PANORAMIC RADIOGRAPHY

SARAB M. ZAKI
BDS, MSc Oral & Maxillofacial Radiology

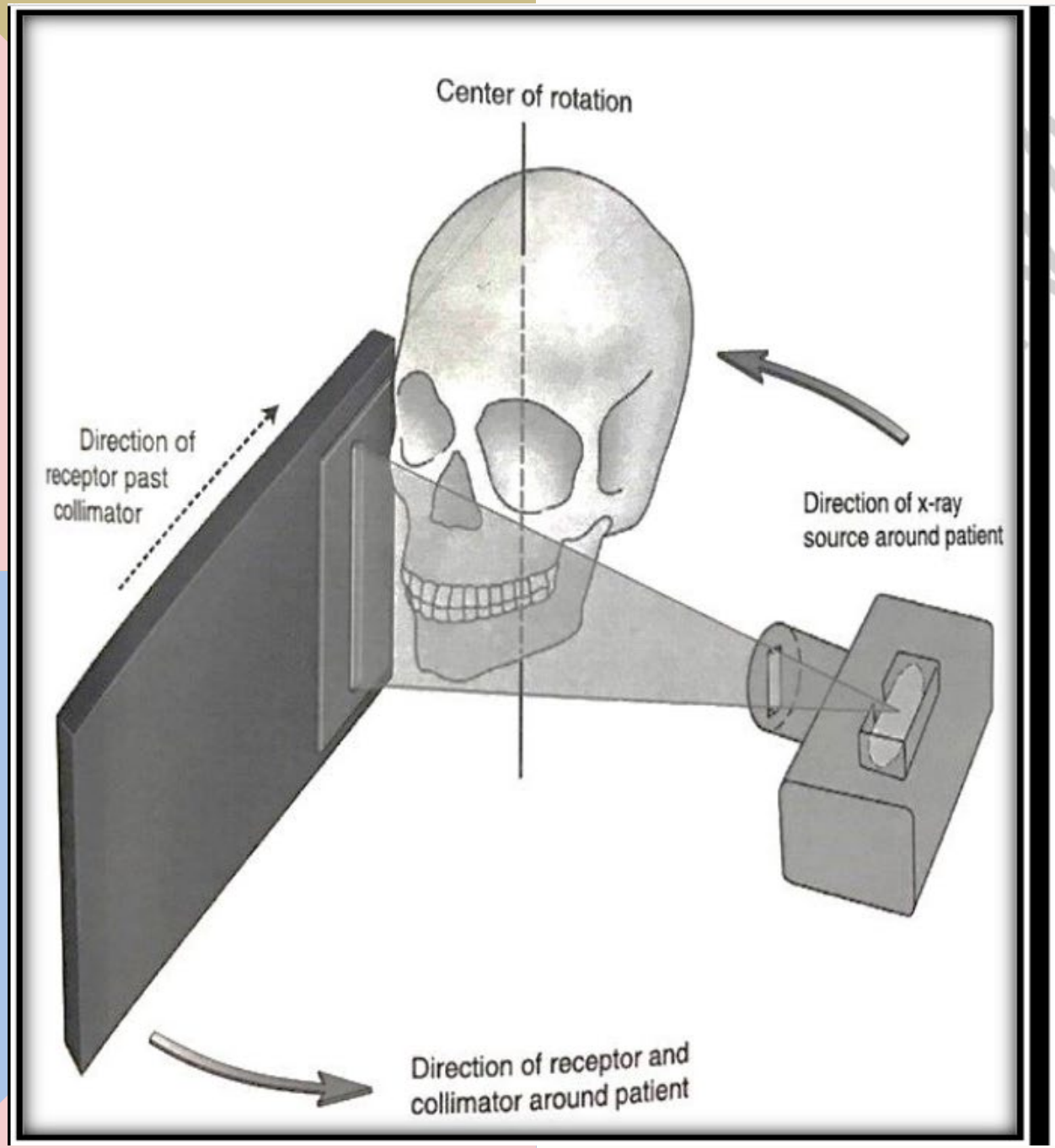
Panoramic imaging (also called pantomography) is a technique for producing a single tomographic image of the facial structures that include both the maxillary and mandibular dental arches and their supporting structures.

PRINCIPLES OF PANORAMIC RADIOGRAPHY

Paatero and Numata were the first to describe the principles of panoramic radiography. The X-ray source and the receptor rotate simultaneously around the patient to produce an image

Lead collimators in the shape of a slit, located at the x-ray source, limit the central ray to a narrow vertical beam.

Collimator also found in the receptor.



