

Panoramic Radiography

L.12 Panoramic Technique

By

Mahmood Al-Fahdawi B.S., M.Sc., Ph.D.

Oral Radiology Teacher, Anbar University

A panoramic radiograph is a panoramic scanning dental X-ray of the upper and lower jaw. It shows a two-dimensional view of a half-circle from ear to ear. Panoramic radiography is a form of focal plane tomography; thus, images of multiple planes are taken to make up the composite panoramic image, where the maxilla and mandible are in the focal trough and the structures that are superficial and deep to the trough are blurred.

Indications:

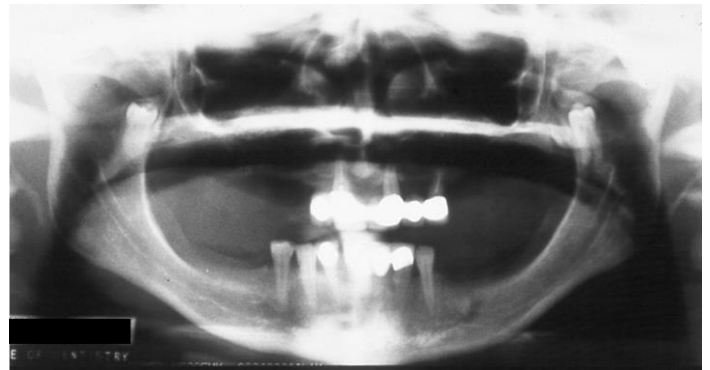
Orthopantomograms (OPTs) are used by health care professionals to provide information on:

1. Impacted wisdom teeth diagnosis and treatment planning - the most common use is to determine the status of wisdom teeth and trauma to the jaws.
2. Periodontal bone loss and periapical involvement.
3. Finding the source of dental pain, and when carrying out tooth-by-tooth diagnosis.
4. Assessment for the placement of dental implants
5. Orthodontic assessment. Pre and post-operative
6. Diagnosis of developmental anomalies such as cherubism, cleido cranial dysplasia
7. Carcinoma in relation to the jaws
8. Temporomandibular joint dysfunctions and ankylosis.
9. Diagnosis of osteosarcoma, ameloblastoma, renal osteodystrophy affecting jaws and hypophosphatemia.
10. Diagnosis, and pre- and post-surgical assessment of oral and maxillofacial trauma, e.g. dentoalveolar fractures and mandibular fractures.
11. Salivary stones (Sialolithiasis).
12. Other diagnostic and treatment applications.

Third Molars:

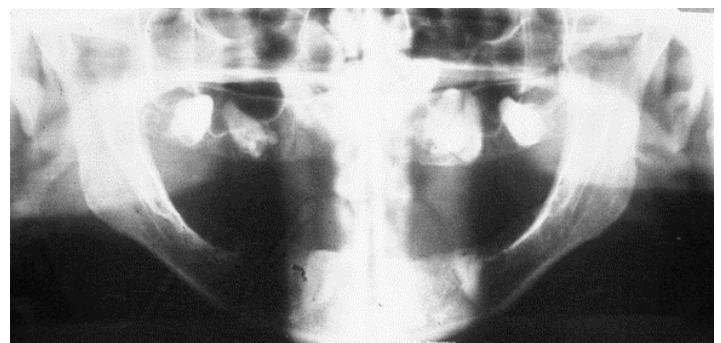
The identification of the location and orientation of third molars is one of the most common uses of panoramic films.

In this film, the mandibular third molars have migrated up into the coronoid process region.



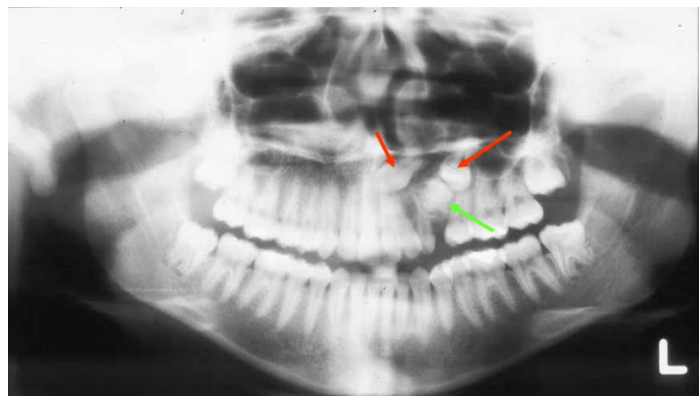
Impactions:

This film demonstrates the importance of having the proper diagnostic information before deciding on a treatment plan. This patient had numerous impacted teeth and several associated cysts. The patient had been wearing dentures for many years and was unaware of the impactions.



Pathology:

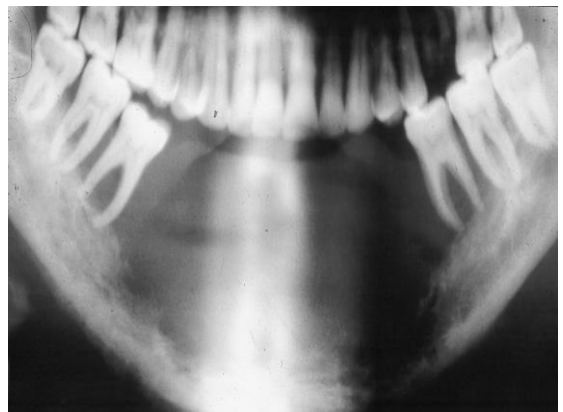
In this patient, tooth numbers 11 and 12 did not erupt. The film shows the location of these unerupted teeth (red arrows) and also identifies the presence of a complex odontoma (green arrow) which contributed to the failure of the teeth to erupt.



This patient has a very large dentigerous cyst which involves the entire ramus and extends forward to the second premolar region.

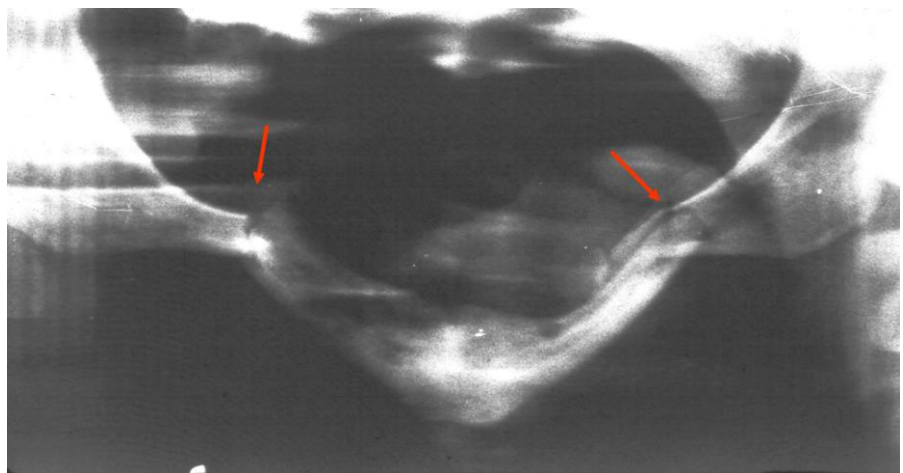


This film shows the extensive destruction of the mandible caused by a metastatic carcinoma.



Fractures:

As a result of trauma, this patient has bilateral fractures of the mandible (red arrows).



Mixed Dentition:

Unerupted permanent teeth in a child are easily seen on a panoramic film. Missing permanent teeth or supernumerary teeth can be readily identified.



Advantages:

1. Short time required for making the image.
2. Broad coverage of facial bone and teeth.
3. Exposes the patient to less radiation (one third the dose from an intraoral full mouth survey).
4. Field limitation techniques result in further dose reduction.
5. Requires less technical expertise.
6. Convenience of examination for the patient (films need not be placed inside the mouth). Easily tolerated by the patient.
7. Can be used when the patient is unable to open his mouth.
8. Patient's ready understandability of panoramic films, making them a useful visual aid in patient education and case presentation (easy for the patients to understand).
9. Patient movement distorts only that part of the image being produced at that instant.
10. Shows both sides of the mandible on one film which is useful when assessing fractures.
11. Shows the floor, anterior and posterior walls of maxillary sinus bilaterally.
12. Shows both condylar heads on one film.

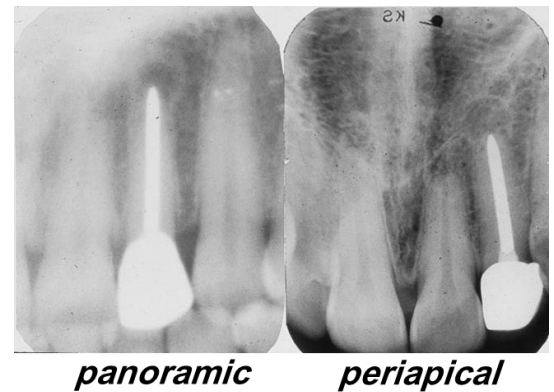
Disadvantages:

1. Produces an image that is less sharp.
2. May not reveal objects that are outside the focal trough.
3. Requires more expensive equipment.
4. Soft tissue and air shadows can overlies the required hard tissue structures.
5. Ghost shadows can overlies the structures in the focal trough.

6. Image magnification (app. 1.3 times) and distortion due to tomographic movement and the distance between the focal trough and film.
7. Not suitable for children under five years and some disabled patients because of the length of the exposure and the need for the patient to stay still.
8. Some patients do not conform to the shape of the focal trough.

Sharpness:

The sharpness or detail seen on a periapical film is much better than that seen on a panoramic film. The images are “fuzzier” on a panoramic film and are not good for diagnosing early pathology.



A periapical or bitewing film is preferred over a panoramic film for:

1. Caries.
 2. Periodontal disease.
 3. Early or limited periapical pathology.
 4. Endo treatment.
- The panoramic radiograph should not be used as a substitute for intraoral films.

Dental panoramic tomography has become a very popular radiographic technique in dentistry. The main reasons for this are as follows:

1. All the teeth and their supporting structures are shown on one film.
2. The technique is reasonably simple.
3. The radiation dose is relatively low, particularly with modern DC units with rare-earth intensifying screens, the dose is equivalent to about 3–4 periapical radiographs.

Panoramic Machines:

There are several manufacturers of panoramic equipment. Most of the units are designed for a patient to stand, but they will also accommodate a patient seated on a stool or in a wheelchair. For some machines, the tubehead always starts out on the same side of the patient (either left or right); for other machines, the tubehead can start from either side (varies from one patient to the next).

