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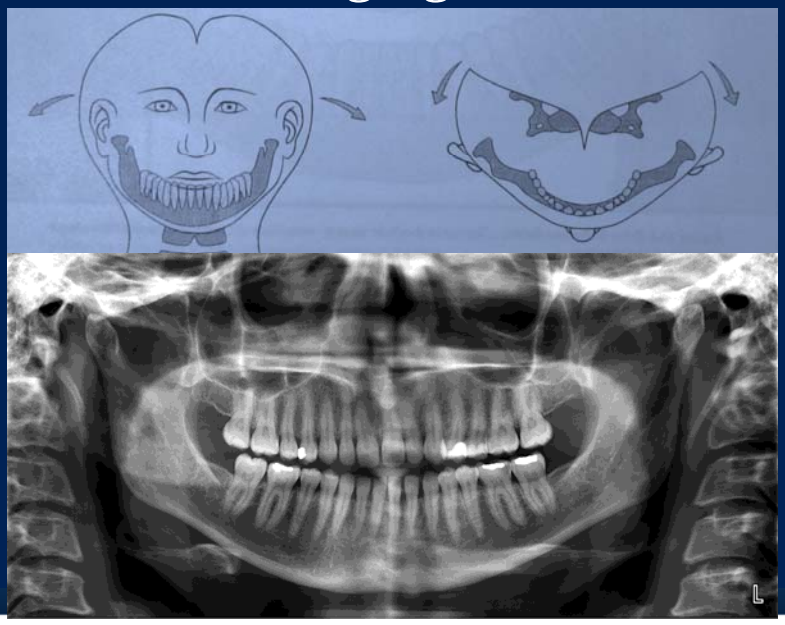
Panoramic Imaging



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Ghosting Zone

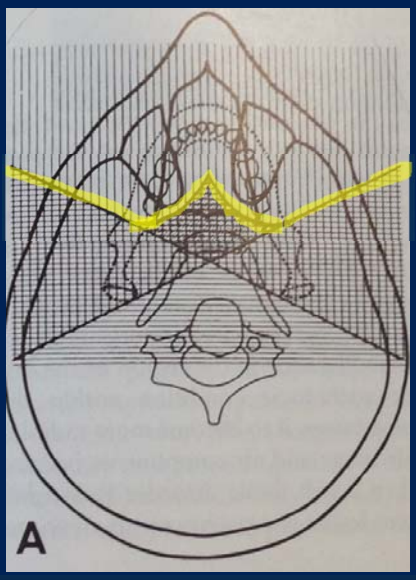

Fig 9.17
Principles of Dental Imaging
Langland and Langlais 1997

Vertical=real images
Horizontal=ghost images
Diamond=double real images (mirror images) ex. hard and soft palate, hyoid bone, epiglottis, cervical spine

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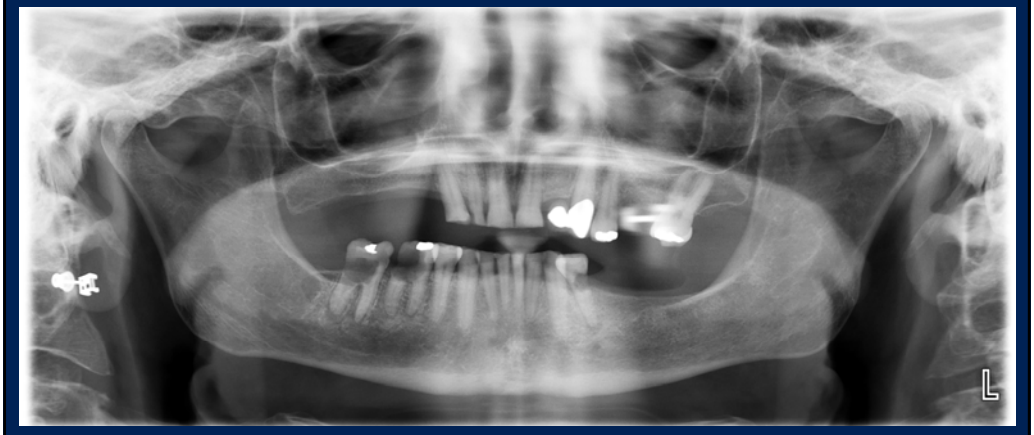
What are we trying to accomplish?



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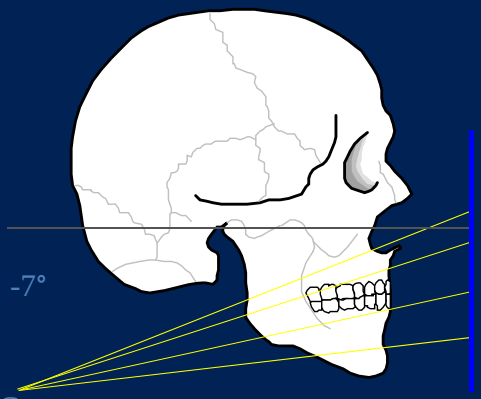
- A narrow beam of x-rays rotates in a horizontal plane around the patient while simultaneously moving the image receptor
- Negative beam angulation to exclude occipital bone



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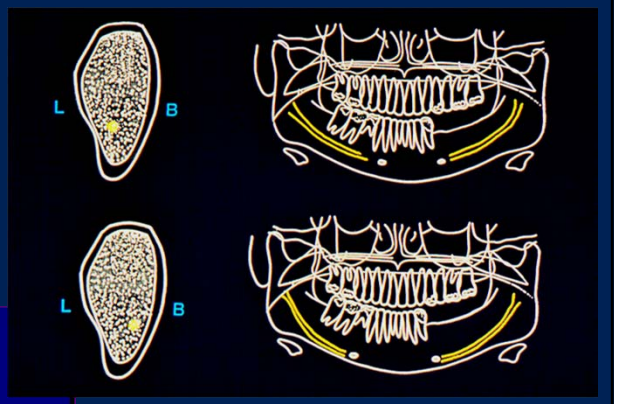
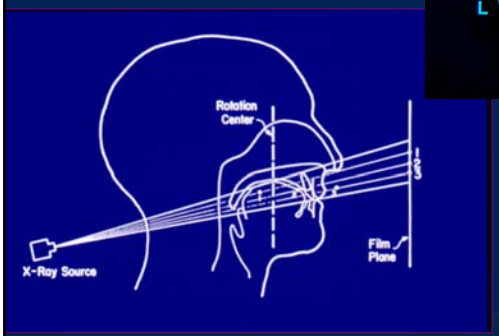
- Since the x-ray beam is angled from below, distortion of position is also present





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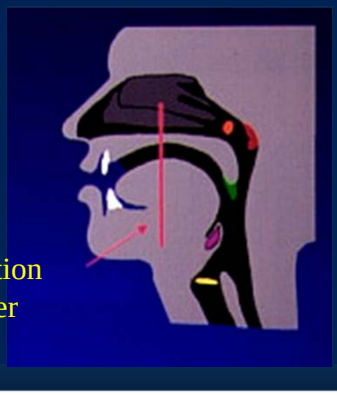
- Rotation occurs around a “rotational axis”
- X-rays appear to diverge from an intraoral source due to the rotation of the beam
  - Known as the center of rotation
    - “Effective focal spot of the projection”