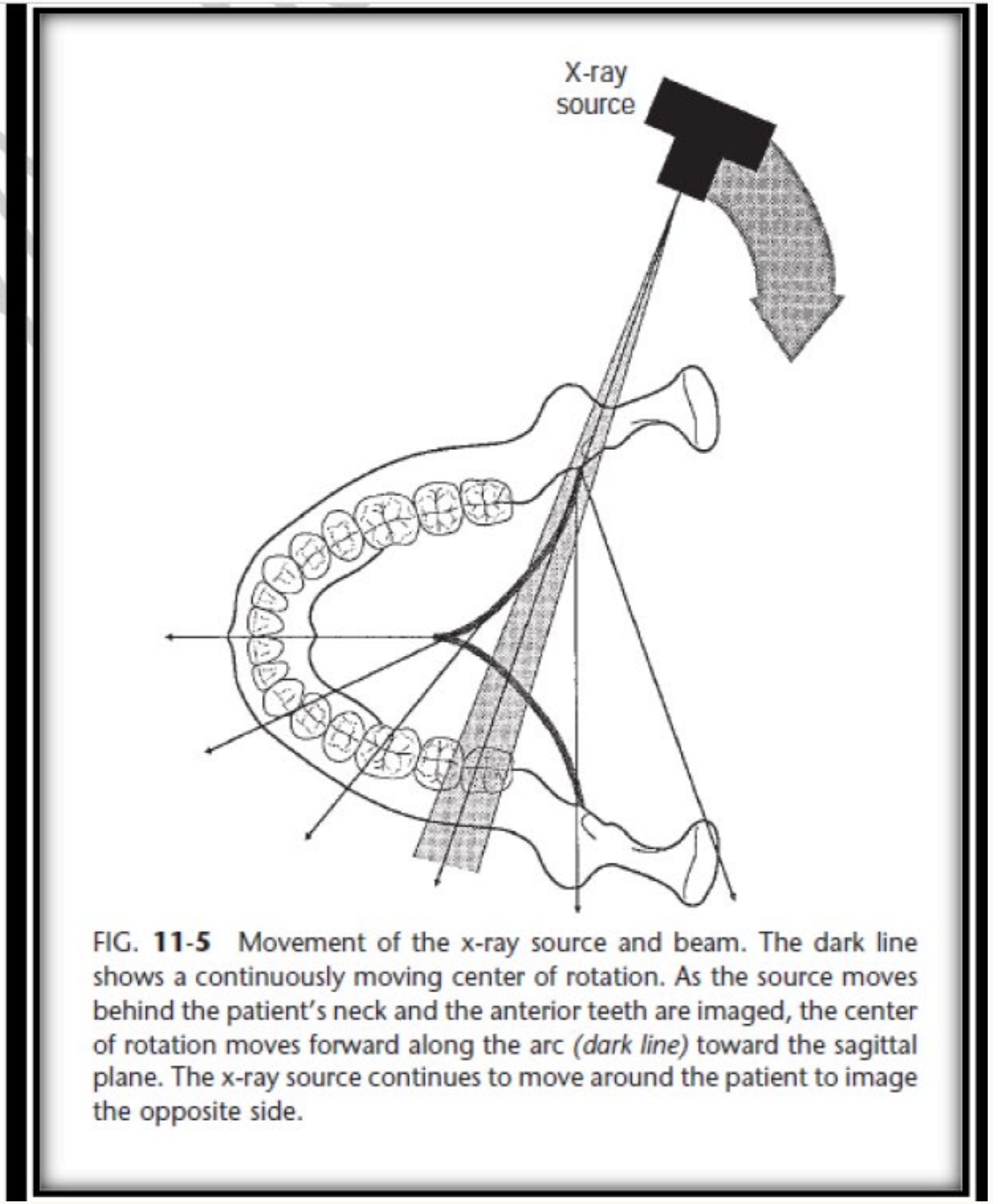


FIG. **11-5** Movement of the x-ray source and beam. The dark line shows a continuously moving center of rotation. As the source moves behind the patient's neck and the anterior teeth are imaged, the center of rotation moves forward along the arc *(dark line)* toward the sagittal plane. The x-ray source continues to move around the patient to image the opposite side.

INDICATIONS

1. Overall evaluation of dentition
2. Evaluation of intraosseous pathologies such as cysts, tumors and infections.
3. Gross evaluation of temporomandibular joints.
4. Evaluation of impacted teeth.
5. Evaluation of permanent teeth eruption and mixed dentition.
6. Dentomaxillofacial trauma such as a fracture.
7. Developmental disturbances of the maxillofacial skeleton.

ADVANTAGES OF PANORAMIC RADIOGRAPH

1. Broad coverage of the facial bones and teeth
2. Low patient radiation dose(compared to full mouth survey and CBCT)
3. Convenience of the examination for the patient
4. Can be used in patients with trismus (unable to open their mouths)or patients with intolerant intraoral film.
5. Short time required to make a panoramic image, usually in the range of 3 to 4 minutes (This includes the time necessary for positioning the patient and the actual exposure cycle.)
6. A useful visual aid in patient education and case presentation.
7. Easy radiographic technique

DISADVANTAGES

1. Lower **resolution** images that don't provide fine details provided by intraoral periapical radiographs. Thus it is **not** as useful as periapical radiography for detecting small carious lesions, the fine structure of the marginal periodontium, or periapical disease. The proximal surfaces of premolars also typically overlap.
2. Unequal **magnification** and geometric **distortion** across the image.
3. The presence of **overlapping structures**, such as the cervical spine, can hide odontogenic lesions, particularly in the incisor regions.

4. Important objects that may be situated outside the plane of focus (image layer) may appear distorted or not present at all.

5. Difficult to image **both jaws** when a patient has a severe maxillomandibular **discrepancy.**

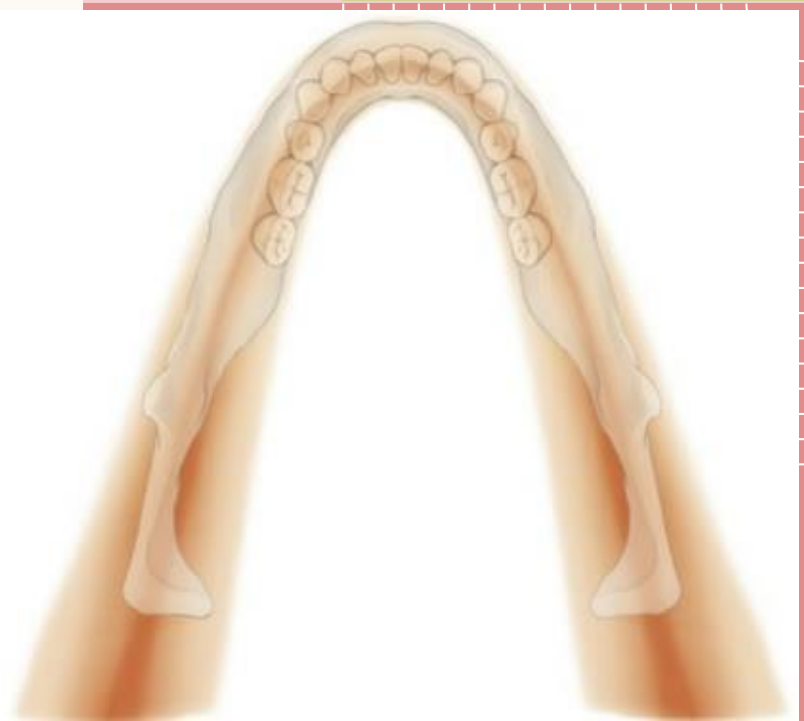
6. Require accurate patient **positioning** to avoid positioning errors and artefacts

FOCAL TROUGH OR IMAGE LAYER

The image layer is a three-dimensional curved zone, where the structures lying within this layer are reasonably well defined on the final panoramic image.

— The structures seen on a panoramic image are primarily those located within the image layer.

Objects outside the image layer are blurred, magnified, or reduced in size and are sometimes distorted to the extent of not being recognizable.