Cassette/Screens/Film:

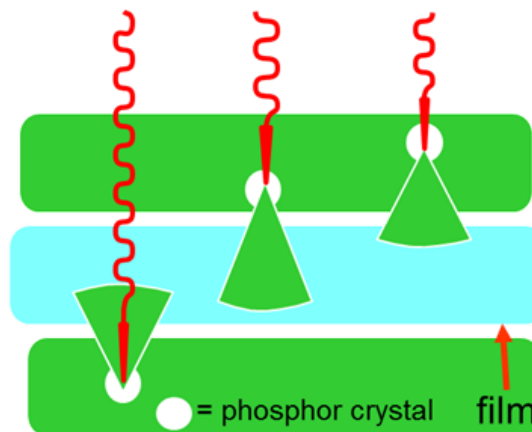
A light-tight cassette is used to hold the x-ray film in tight contact with two intensifying screens (one on each side of the film). The cassette can be either rigid metal or soft vinyl, depending on the type of panoramic machine.

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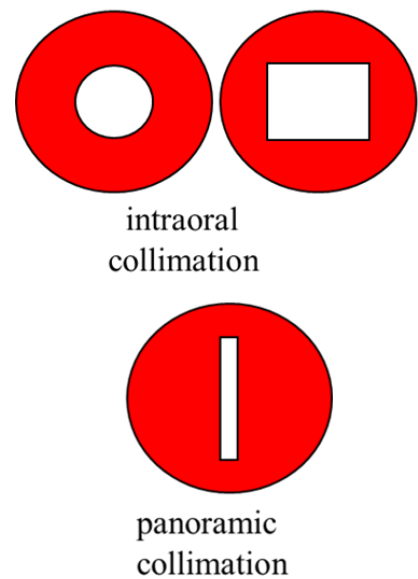
Screens/Film:

Most of the intensifying screens used for panoramic radiography emit green light. The phosphor crystals on the screens emit green light when struck by x-rays. This light in turn exposes the film, which is sensitive to green light. T-MAT or Ektavision film are two types of film used for panoramic radiography.



Collimation:

In order to limit the exposure to the patient, the x-ray beam is collimated. The collimator controls the size and shape of the x-ray beam. Intraorally, the x-ray beam is either round or rectangular and is large enough to cover the entire intraoral film. The collimator for panoramic radiography produces a narrow, rectangular x-ray beam that exposes a small portion of the film as the tubehead and film rotate around the patient.



Tomography:

Tomography is a radiographic technique that allows imaging of one layer or section of the body while blurring images from structures in other planes.

During tomography, the equipment is designed to move in one of five ways: linear, circular, elliptical, spiral and hypocycloidal.

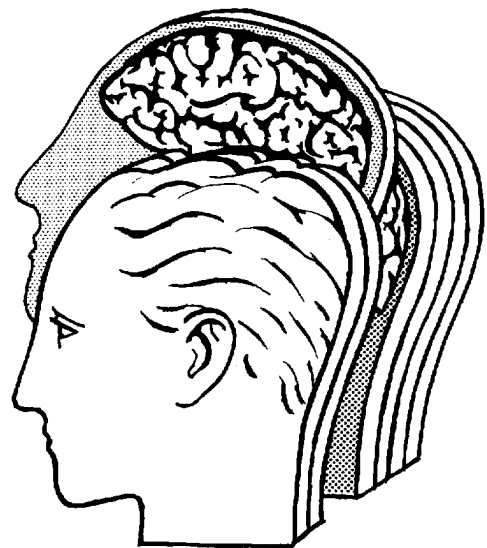
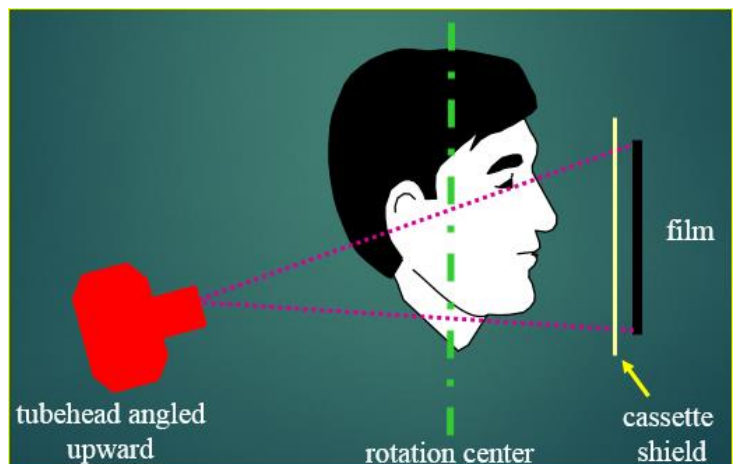


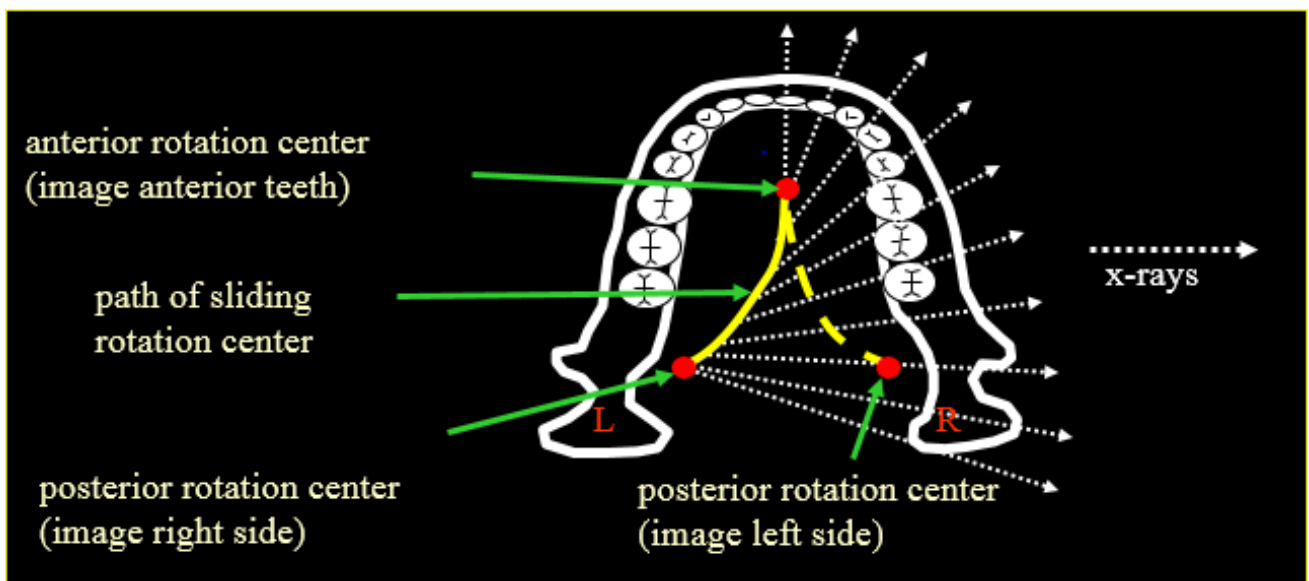
Fig. 14.1 Diagram illustrating the analogy of tomography dividing the patient up like a loaf of sliced bread.

Rotation Center:

- The tubehead rotates in an arc around the back of the patient's head.
- The film rotates in front of the patient.
- The center of this rotation varies as the tubehead rotates, producing a sliding rotation center.
- The vertical angulation cannot be varied. The X-ray beam is directed slightly upwards.



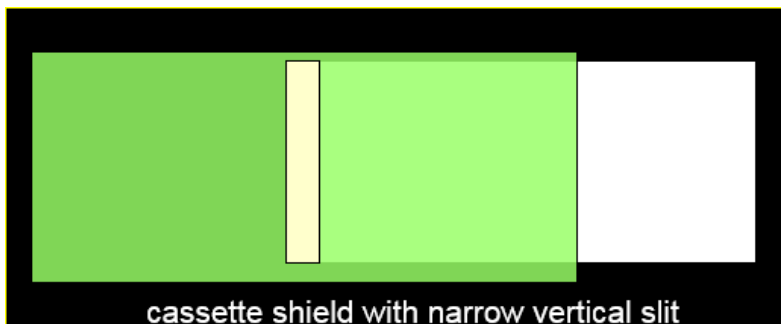
Sliding Rotation Center:



At the starting point with the tubehead on the patient's left, the rotation center is located posteriorly, on the same side as the tubehead, as shown below. As the tubehead moves behind the patient, the rotation center "slides" toward the front. As the tubehead continues to move to the patient's right, the rotation center "slides" back posteriorly.

Tubehead Rotation:

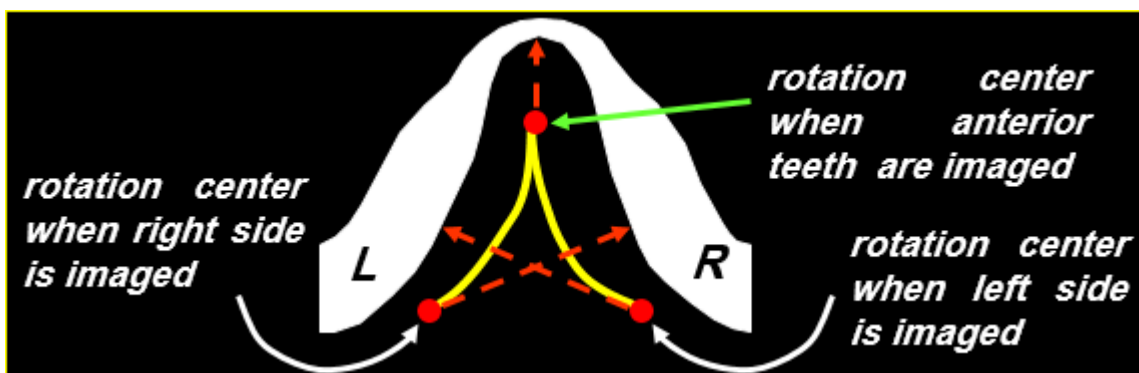
As the tubehead rotates around the patient, the cassette holder is also rotating so that it is always lined up with the x-ray beam. The x-ray beam passes through a narrow vertical opening in the cassette shield, which allows only a small portion of the film to be exposed at a time. The film/cassette slides within this shield, constantly exposing different parts of the film as the whole unit rotates.