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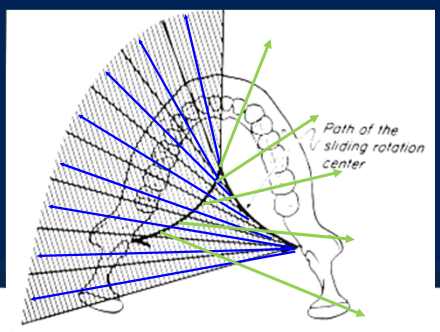
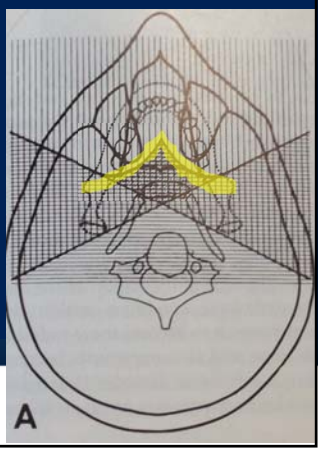
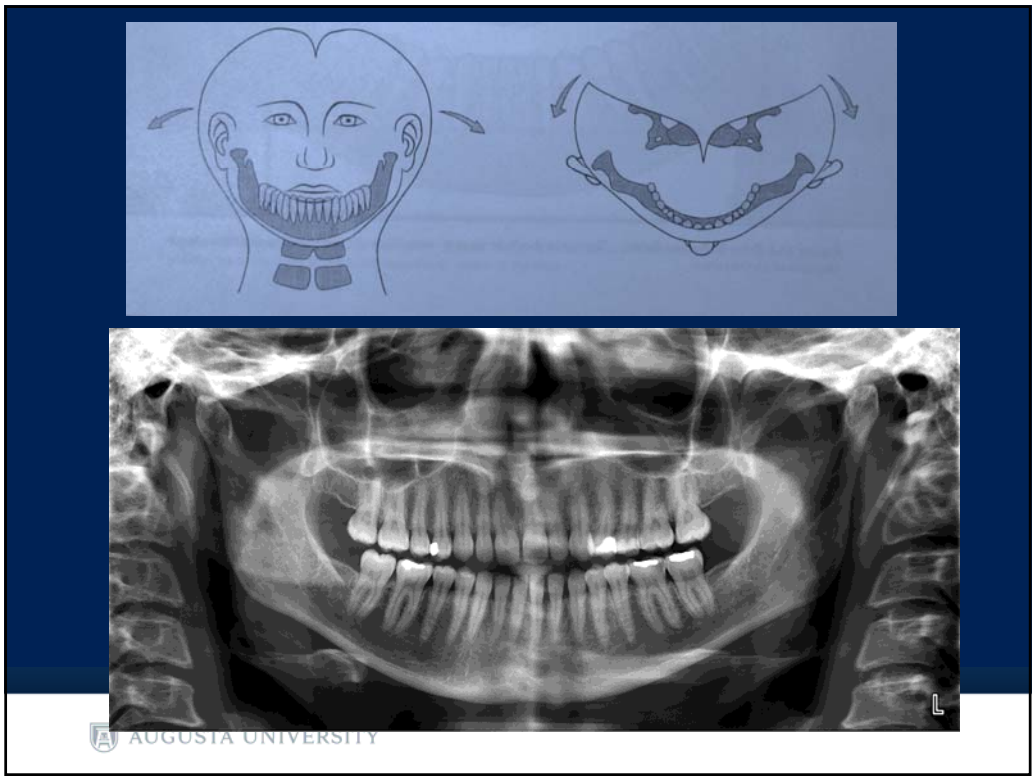
Moving Center of Rotation

- The center of rotation can be made to follow a defined curved path
- During image projection, the central ray of the x-ray beam is maintained tangential to this path
- The form of the defined curved path (center of rotation) dictates the direction of the x-ray beam and hence defines the projection of each successive part of the jaws



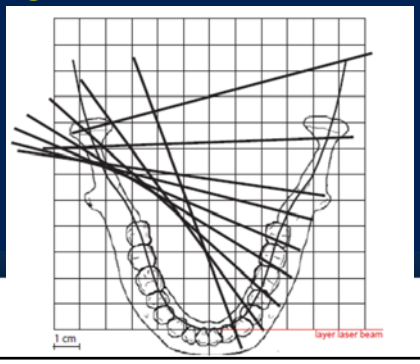


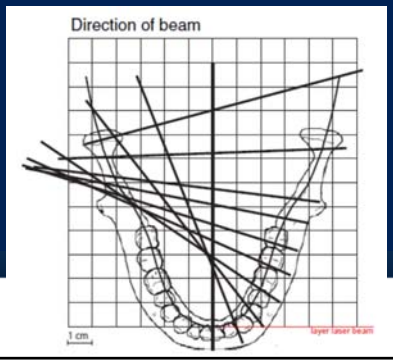


Can change shape of center of rotation to direct beam through contacts of teeth

STANDARD PAN

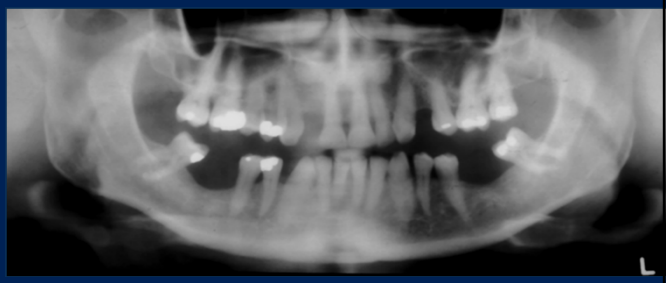
BITEWING PAN





We've come a long way with our image quality-
but every pan contains some degree of magnification, distortion, and unsharpness

Film/screen pan



Direct Digital pan

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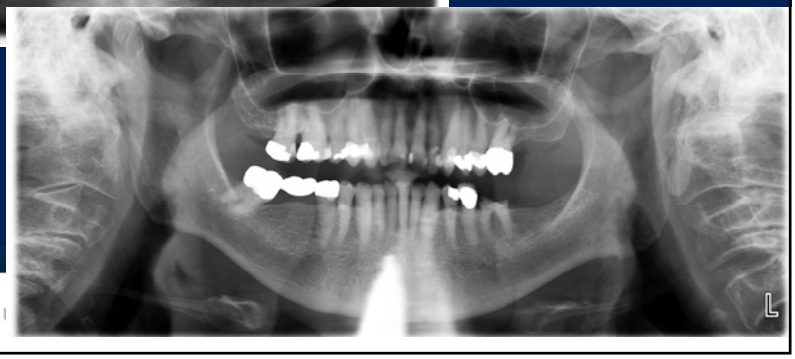
And so patient positioning is still important



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Basic Characteristics of Panoramic Radiography

- Panoramic radiographs always display the jaws with some degree of magnification, unsharpness and distortion-Minimized by proper patient positioning
- Overall objects in the central plane of the image layer are magnified 20-30%

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Why do pans have distortion?

- primarily the result of having 2 focal spots
  - the center of rotation serves as the focal spot for the horizontal dimension
  - the anode (target) of the x-ray tube serves as the focal spot for the vertical dimension

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2 aspects of the panoramic projection

- Horizontal Aspect of the Projection
  - Affected by beam rotation
- Vertical Aspect of the Projection
  - Not affected by beam rotation

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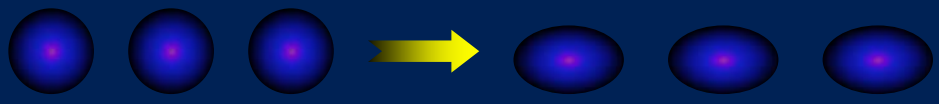

Rotating beam projects objects onto a stationary piece of film

Distortion

magnification factor for the horizontal dimension is greater due to the decreased focal spot to image receptor distance

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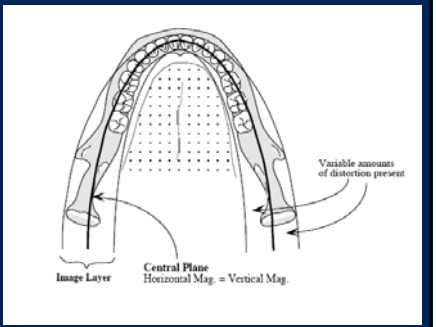


