

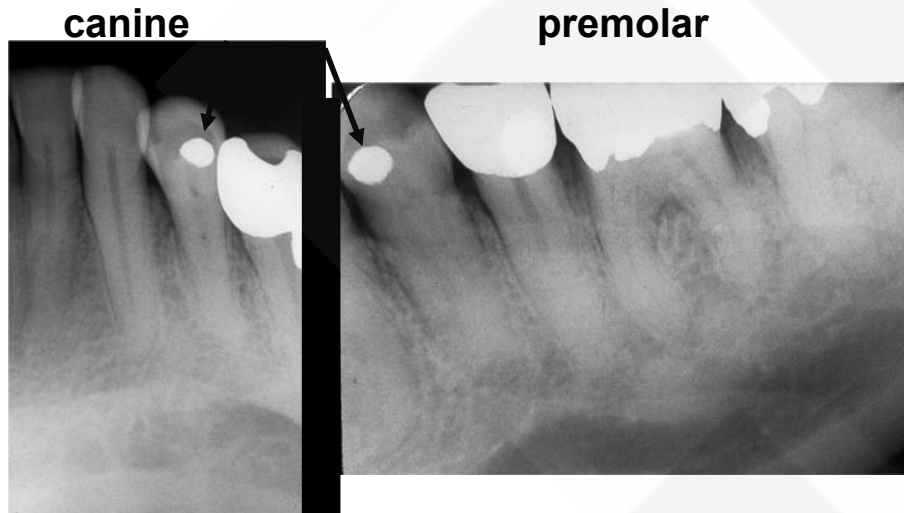
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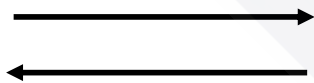
tubehead
restoration



L
50

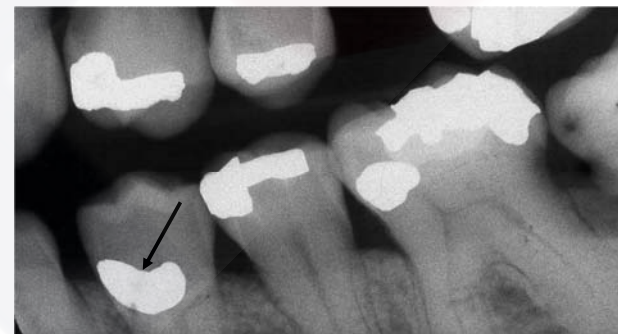


tubehead
restoration



B

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BW

tubehead



PA

B