As the tubehead rotates around the patient, the x-ray beam passes through different parts of the jaws, producing multiple images that appear as one continuous image on the film ("panoramic view").

Focal Trough (Image layer):

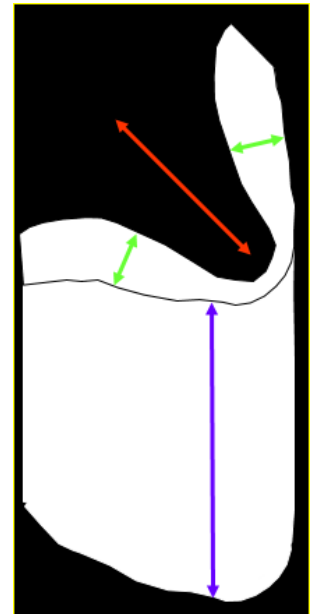
The focal trough is a three-dimensional curved zone or image layer in which structures are reasonably well defined. Through the design of the panoramic machine, this zone corresponds to the shape of the upper and lower jaws. The shape and width of the focal trough is determined by the path of the sliding rotation center. The closer the rotation center is to the teeth, the narrower the focal trough in that area. Because the rotation center is closer to the anterior teeth, the focal trough is narrower in this area.



The three dimensions of the focal trough are:

1. Front-to-back (anterior-posterior). Red arrow.
2. Side-to-side (buccolingual). Green arrows.
3. Up-and-down (Vertical). Blue arrow.

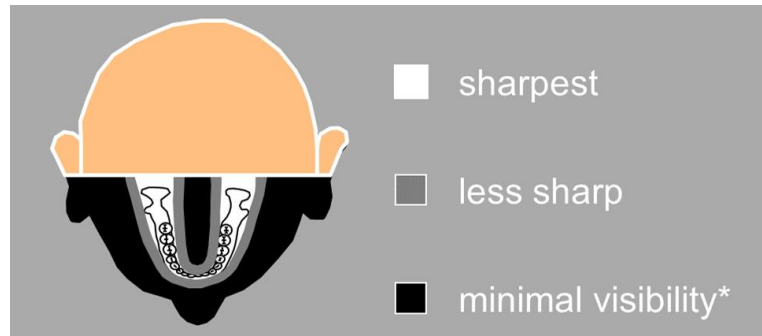
The quality of the resulting panoramic radiograph depends on the positioning of the patient's teeth within the focal trough and how closely the patient's jaws conform to the focal trough designed for the average jaw



Sharpness:

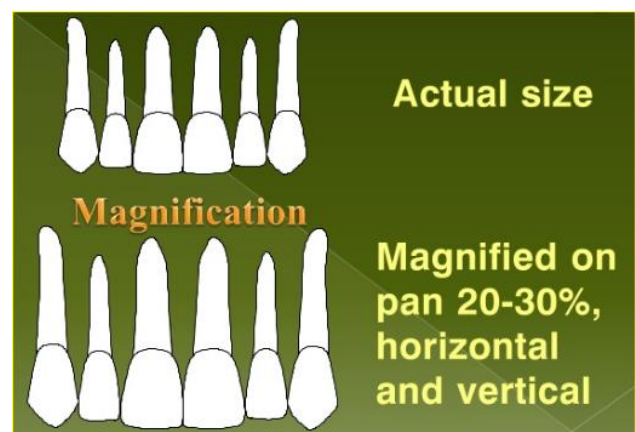
The sharpness of objects will vary depending on their location relative to the focal trough.

* The images of objects with minimal tissue density are blurred and are not easily seen on the film. Dense objects, such as a bullet fragment, will still be seen.



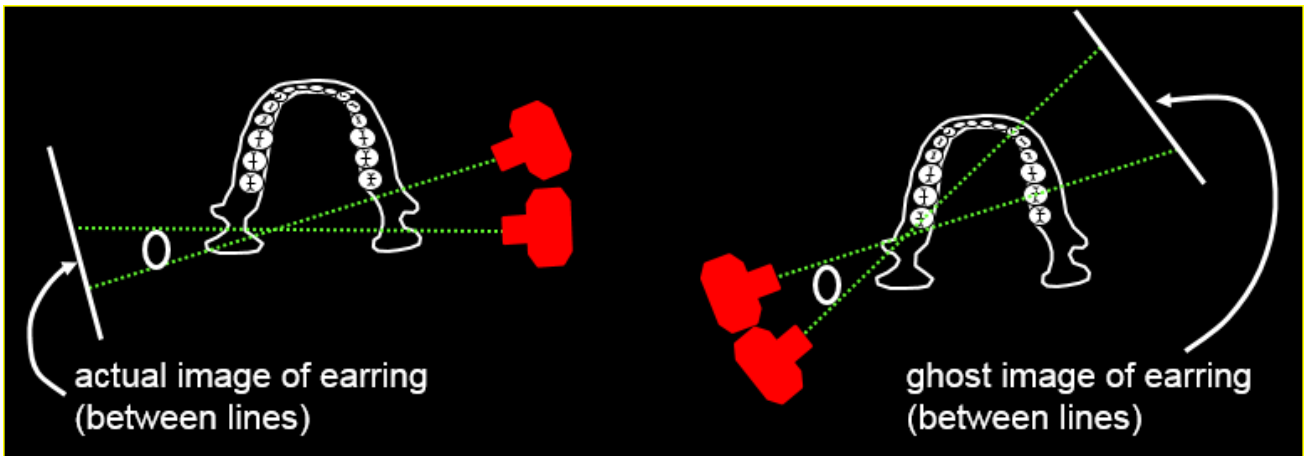
Magnification:

Objects in the focal trough will be magnified in both the horizontal and vertical dimensions. The overall magnification will be 20-30%.

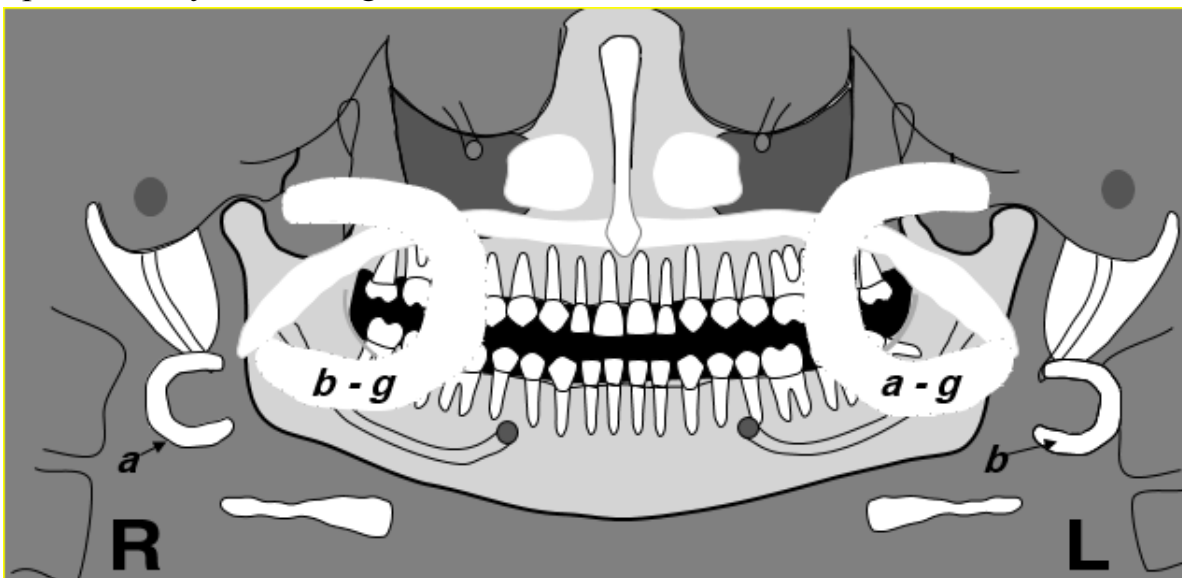


Ghost image:

A ghost image is the opaque shadow of a dense object (jewelry, anatomy) located on the opposite side of the patient. E.g., the ghost image of an earring in the patient's right ear will be seen in the maxillary left region on the film.



In the diagram below, the ghost image b-g is created by the earring b and a-g is produced by the earring a.



Characteristics of a Ghost Image:

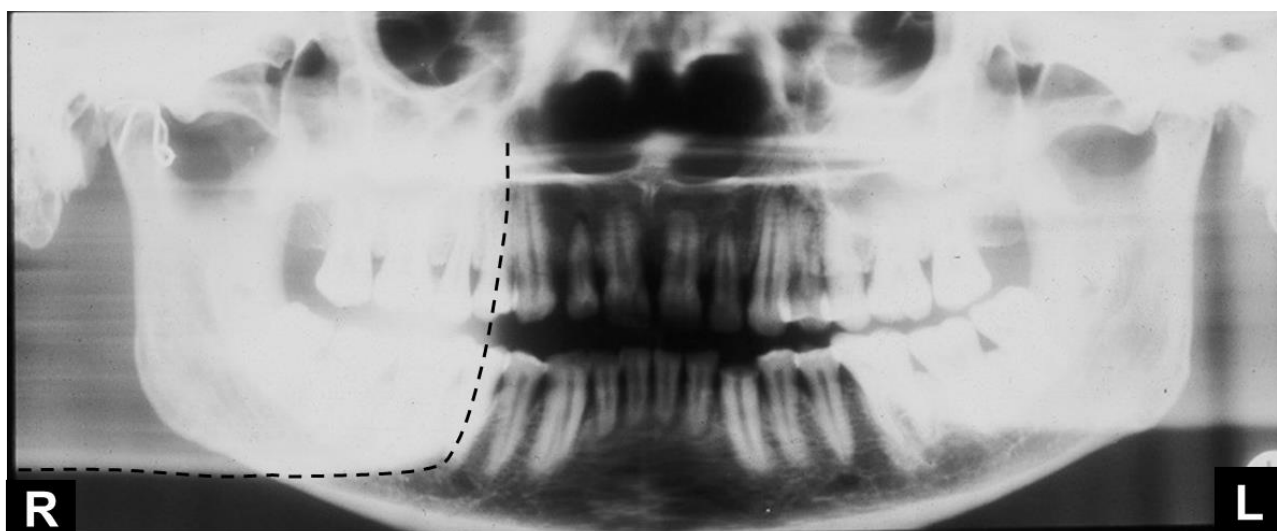
A ghost image will be:

1. Located on the opposite side from the image of the actual object.
2. The same shape as the actual object.
3. Larger than the image of the actual object.
4. Projected higher on the film.
5. Blurred (less sharpness; “ghostlike”).