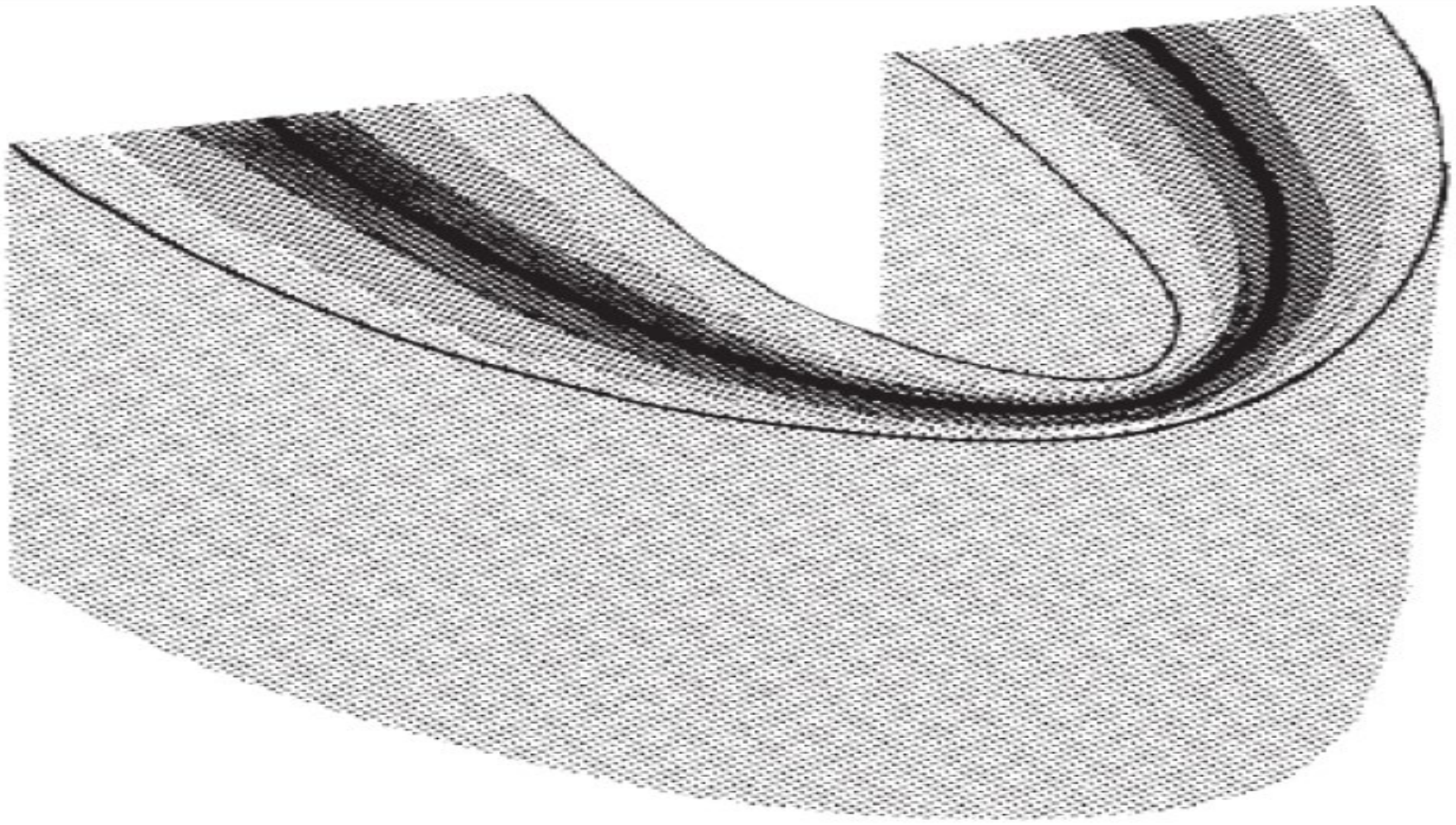


FIG. **11-6** Focal trough. The closer to the center of the trough *(dark zone)* an anatomic structure is positioned, the more clearly it is imaged on the resulting radiograph.

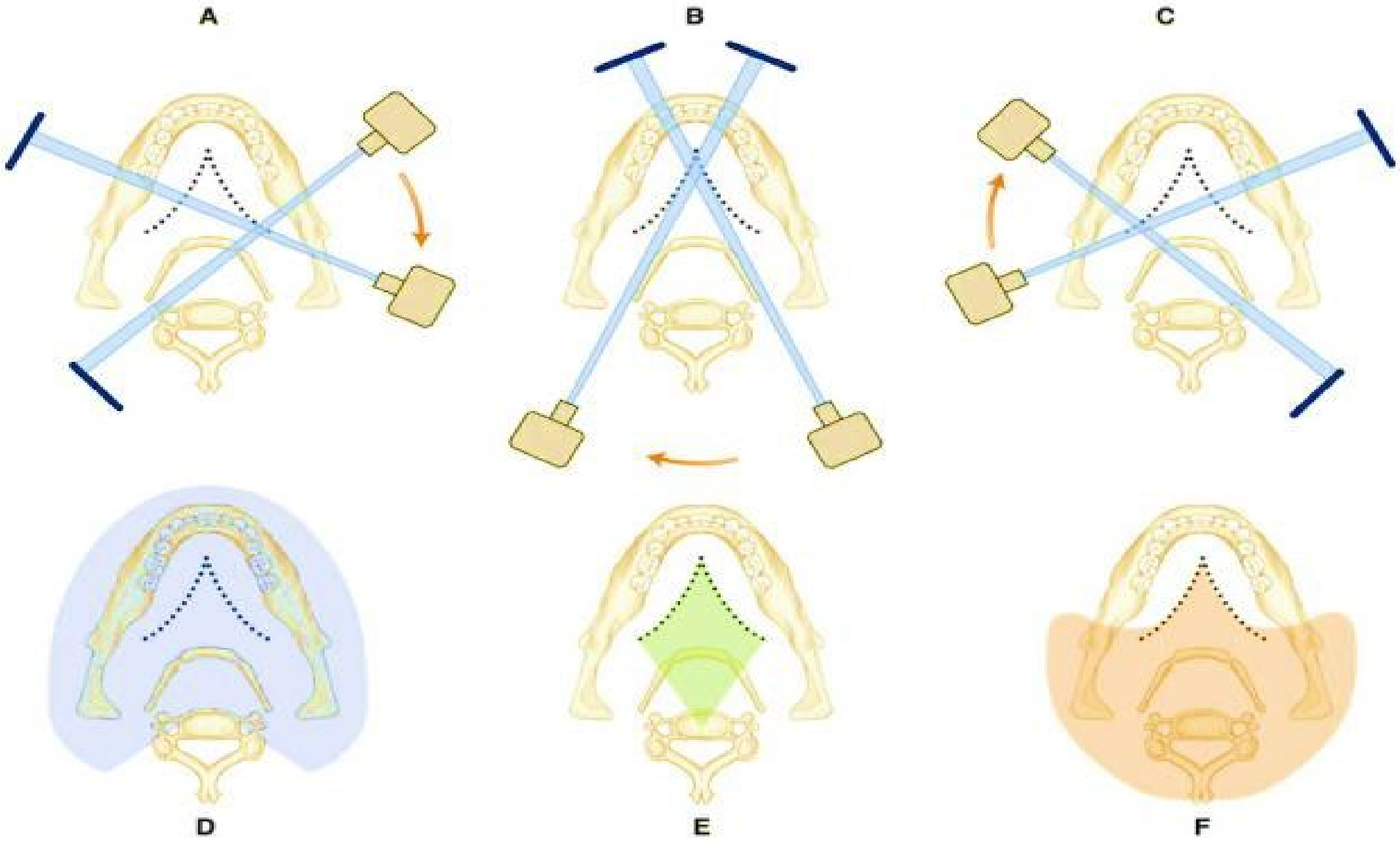
REAL, DOUBLE AND GHOST IMAGES

Because of the rotational nature of the x-ray source and receptor, the x-ray beam intercepts some anatomic structures twice. Depending on their location, objects may cast three different types of images:

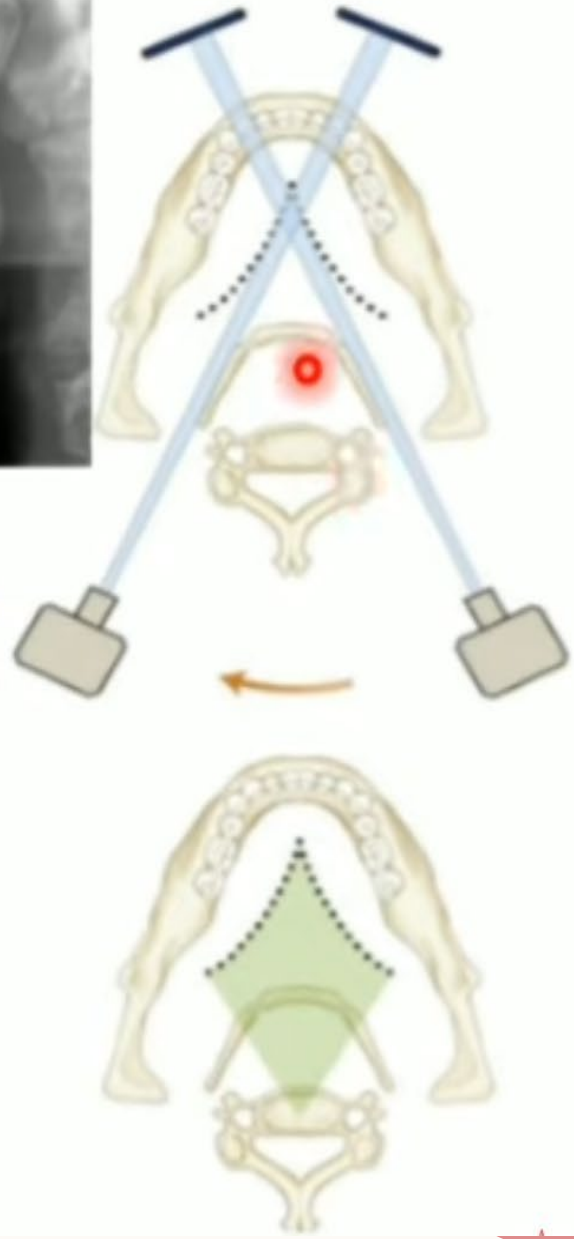
1. Real images: objects that **lie between the centre of rotation and the receptor** form a real image(all the objects within the focal trough cast relatively sharp images). (figure D)

2. Double images: objects that lie posterior to the centre of rotation and that are intercepted twice by the x-ray beam form double images (figure E).

3. Ghost images: objects that are located between the x-ray source and the centre of rotation, can cast ghost images. The ghost image appears on the opposite side of its true anatomic location and at a higher level. (figure F)