- By moving the image receptor, the registered image is foreshortened in the direction of the movement
- It is possible to reduce the horizontal magnification factor until it matches the vertical magnification factor for one particular curved plane within the patient
  - This curved plane is referred to as the central plane of the image layer

Image Layer

- Contains those anatomic structures depicted in sufficient detail to be distinguished
- Most panoramic machines generate an image layer that is narrower in the anterior region and wider in the posterior region

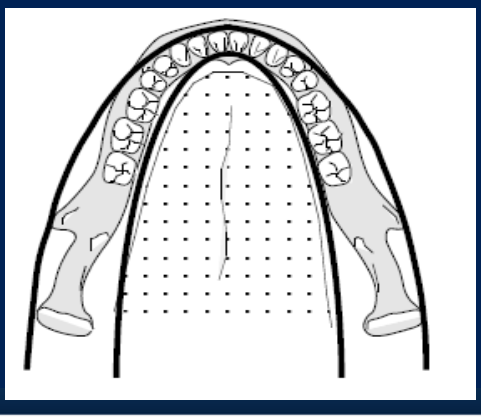
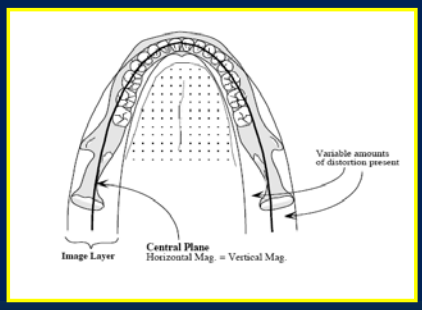


Image Layer Formation

- The projection of object points lying outside the plane of equal horizontal and vertical magnification (central plane) have a projected speed at the detector plane different from the speed of the detector.
- This discrepancy increases with the distance from the central plane
- At some distance the motion unsharpness reaches a level at which an object point is no longer perceptible in the image

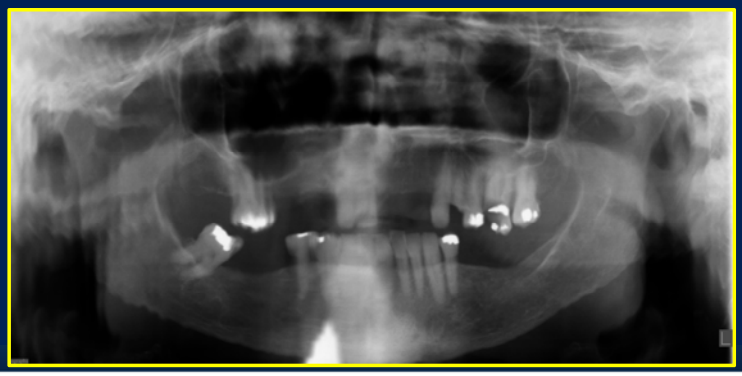
Image Layer Formation

- In this way a zone may be defined that contains those object points that are depicted with sufficient resolution so that they may be distinguished
- This zone is called the image layer
  - the distortion free plane that lies in its central region is called the central plane of the image layer



Why do pans have unsharpness?

- Due to tomographic technique
  - results from the mismatch between the speed of the detector and the speed at which structures that lie outside the central plane of the image layer are projected onto the detector



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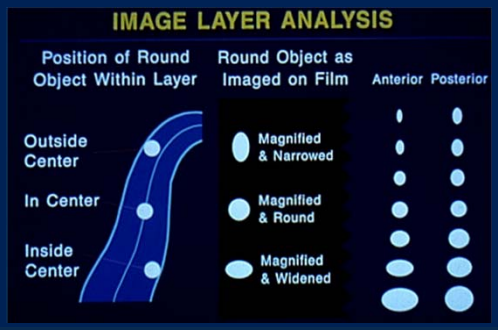
Unsharpness and distortion

- The slightest malpositioning of the patient (especially in anterior region) lends to unsharpness and severe distortion
- Motion unsharpness increases more steeply in the anterior region of the jaws than in the posterior region of the jaws
- Magnification, which leads to distortion, varies more in the anterior region



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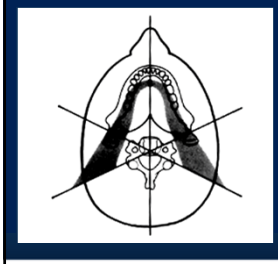

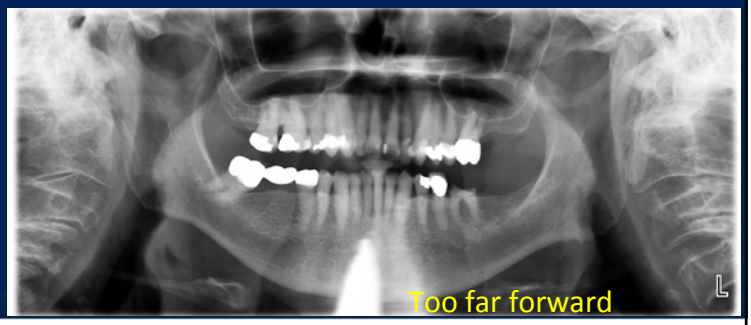

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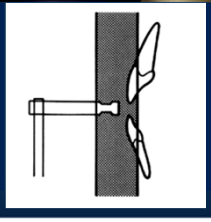
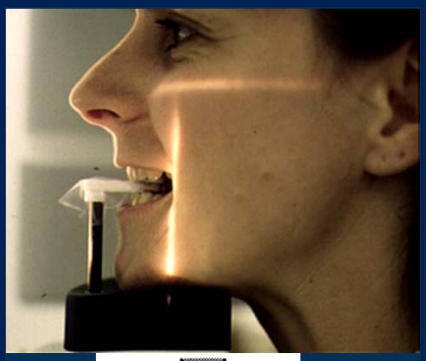
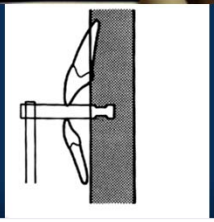
Can cut roots off in image

Patient Too Far Back



Patient Too Far Forward





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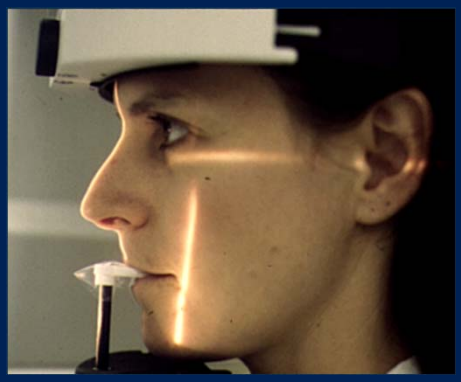
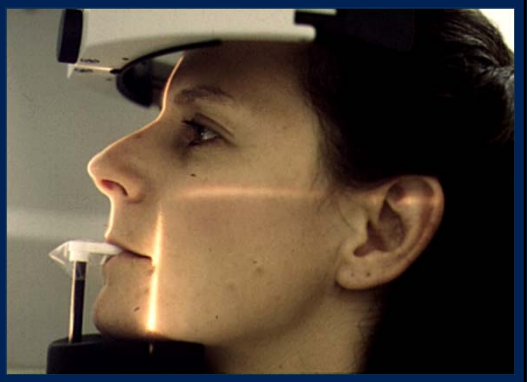
Patient's Chin Too Low