The earring indicated by the red arrow left (patient's right ear) produced the ghost image indicated by the green arrow.



The dotted line below outlines the shape of the ghost image of the left side of the mandible. Because it is very dense bone, this normal anatomy can produce a ghost image.



Patient Exposure:

The exposure from a panoramic film is approximately equal to that from four intraoral films. Because of this relatively low dose and the extensive area covered, the panoramic film is a very popular choice when combined with bitewings and selected periapical films.

Panoramic Technique:

Equipment Setup:

Load the film between screens (in the darkroom) and position the cassette in the machine.



Patient Preparation:

Patient preparation is extremely important for ensuring that a high-quality image is produced and that errors are avoided (the following table). For instance, incorrect patient preparation can lead to "ghost images" which can render the radiographic image undiagnostic. While ghost images often occur due to metallic objects, they can also occur due to anatomical structures located outside the image layer or focal trough. Ghost images always appear higher and distorted on the opposite side of the radiographic image (see below figure). Some errors are unavoidable due to the patient's stature, facial asymmetry, or difficulty following instructions.

Patient Preparation Guidelines.

Jewelry All necklaces, piercings (earrings, tongue rings, etc.) and jewelry in the head and neck regions need to be removed prior to exposure.

Metal objects Items such as headbands, bobby pins, hair clips, hearing aids, etc. must be removed prior to exposure. Removable partial dentures and orthodontic appliances should be taken out prior to imaging.

Basically, remove anything between the neck and the top of the ears. Berets, etc., above the top of the ears will not be seen on the film. The two patients below would have some difficulties doing this.

Lead Apron Apron must not have a thyroid collar and should be placed properly so it does not block the x-ray beam.

An important item to include when preparing the patient is the use of a lead apron, which is recommended for all radiographic procedures. Lead aprons help provide protection for radiosensitive tissues in the neck, chest, reproductive areas, and blood forming tissue. In addition, lead aprons stop nearly 98% of scattered radiation from reaching reproductive organs. There are lead-free aprons that use an alloy material instead of lead. They are 50% lighter and safer for patients and clinicians because they are lead-free.

While thyroid collars are not indicated for panoramic imaging, they are effective for use during intraoral imaging, because they have been shown to stop 92% of scatter radiation. One study revealed that only 2% of the general dentists surveyed report using a lead apron with a thyroid shield prior to taking radiographs.

Place the lead apron on the patient (no thyroid collar; it might block part of the x-ray beam). An apron with equal sides is usually used to protect the patient. Make sure the apron is positioned low on the back of the patient's neck (arrow) so that it does not block the beam as the tubehead rotates behind the patient.

A poncho style lead apron protects the front and back of the patient.



Patient Positioning:

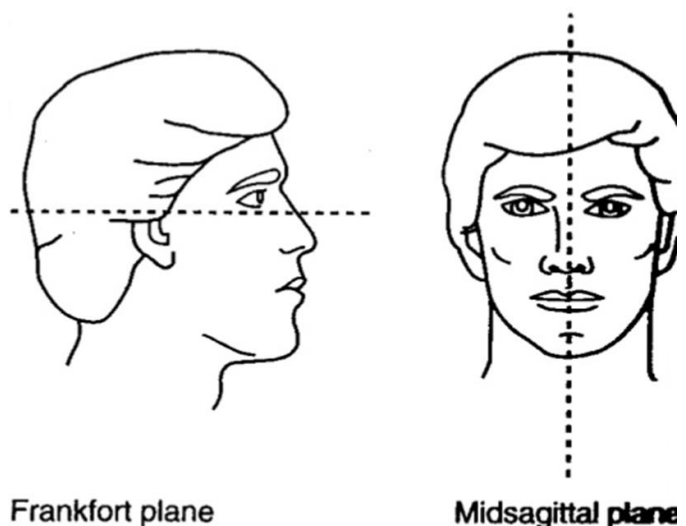
No matter the type of panoramic machine, there are four basic steps in patient positioning.

1. The maxillary and mandibular incisors are placed in the notch of the bitestick.
This positions the anterior teeth in the focal trough.
2. The Frankfort Plane should be parallel to the floor.
3. The Midsagittal Plane is perpendicular to the floor and centered on the bitestick.
4. The vertebral column should be straight.

Reference Lines:

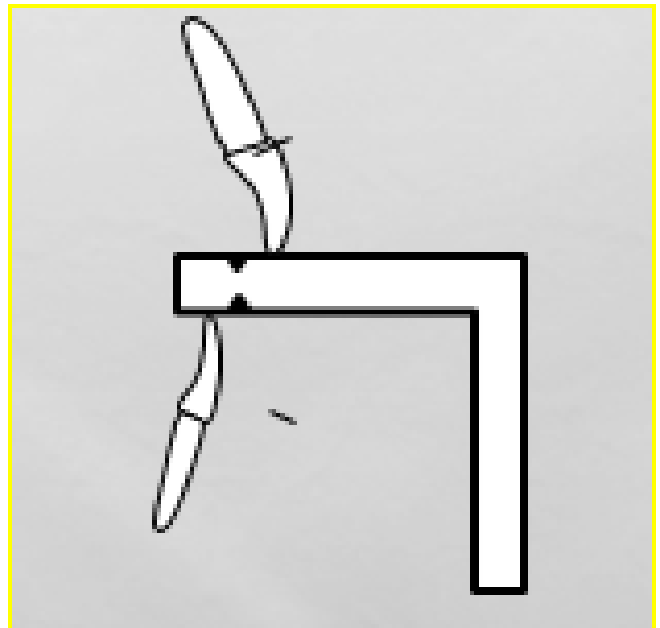
Frankfort Plane: represented by a line from the inferior border of the orbit to the top of the external auditory meatus.

Midsagittal Plane: divides the head into right and left halves.

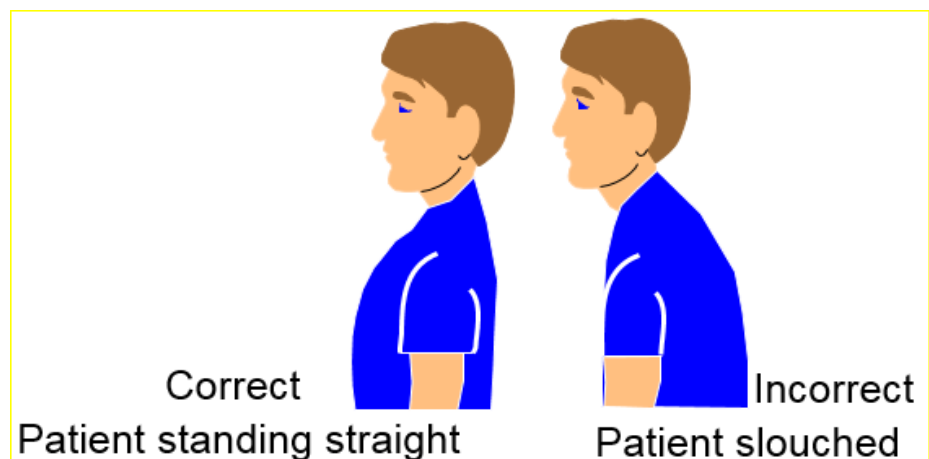


For edentulous patients, align the anterior edentulous ridges with the notches in the bitestick. Have the patient close gently.

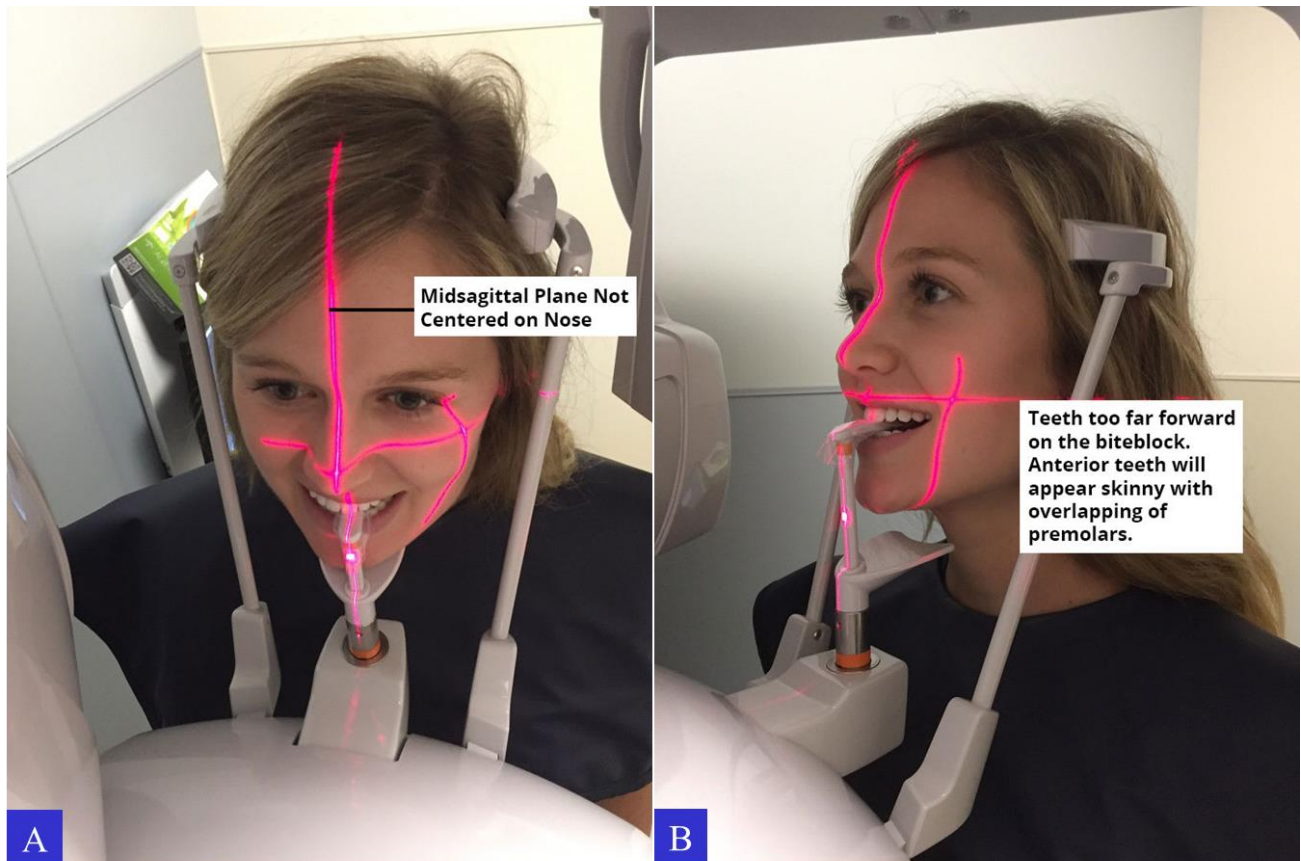
For patients with severe Class II or Class III occlusion, align the front teeth as closely as possible with notches. Split the difference between the two if both arches cannot be aligned in the notches.