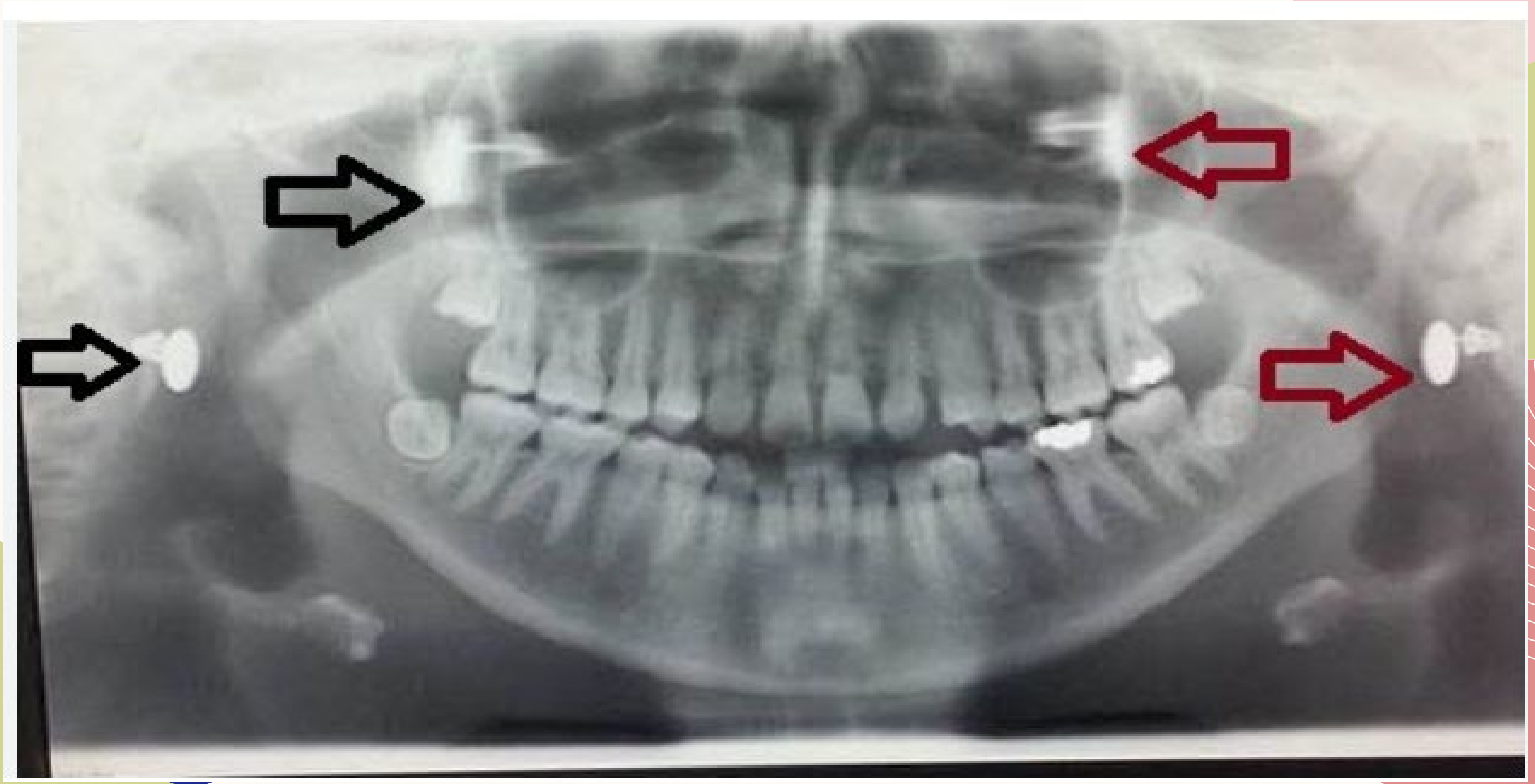

A
B
C
D
E
F

Double Images



- This region includes the hyoid bone, epiglottis, and cervical spine, all of which cast images on both the right and left side of the image.

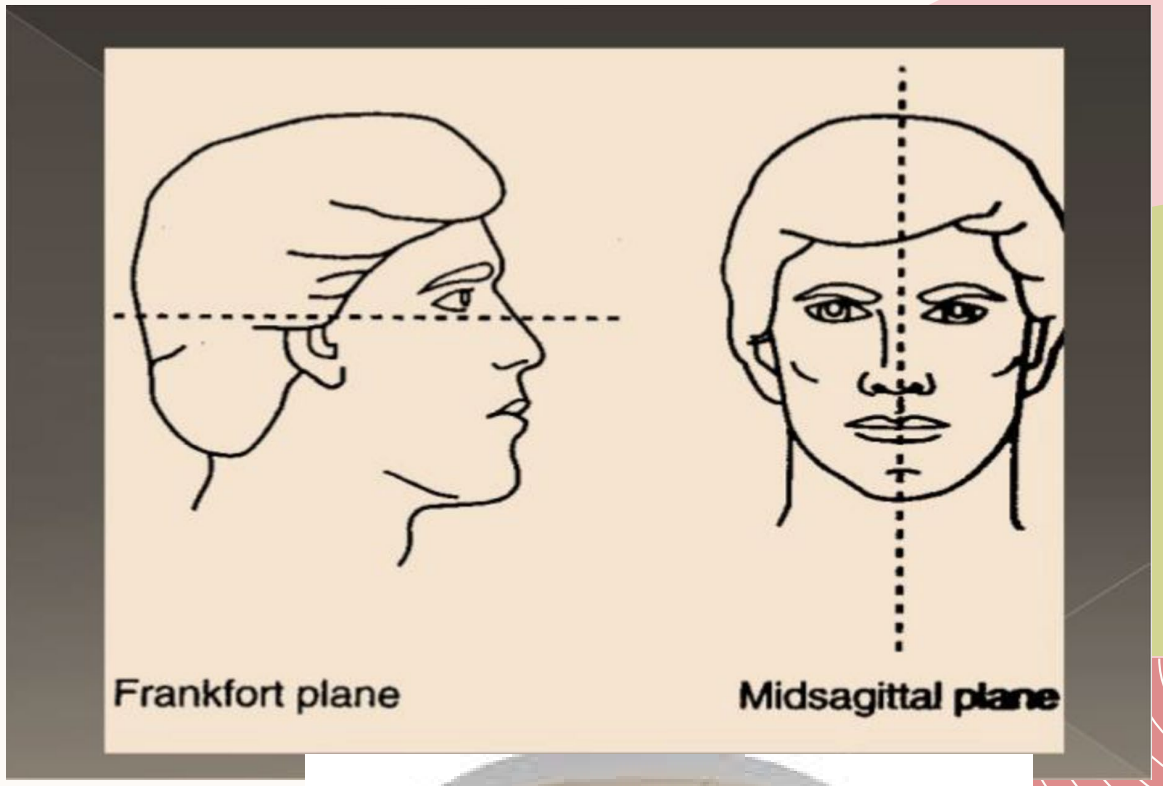
The ghost image appears on the **opposite side** of its true anatomic location and at **a higher level**.

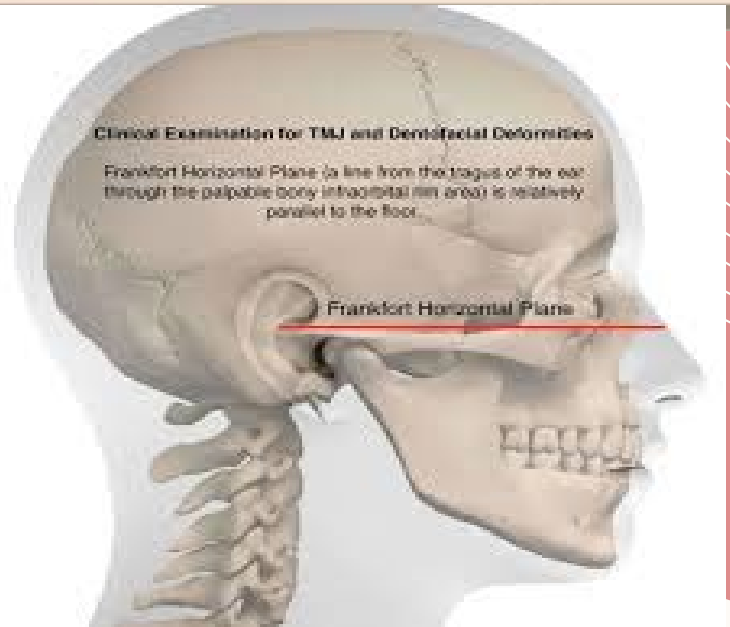


PATIENT POSITIONING AND HEAD ALIGNMENT

1. Dental appliances, earrings, necklaces, hairpins, and other metallic objects should be removed from the head and neck region.
2. Demonstrate the machine to the patient by cycling it while explaining the need to remain still during the procedure. This is particularly true for children, who may be anxious. Children should be instructed to look forward and not follow the tube head with their eyes
3. The anteroposterior position of the patient's head is achieved typically by placing the incisal edges of their maxillary and mandibular incisors into a notched positioning device (the bite block).
4. The midsagittal plane must be centred within the image layer of the particular x-ray unit. (Patients should not shift the mandible to either side)