Patient's Chin Too High



Can cut roots off in image

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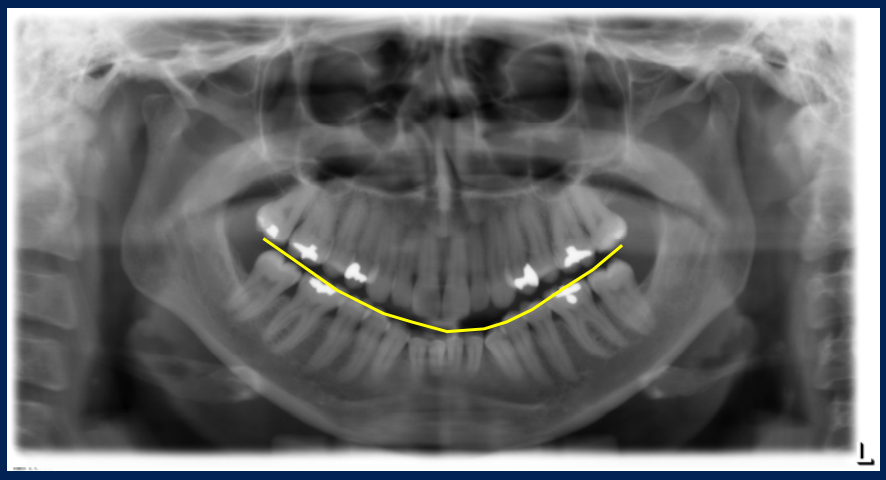
Chin Too Low



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Chin Too High

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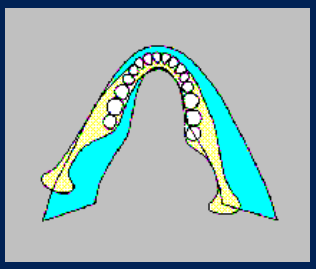
Patient Rotated/turned



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Tongue not against palates

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Patient Slumped

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Patient tilted

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Patient Movement

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Correct Patient Positioning-minimizes distortion and unsharpness

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- Unsharpness and distortion may also result if the patient is properly positioned but the patient's anatomy does not conform to the form and position of the image layer

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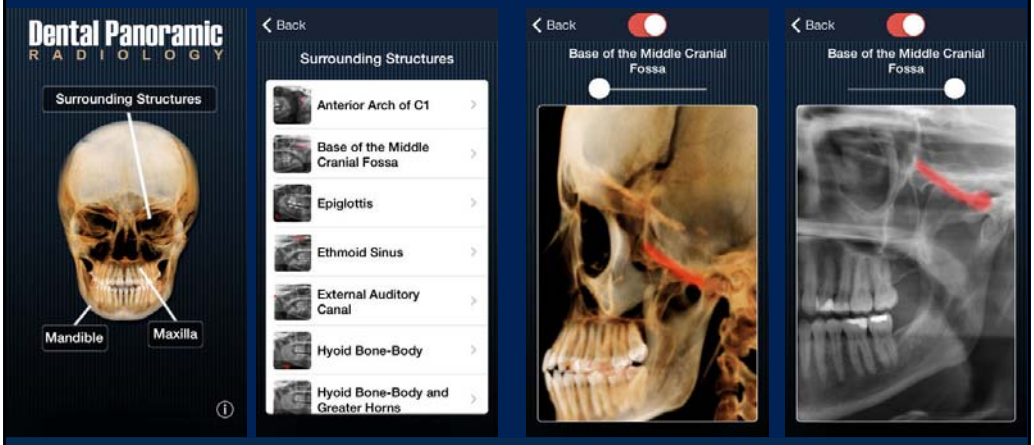
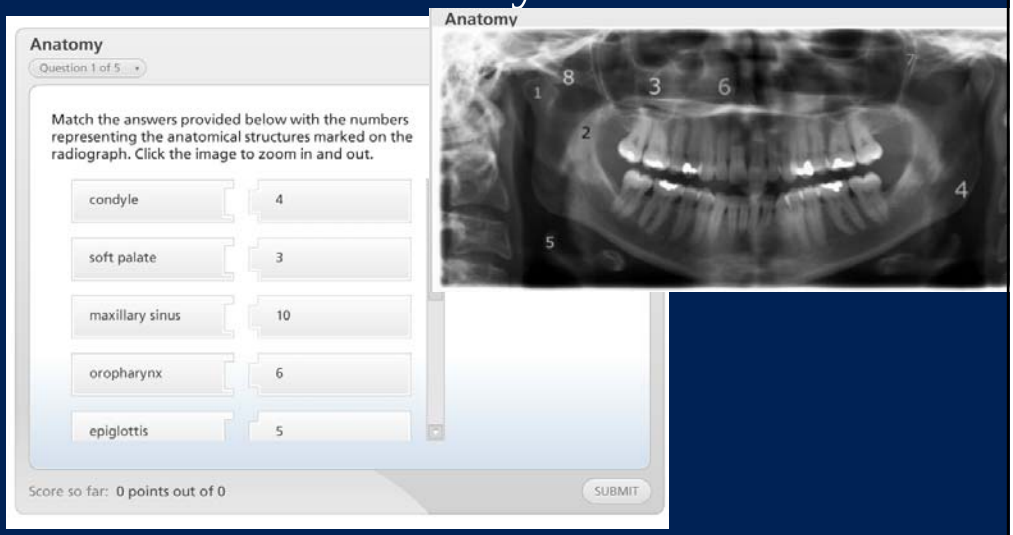
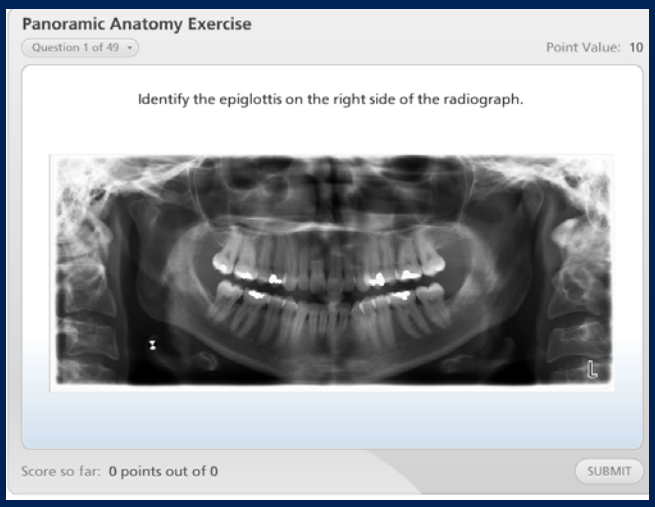
Panoramic Anatomy Exercise



Panoramic anatomy Exercise



Panoramic anatomy Exercise



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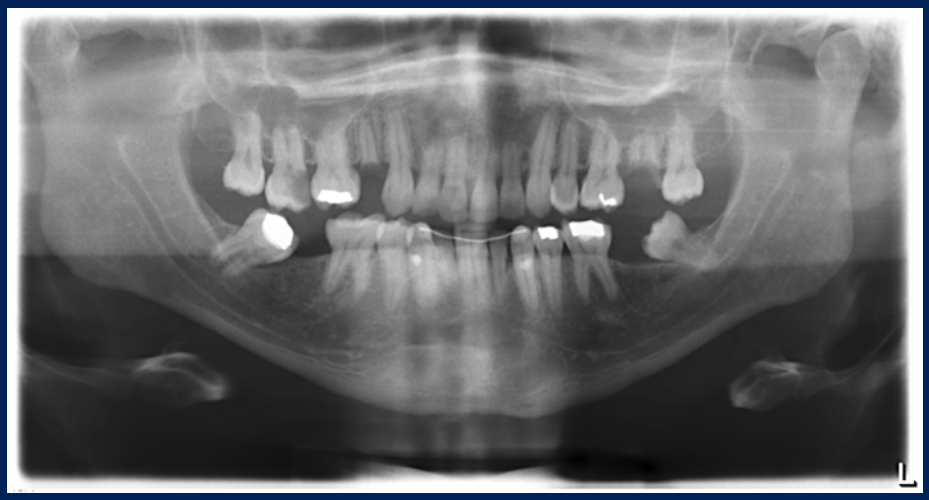
Panoramic Error Exercises