The patient is encouraged to stand straight. Since the x-ray beam is angled upward, it may pass through the vertebra if the patient is “slouched”, creating a white shadow on the film.



Just before you are ready to begin the exposure sequence, advise the patient to swallow and feel the tongue contact the palate. Tell the patient to maintain this contact the entire time of the exposure (approximately 20 seconds). If they have a hard understanding this, just tell them to force as much of their tongue as possible against the roof of the mouth and hold it there. Advise the patient to keep the head still during the entire exposure.



(A) Example of incorrect patient positioning, because the midsagittal plane is not centered along the midline of the face. (B) Example of correct patient positioning with the tongue pressed against the palate, teeth in the groove of the bite-block, and the indicator light for the midsagittal plane centered and perpendicular to the floor.

If patient positioning is incorrect, errors are likely to occur. Patient positioning errors are the most common type of error when performing panoramic radiography.

The most common patient positioning error occurs when the tongue is not placed close enough to the palate. This may be due to the patient misunderstanding the instructions and only placing the tip of their tongue on the palate. Incorrect positioning of the tongue creates radiolucency near the apices on the maxilla, which makes diagnosis of periodontitis and root resorption challenging.

It is helpful to note that each manufacturer provides specific operation instructions in the manual that accompanies the unit. It is worth the time and effort for each team member to become acquainted with the contents of the manual. While the instructions make panoramic imaging easy to perform well, it is equally as easy to perform badly when manufacturers' instructions are not followed. Proper patient positioning (the following table) will help reduce the possibility of errors in panoramic imaging.

Patient Positioning Guidelines.

Standing/Sitting	If patient is able to stand, have them stand erect without the spine being slumped. If patient is seated, they should sit as upright as possible. It helps to do a test run with the panoramic machine to make sure it will not hit the patient's shoulders.
Mouth position	Patient needs to place maxillary/mandibular incisors correctly on bite block in order to achieve proper alignment of the teeth. Most units have a notch in the bite block indicating the proper location for the patient to bite.
Midsagittal Plane	The patient's head must be straight & not tilted. The midsagittal plane must be kept perpendicular to the floor.
Frankfort Plane	Keep the Frankfort plane parallel with the floor.
Tongue	Instruct the patient to place their entire tongue on the hard palate and leave it there for the duration of the exposure.
Lips	Instruct patient to keep their lips together for the duration of the exposure.
Eye	Have patient close their eyes so they do not follow the movement of the tube head.

Exposure Settings:

The kVp and mA can be adjusted on panoramic machines. Exposure time is fixed and cannot be changed. The larger the patient, the higher the settings need to be.

Follow the manufacturer's suggestions for varying the exposure settings based on patient size. Using these guidelines and recognizing adjustments you need to make based on experience, you should have no problems selecting the correct exposure factors for your patients.

Exposure:

Complete the exposure by depressing the exposure button and holding it down until the x-ray tube has completed its arc and has come to a stop. Some machines have an audible signal that indicates the completion of the exposure.

Infection Control:

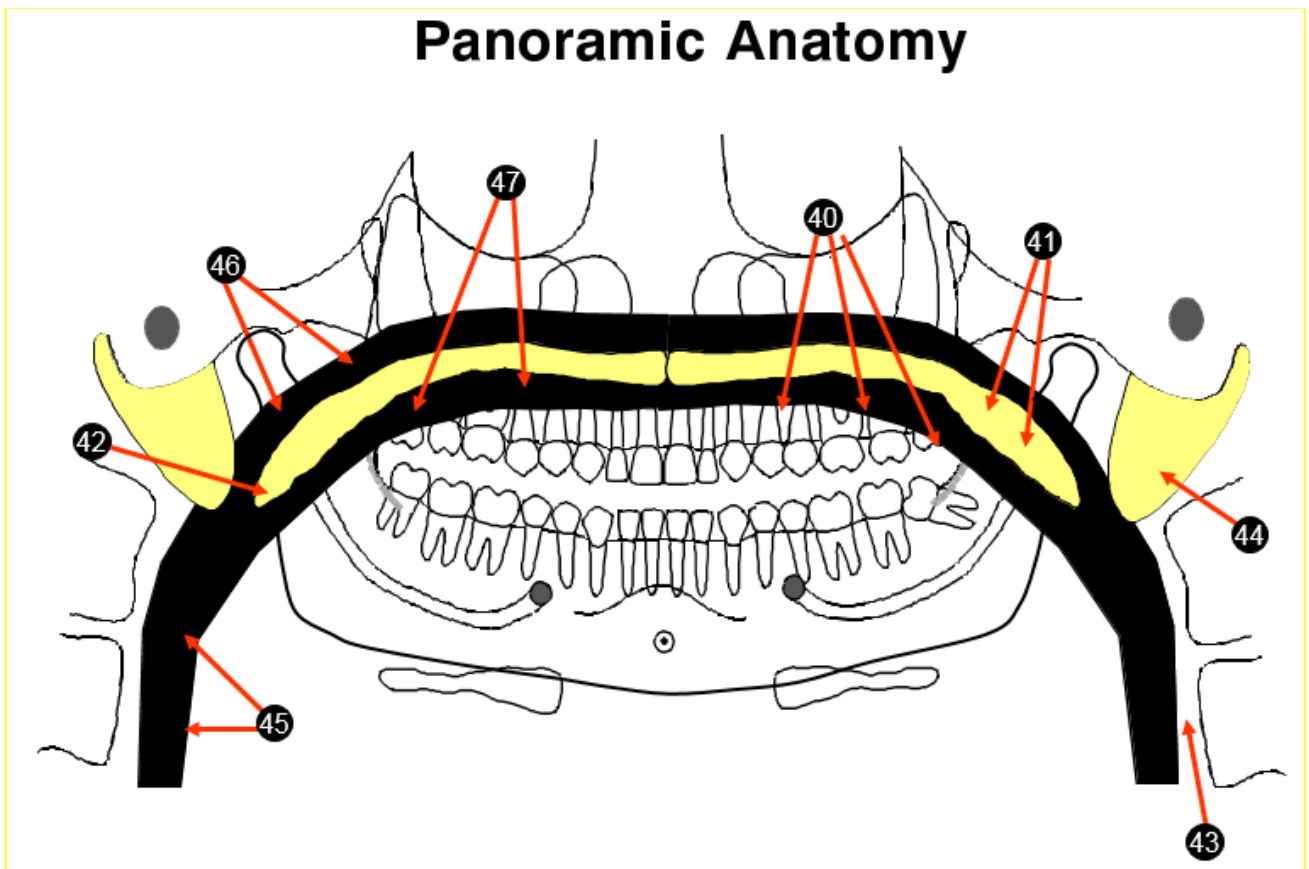
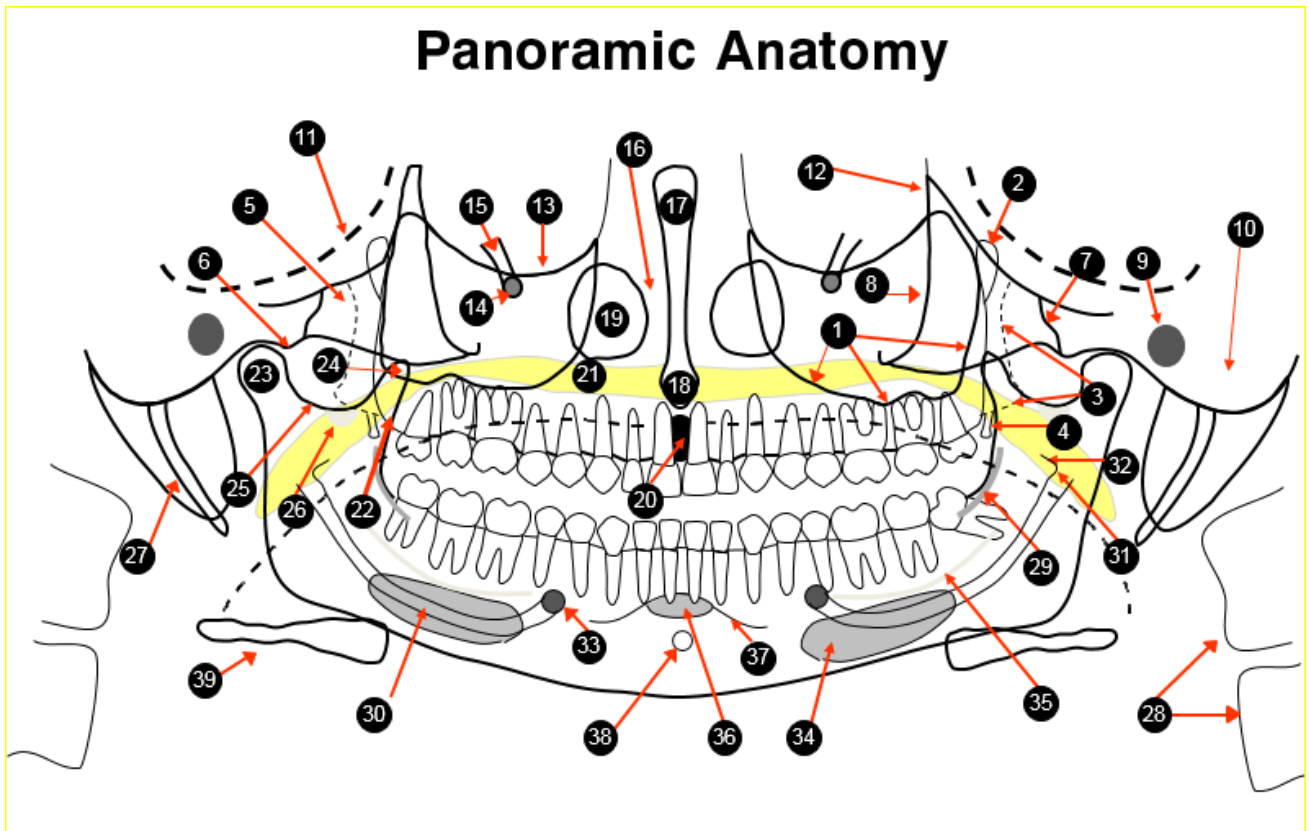
The cover is placed on the bitestick before patient positioning. After exposure, the cover is removed and discarded. Following this, the bitestick and all surfaces that contacted the patient's head should be wiped with a disinfectant.