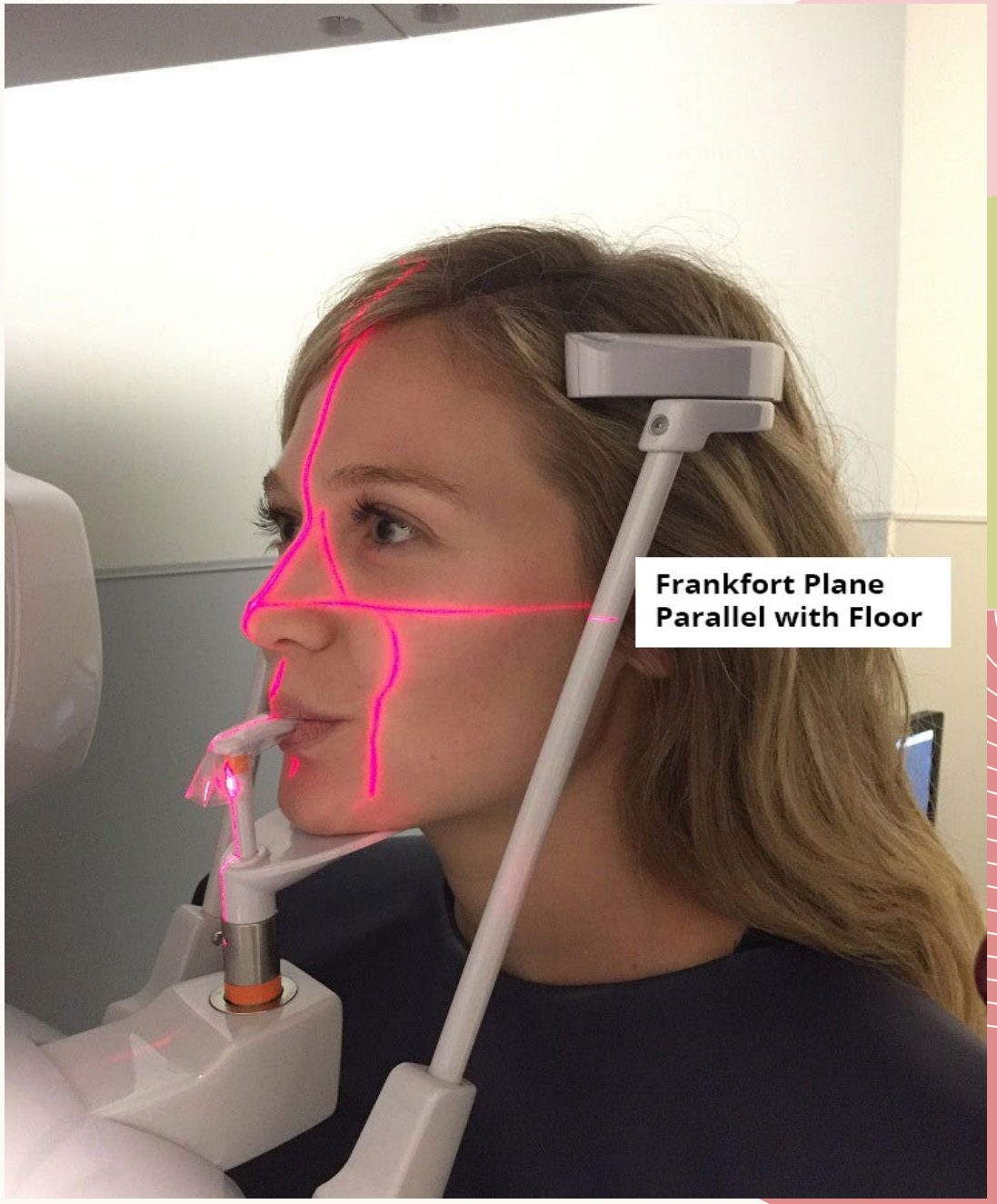
5. The patient's chin and occlusal plane must be properly positioned to avoid distortion. The occlusal plane is aligned so that it is lower anteriorly, angled 20 to 30 degrees below the horizontal. A general guide for chin positioning is to place the patient so that a line from the tragus of the ear to the outer canthus of the eye is parallel to the floor. (Frankfort plane)





6. Patients are positioned with their backs and spines as erect as possible and their necks extended.

7. Ask the patient to swallow and hold the tongue on the roof of the mouth. This raises the dorsum of the tongue to the hard palate, eliminating the air space and providing optimal visualization of the apices of the maxillary teeth.


Frankfort Plane
Parallel with Floor

MOST COMMON ERRORS IN PANORAMIC RADIOGRAPH

1. Placement of the patient either too far anterior or posterior results in significant dimensional aberrations in the images.

Too far posterior results in magnified mesiodistal dimensions and resulting in "fat" teeth (see Figure 11.7, F).

Too far anterior results in reduced mesiodistal dimensions and resulting in "thin" teeth (see Figure 11.7, D).