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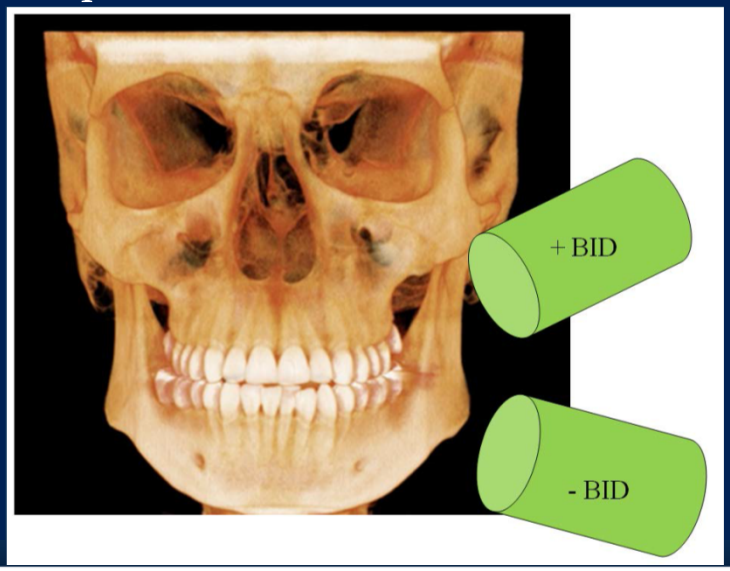
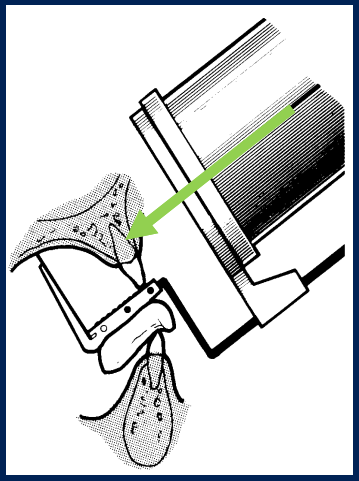
Intraoral Imaging-Paralleling Technique



What are we trying to achieve?

Anatomical accuracy

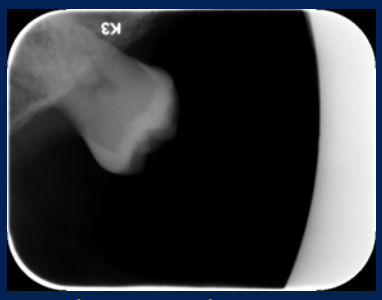
1. position the image receptor parallel to the long axis of the teeth
2. orient the central ray of the x-ray beam perpendicular to the teeth and the image receptor



The paralleling technique is used to create anatomical accuracy and minimize distortion

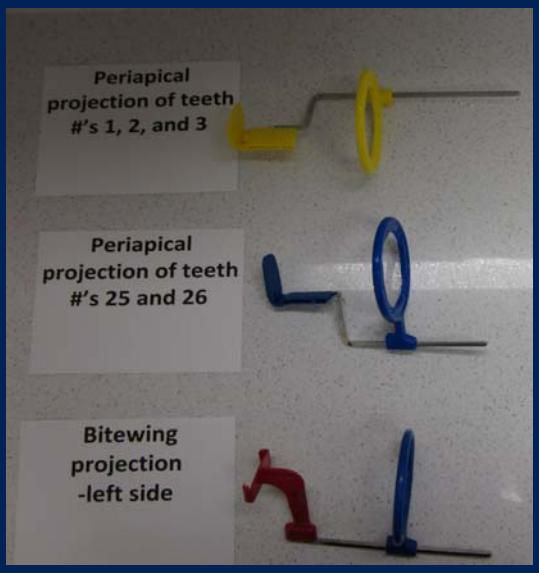
Why use a positioning device?

Tooth #2-retake image

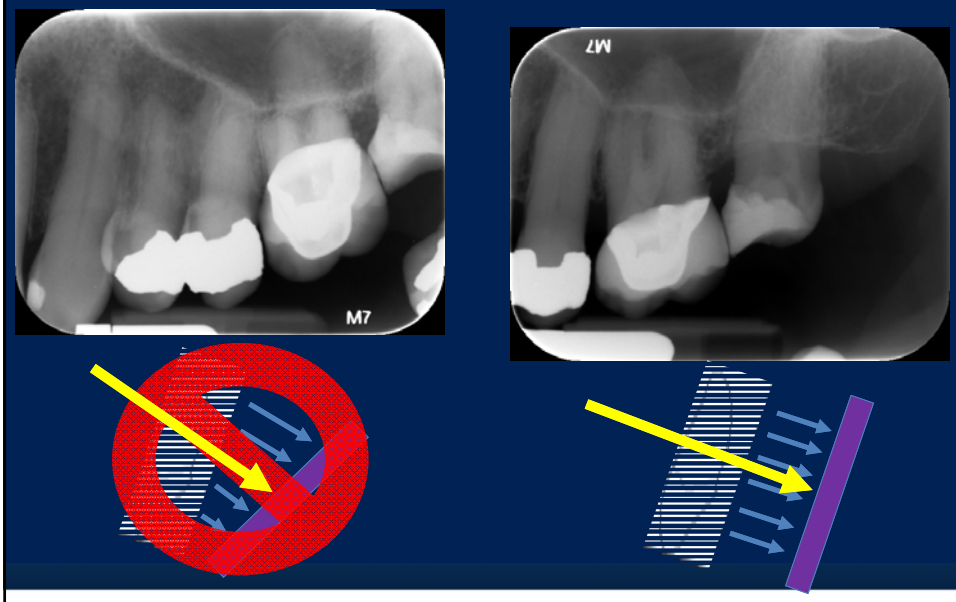


Tooth #2-initial image

XCP RINN Instrument Positioning Devices



Paralleling technique-image receptor should be positioned parallel to the long axis of the teeth



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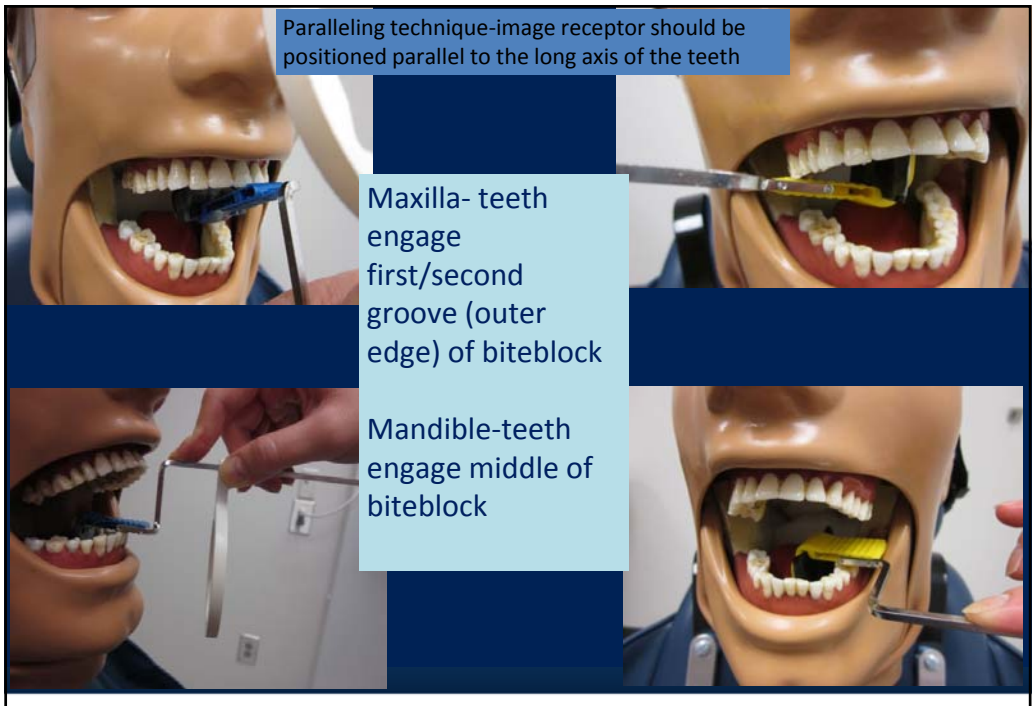