Types of Panoramic Image:

Single Real Image: Only one image results from a given anatomical structure. Most images seen on a panoramic film are of this type. The object is between the center of rotation and the film.

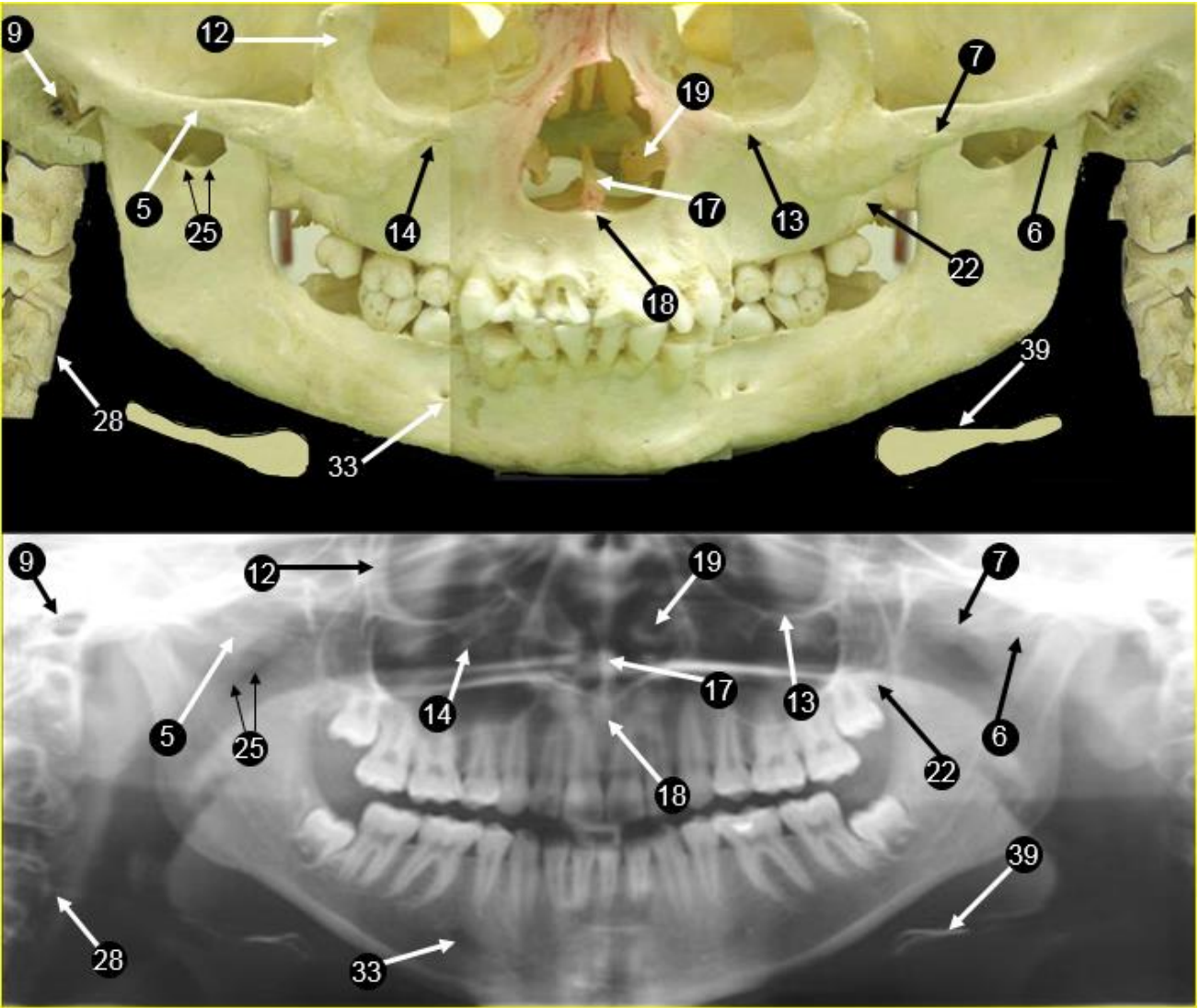
Double Real Image: Two images of a single object which is located in the midline. Structures that produce these double real images include the hard & soft palate, hyoid bone and cervical spine. Object is between the center of rotation and the film.

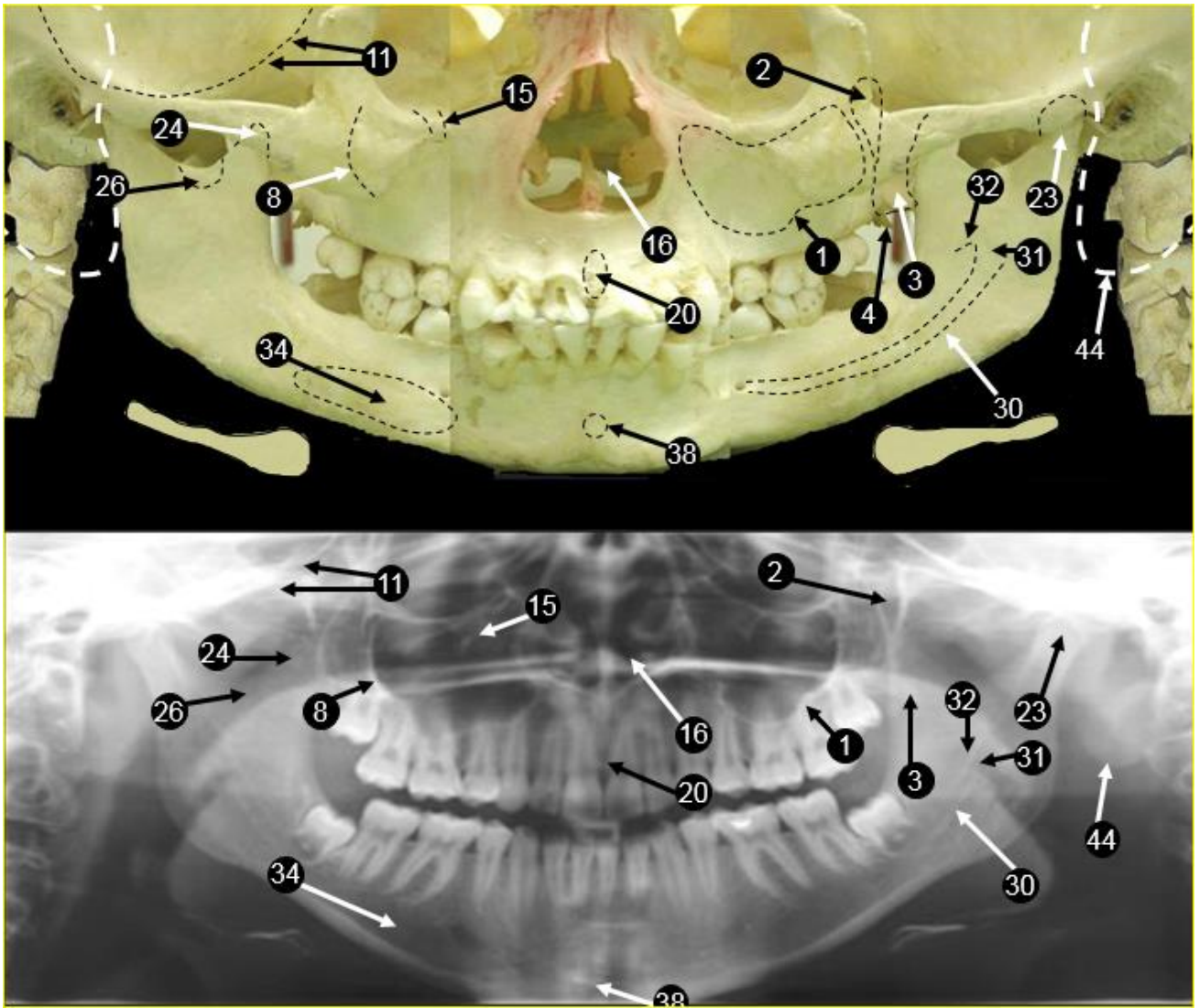
Ghost Image: Usually caused by external objects such as earrings but may be produced by dense anatomical structures such as the mandible. Objects located between center of rotation and X-ray source.