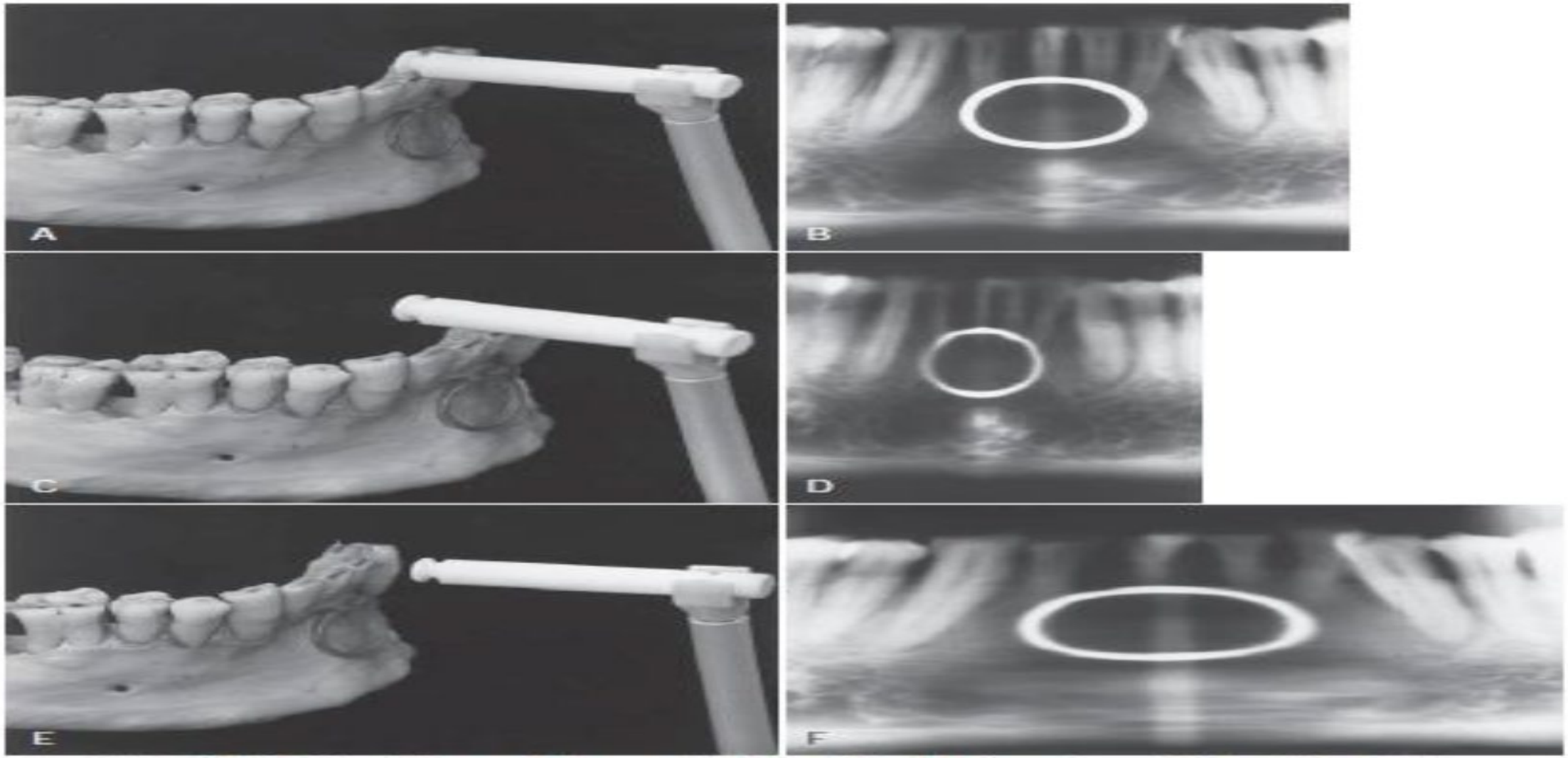


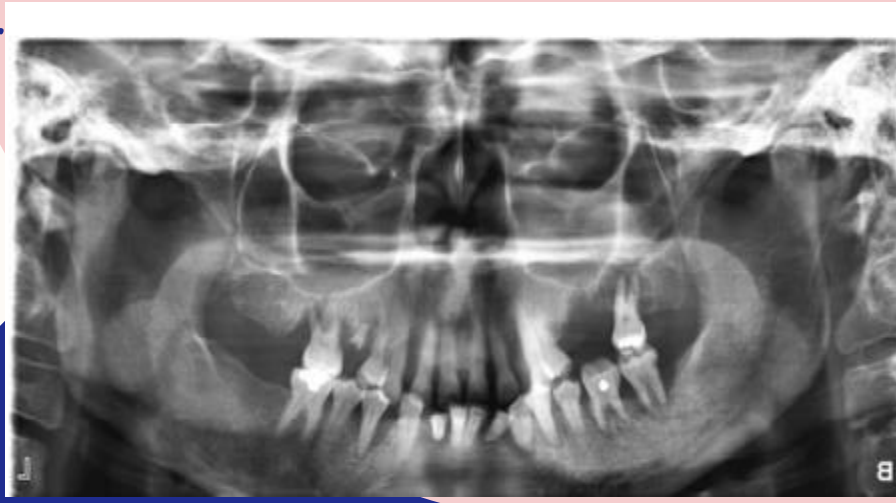
FIG. **11-7** **A,** Mandible supporting a metal ring positioned at the center of the focal trough. The incisal edges of the mandibular teeth are indexed by a bite rod–positioning device. The mandible is positioned at the center of the trough. **B,** Resultant panoramic radiograph. **C,** Mandible and ring positioned 5 mm anterior to the focal trough. The incisal edges of the teeth are anterior to the trough. **D,** Resultant panoramic radiograph demonstrating the horizontal minification of both ring and mandibular teeth. **E,** Mandible and ring positioned 5 mm posterior to the focal trough. The incisal edges of the teeth are also posterior to the trough. **F,** Resultant panoramic radiograph demonstrating the horizontal magnification of both ring and mandibular teeth.

2-Failure to position the midsagittal plane leads to rotational midline results in a radiograph showing right and left sides that are unequally magnified in the horizontal dimension. Poor midline positioning is a common error, causing **horizontal distortion** in the posterior regions, excessive tooth **overlap** in the premolar regions and, on occasion, nondiagnostic, clinically unacceptable images.

❖ A simple method for evaluating the degree of horizontal distortion of the image is to compare the apparent width of the **mandibular first molars bilaterally**. **The smaller side is too close to the receptor and the larger side is too close to the x-ray source**

3- If the chin is tipped too **high**, the occlusal plane on the radiograph appears flat or inverted, and the image of the mandible is distorted (Fig. A). In addition, a radiopaque shadow of the **hard palate** is superimposed on the roots of the maxillary teeth.

While If the chin is tipped too **low**, the teeth become severely overlapped, the **symphyseal region** of the mandible may be cut off the film, and both mandibular **condyles** may be projected off the superior edge of the film (Fig. B).