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Error-Excessive vertical angulation
Foreshortening-incorrect image receptor placement

Vertical angulation error (shape distortion error)

Caused by improper image receptor placement (i.e. improper use of the XCP RINN instrument) or/and improper vertical angulation of the cone (BID-beam indicating device)

Can lead to foreshortening and elongation

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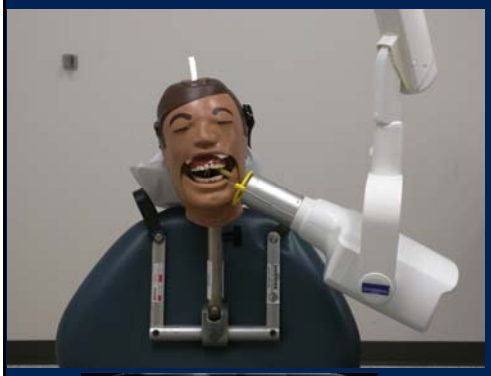
Error-Excessive vertical angulation
Foreshortening-incorrect image receptor placement



Incorrect vertical angulation-foreshortening

Correct vertical angulation

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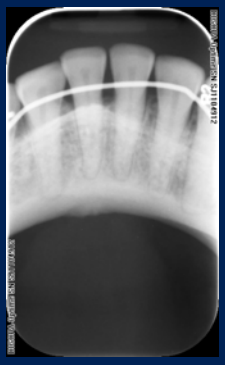
Error-Excessive vertical angulation
Foreshortening-incorrect image receptor placement



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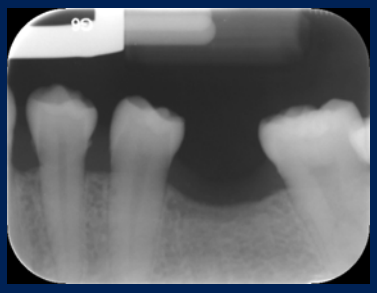
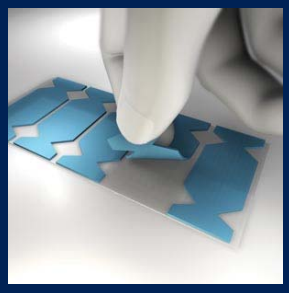
Sensitive Mandibular Premolar Region

- Anatomy of the mandible
- high muscle attachments
- Thin and sensitive gingiva


patient open/not biting on biteblock

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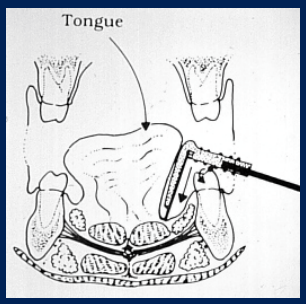
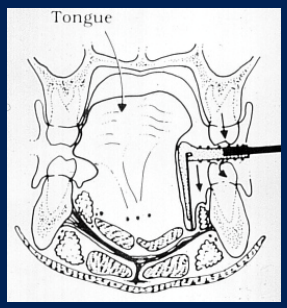
- Place biteblock on teeth with image receptor angled
  - Use occlusal table as a fulcrum
- Ask patient to close slowly
- Rotate image receptor into position as the patient slowly closes
- Muscles of the floor of the mouth relax as the patient closes
- Cotton roll may help as well
- If necessary, topical anesthetic can be used





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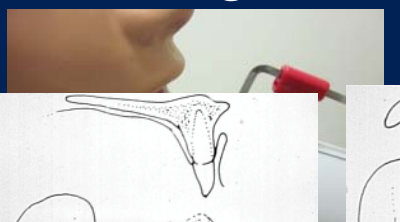
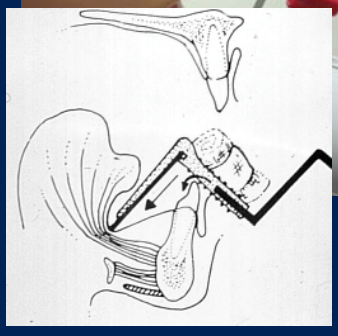
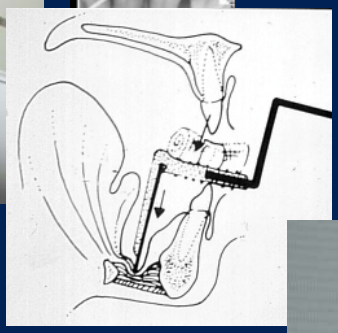
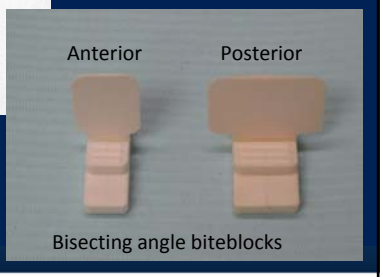
Use same technique for Sensitive Mandibular Anterior Region







Sometimes patient can not bite down and bisecting angle biteblock has to be used



Bisecting angle biteblocks

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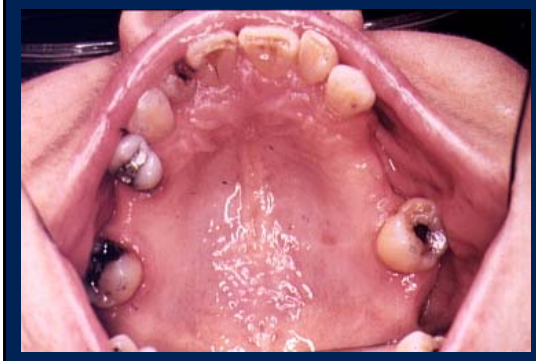
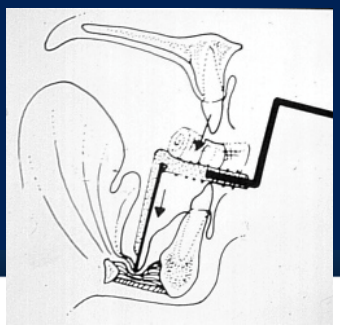
Partially edentulous patients-use cotton rolls in edentulous spaces to help stabilize the biteblock



Cotton rolls also help patients that have a sensitive/shallow floor of the mouth



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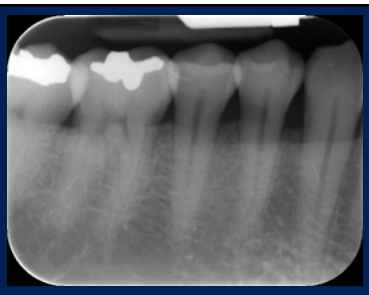
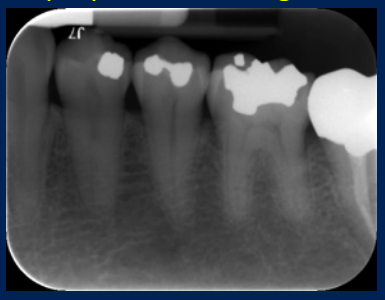


Improper horizontal angulation

Improper vertical angulation

Proper horizontal angulation



Proper vertical angulation

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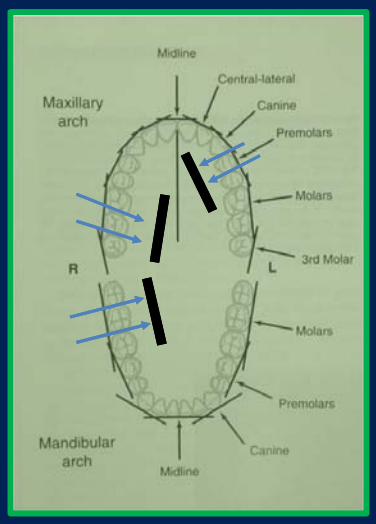
Proper Horizontal Angulation of the x-ray beam