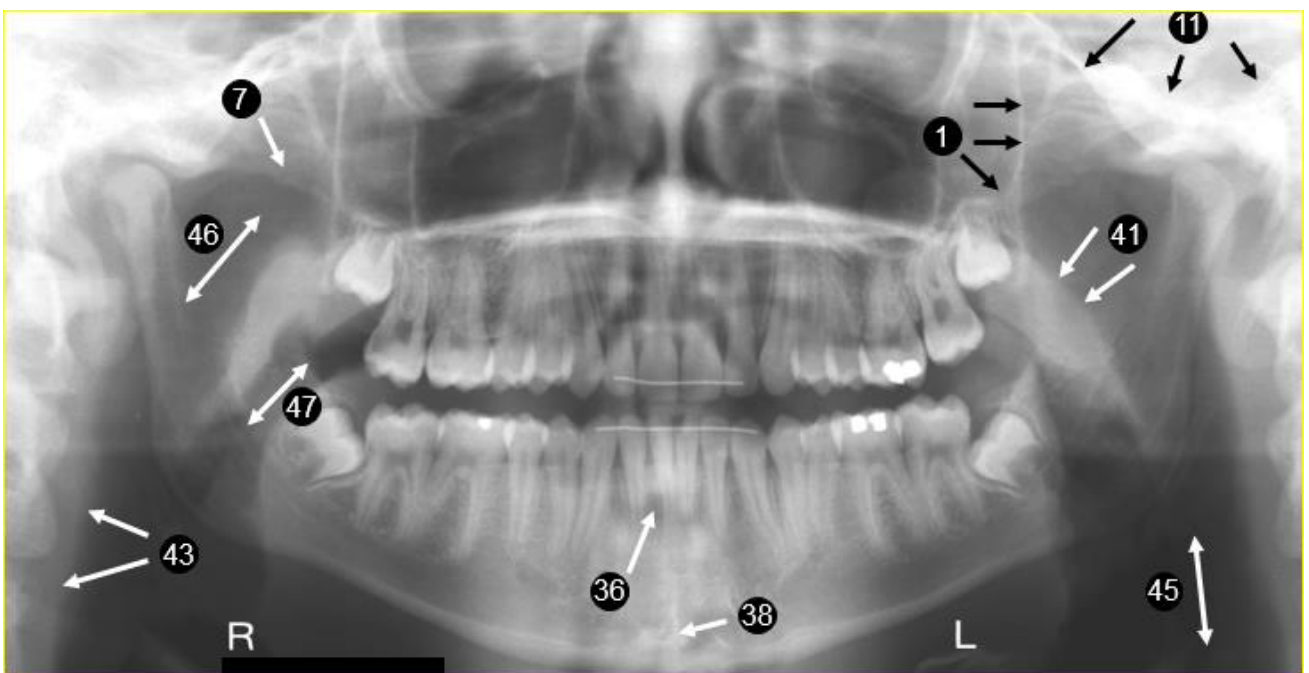
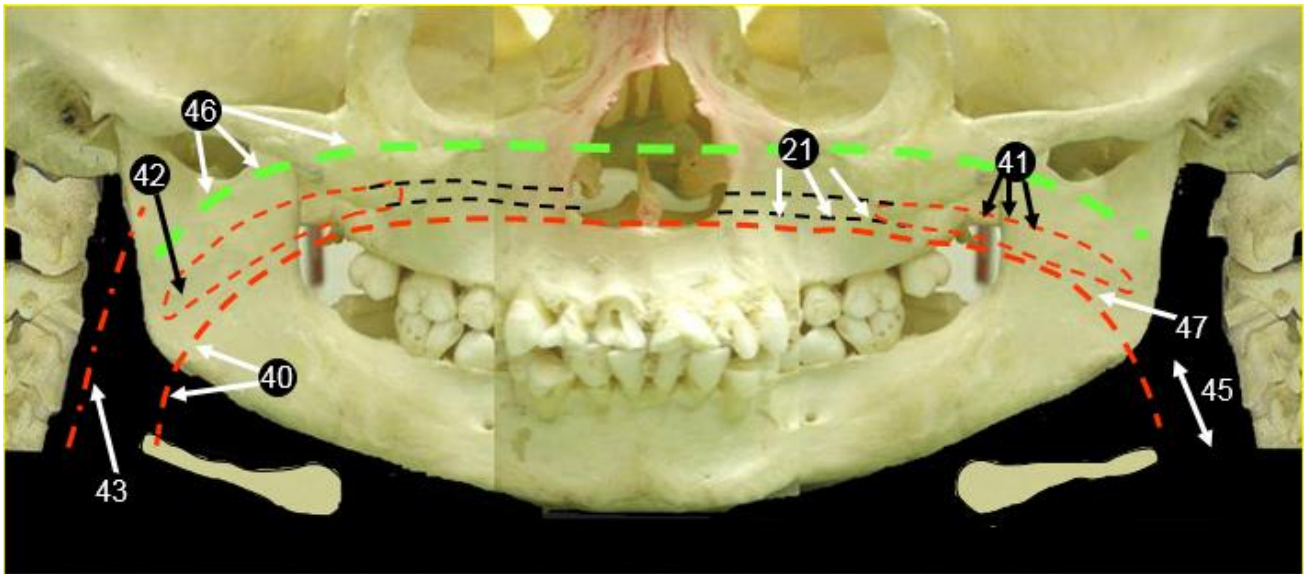


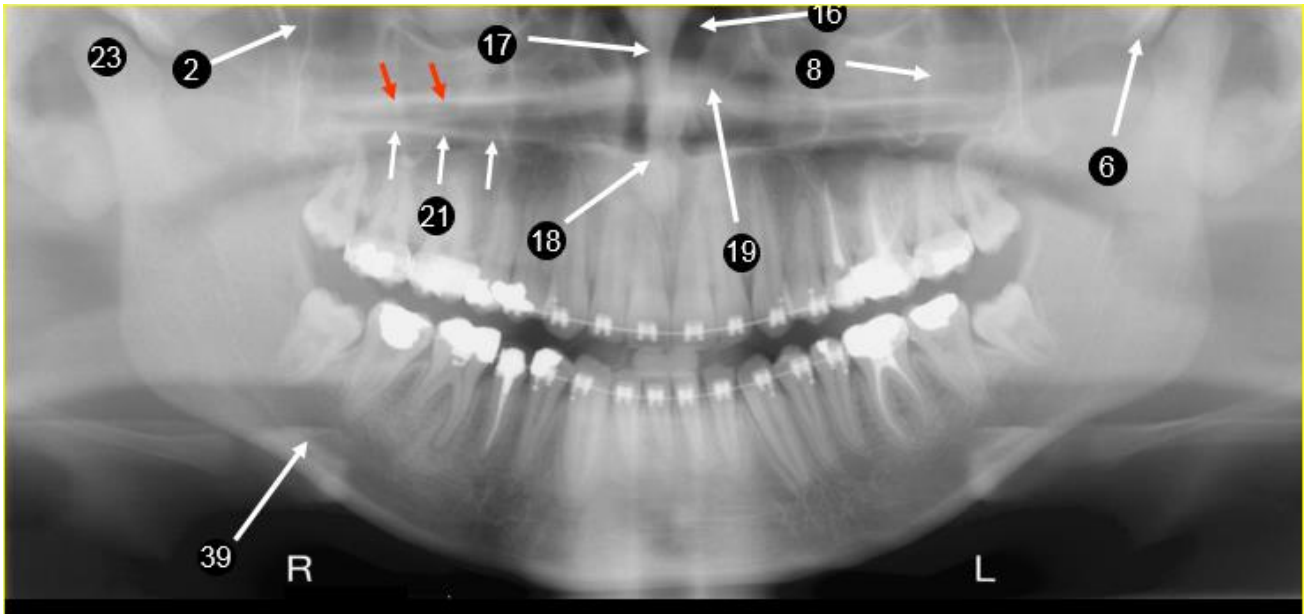
Panoramic Anatomy Key

1. maxillary sinus
2. pterygomaxillary fissure
3. pterygoid plates
4. hamulus
5. zygomatic arch
6. articular eminence
7. zygomaticotemporal suture
8. zygomatic process of maxilla
9. external auditory meatus
10. mastoid process
11. middle cranial fossa
12. lateral border of the orbit
13. infraorbital ridge
14. infraorbital foramen
15. infraorbital canal
16. nasal fossa
17. nasal septum
18. anterior nasal spine
19. inferior concha
20. incisive foramen
21. hard palate
22. maxillary tuberosity
23. condyle
24. coronoid process
25. sigmoid notch
26. medial sigmoid depression
27. styloid process
28. cervical vertebrae
29. external oblique ridge
30. mandibular canal
31. mandibular foramen
32. lingula
33. mental foramen
34. submandibular gland fossa
35. internal oblique ridge
36. mental fossa
37. mental ridges
38. genial tubercles
39. hyoid bone
40. tongue
41. soft palate
42. uvula
43. posterior pharyngeal wall
44. ear lobe
45. glossopharyngeal air space
46. nasopharyngeal air space
47. palatoglossal air space