Orient image receptor parallel to lingual surfaces of teeth and direct x-ray beam through the proximal spaces



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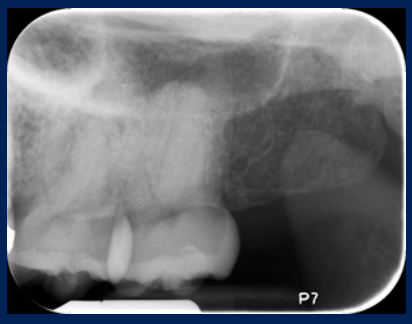
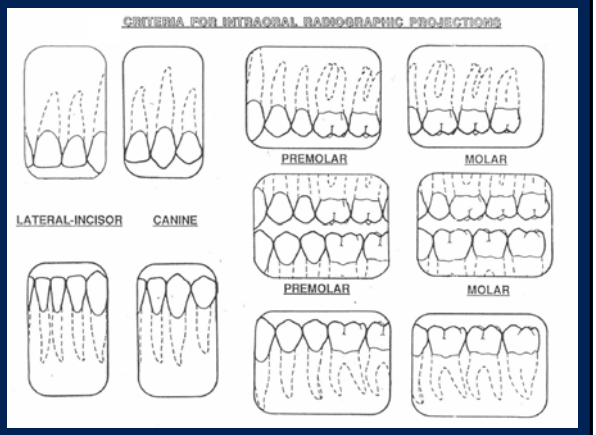
Adequate coverage?

FMX critique exercises





Periapical radiographs **must** show the entire crowns and roots of teeth being examined, as well as at least 2 mm beyond the root apices.

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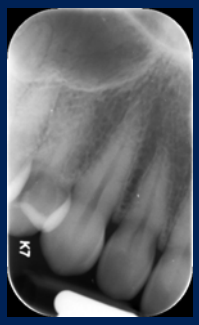
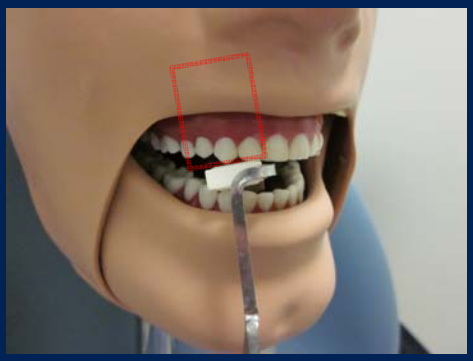
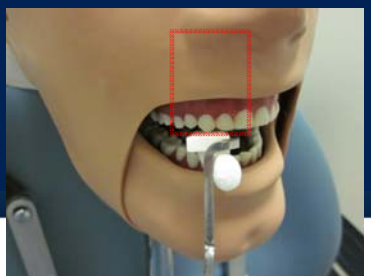
Plate tilted-packet placement error







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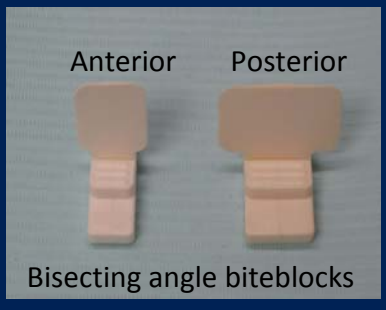
- Narrow Palate-may need to use the bisecting angle technique



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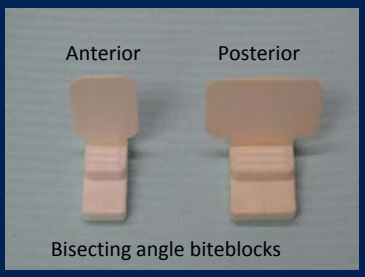
Tongue Size

- Variable, especially in edentulous and partially edentulous patients
- May have to use bisecting angle technique



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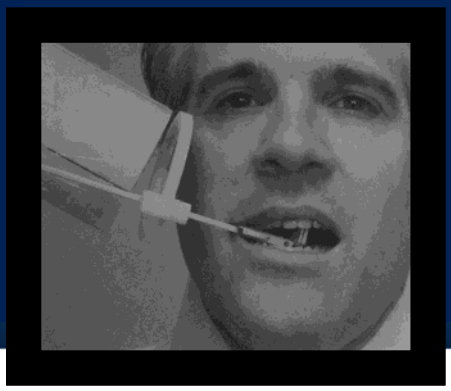
Would you ever want to foreshorten on purpose?

1. Very low or shallow palate

Low and Shallow Palates-Absolute parallelism is difficult

If the discrepancy between the image receptor and the teeth does not exceed 20°, the resulting images are usually acceptable

vertical angulation should be increased by 5-15° greater than the dentsply/Rinn XCP instrument indicates



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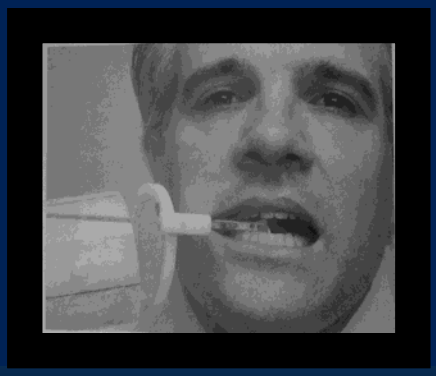
Would you ever want to foreshorten on purpose?

2. Long roots with high muscle attachment

high muscle attachments along with long roots (occlusal scheme plays a role too), foreshortening by 5-15°, may be necessary in premolar region.



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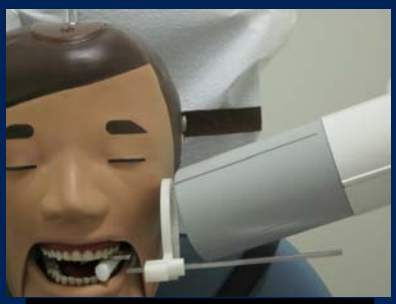
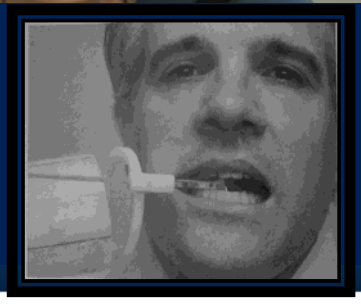
Excessive vertical angulation- foreshortening (incorrect BID alignment)-crowns cut off





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Error-insufficient vertical angulation = elongation

- Insufficient vertical angulation leads to elongation.
- Elongation results when the x-ray beam is aligned perpendicular to the long axis of the tooth but not to the image receptor. White and Pharoah, 2009

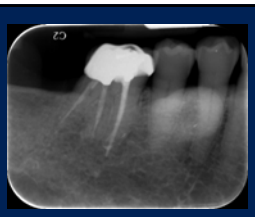
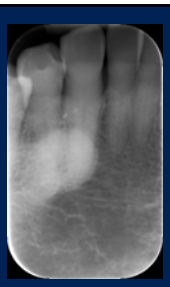
Roots are cut off

Error-insufficient vertical angulation = elongation

Initial image

Retake

Tori

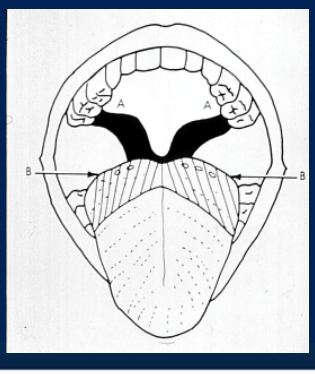
- Palatal torus
  - The plate must be placed on the far side of the torus
- Mandibular tori
  - If large-may need to go behind the tori

Gagging Patients

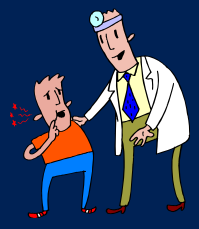
- Receptors located in the soft palate, lateral posterior 1/3 of the tongue, and the region of the retromylohyoid space (9th cranial nerve)

Gagging is initiated usually by two categories of stimuli

- Psychic
- Tactile



Gagging Patients

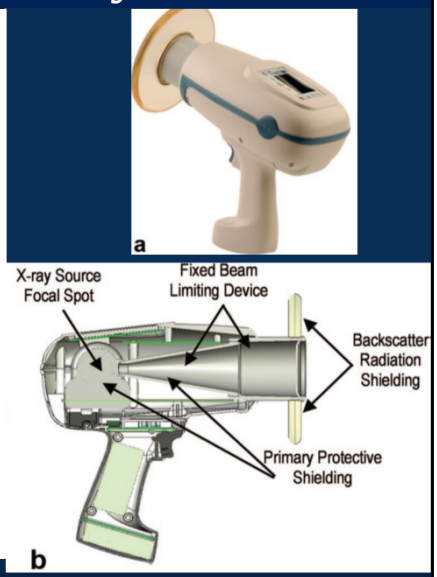


- Establish rapport with patient
  - Acquire anterior projections first
  - Patient hold RINN instrument for maxillary posterior periapicals
  - Bisecting angle
  - Salt
  - Cetacaine® Spray
  - Quick with good quality
    - Don't ask patient if they are a gagger

NOMAD hand held x-ray unit

The Aribex Nomad handheld intraoral x-ray system (Fig. 1) is designed as a handheld device and includes five unique features:

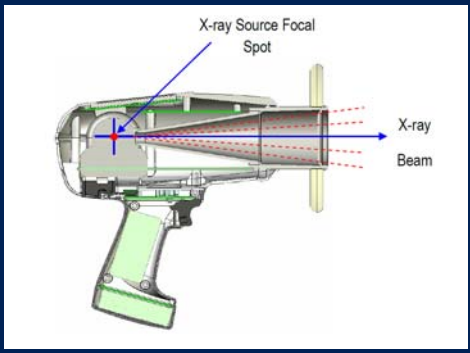
1. Proprietary shielding around the x-ray tube to minimize leakage radiation;
2. A built-in leaded acrylic shield to protect the operator from backscatter (Fig. 2);
3. A lead shielded positioning indicating device (PID) or cone;
4. A 6-cm-diameter PID, which reduces the area irradiated to 56.2% of that for conventional x-ray units with 8-cm-diameter PIDs (the smaller area reduces patient and staff doses by an amount proportional to the irradiated area); and
5. A 0.4-mm x-ray focal spot compared to a 0.6-mm focal spot for conventional units (a small focal spot produces superior image quality with finer detail) (Bailey et al. 2009).



Gray et al., 2012

NOMAD hand held x-ray unit

https://youtu.be/peWyX9lOEU0



NOMAD hand held x-ray

Maximum scattered radiation will be backwards, *i.e.*, 90 to 180 degrees from the primary beam as it enters the patient.

NOMAD hand held x-ray unit

- Backscatter shield needs to be perpendicular to collimator cone, at the outer edge of the collimator cone, and close to the patient.

- To keep the operator within the protection zone, the NOMAD should be perpendicular to the operator. Adjust patient head as needed to maintain perpendicular relationship.
- To maintain low patient exposure the x-ray beam should be perpendicular to the image receptor.

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NOMAD hand held x-ray unit

- In atypical exposure situations (the patient is not positioned upright) the feet, abdomen, reproductive regions, and thyroid have been shown to fall outside of the hand-held radiation device's lead shield zone of protection.
  Danforth et al.k, 2009

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Move patient to stay within protective zone

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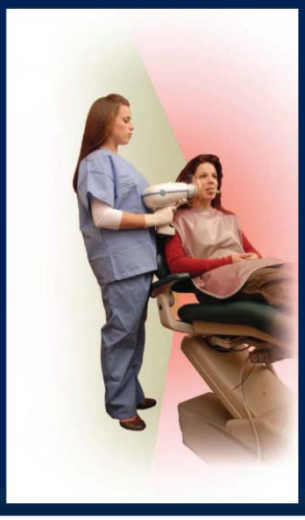
NOMAD hand held x-ray unit

Green-Shielding from leaded acrylic. Gray et al., 2012

Red-scatter radiation predominant. Gray et al., 2012

Used in a typical manner, the unprotected operator will sustain a small additional amount of radiation (<1% of the Maximum permissible dose). Danforth et al., 2009



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Results are applicable only to Nomad

DENTAL STAFF DOSES WITH HANDHELD DENTAL INTRAORAL X-RAY UNITS

Joel E. Gray,* Edgar D. Bailey,† and John B. Ludlow‡

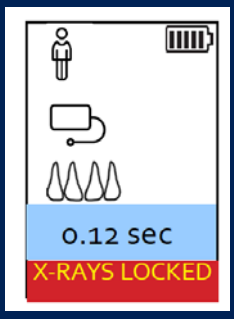
Health Phys. 102(2):137–142; 2012

The results of this comparison of dental staff doses between the Nomad handheld intraoral x-ray system and conventional wall-mounted intraoral x-ray systems indicate that the staff doses for the handheld systems are significantly less than those for wall mounted systems. (It

Consequently, there should be no concern about the use of the Nomad handheld dental intraoral x-ray system. Additional shielding efforts (e.g., wearing a lead apron) are not necessary based on the personnel exposures at actual dental facilities as reported in this study.

X-Ray disable

- X-ray Disable: With the device on, press and hold down the Select ( ) button and while continuing to hold, press the Patient ( ) button. The device shifts into a X-RAYS LOCKED state and the buttons can be released. Repeat the process to unlock the X-ray.



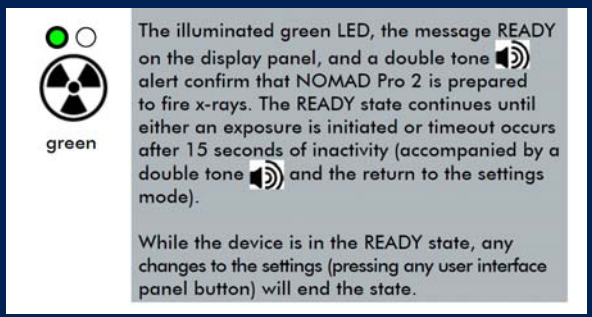
NOMAD hand held x-ray unit

- For increased stability place one hand on the grip and the other on the underside of the housing (but not on the collimator cone).

X-ray Emission-NOMAD

Press and release the trigger once to ready the device. The device will briefly display an ENABLING X-RAYS message before indicating READY.

NOTE: As a safety precaution, if the trigger is held longer than one second or pulled a second time while still in the ENABLING X-RAYS state, the device will not transition to the READY state.



X-ray Emission

To begin the exposure, press and hold the trigger. The READY message is replaced with X-RAY ON, the green LED is replaced with a yellow LED, and there is an alert tone for the duration of the exposure.

Duty cycle-NOMAD

Exposure Duration	0.09 sec	0.20 sec	0.40 sec	1.00 sec
Hypothetical Time Between Exposures	6 seconds	12 seconds	24 seconds	60 seconds
Exposures Per Minute	>10	>8	>2	1

- 0.32s=19 sec between exposures

Radiation safety for this course will use the Position and distance rule:

The operator should be positioned a minimum of 6 feet from the tubehead during the exposure.

Wall mount unit

The non-operator should be positioned a minimum of 6 feet from the tubehead during the exposure.

NOMAD®

NCRP 145, 2003 and GA law