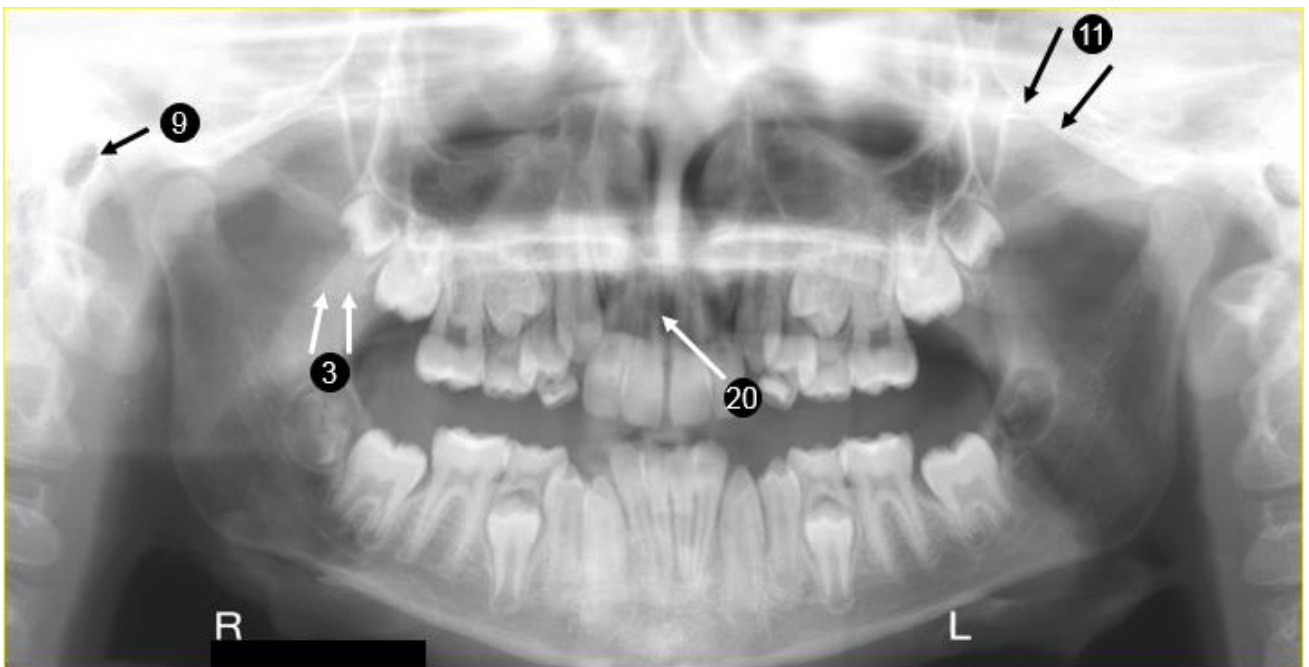


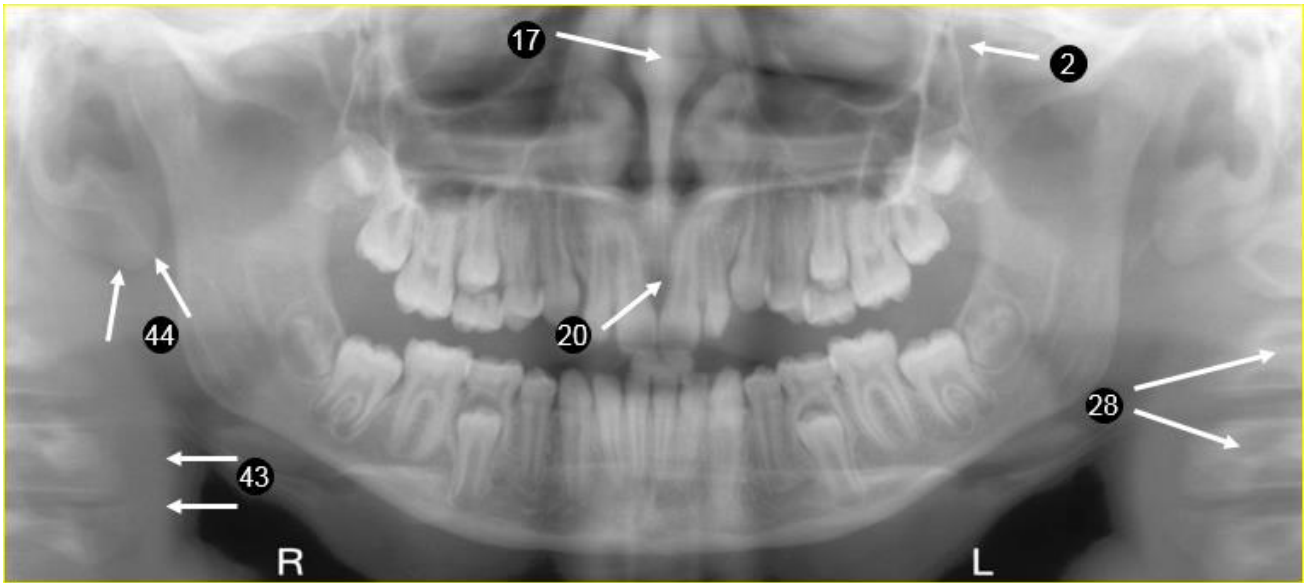


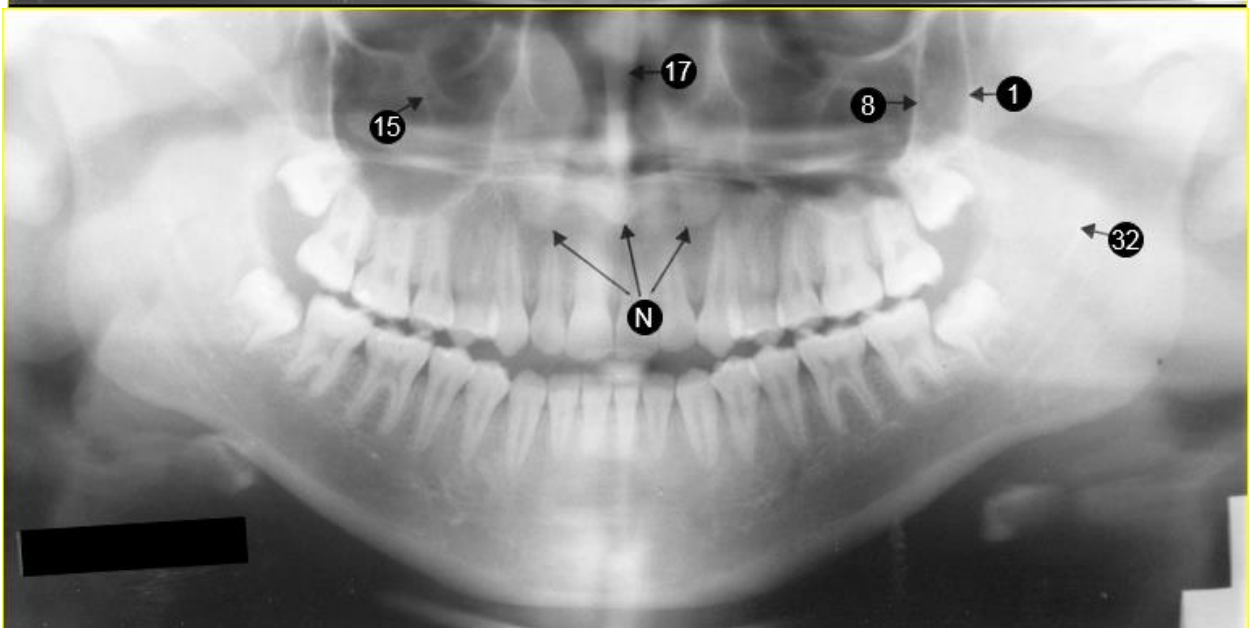
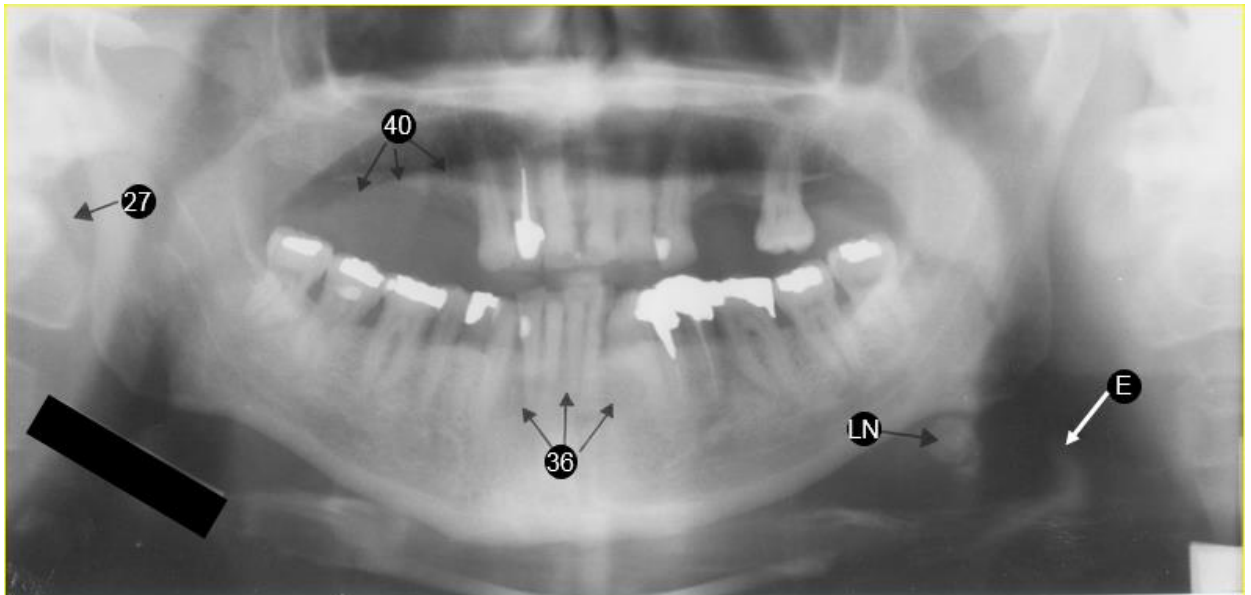
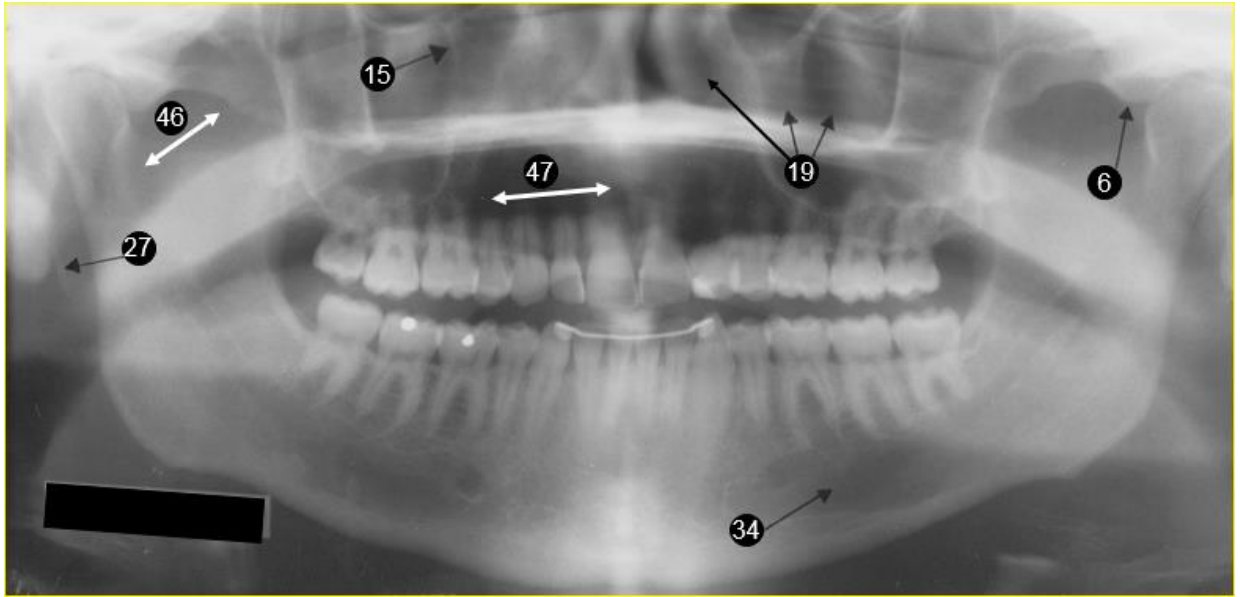




Red arrows point to ghost image of hard palate







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