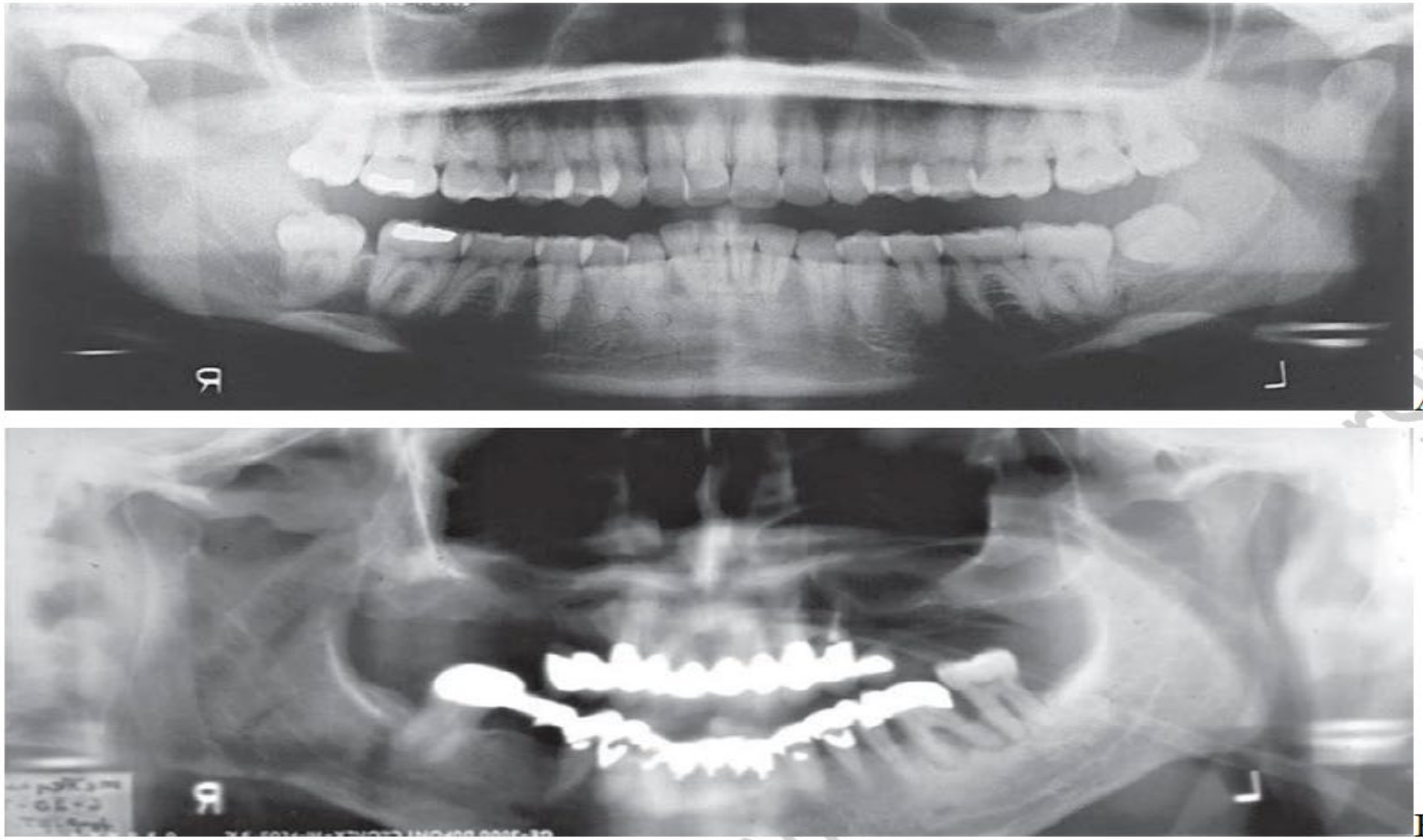
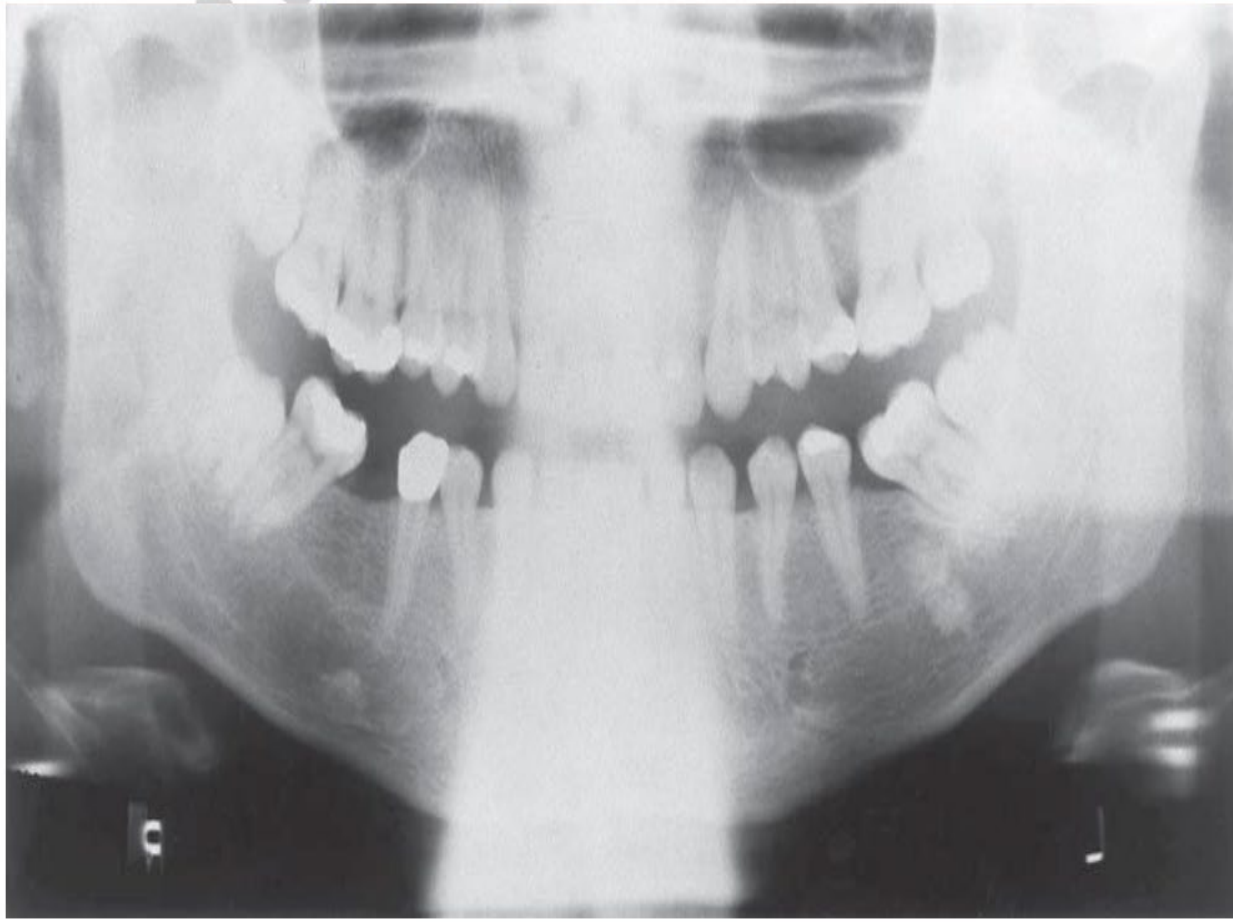


FIG. **11-12** Panoramic radiographs demonstrating poor patient head alignment. **A,** The chin and occlusal plane are rotated upward, **B,** The chin and occlusal plane are rotated downward.

4. improperly positioned patient. Patients don't sit straight and align or don't stretch their back leading to a large radiopaque region in the middle (spine-shadow ghost).



INTERPRETATION OF PANORAMIC IMAGES

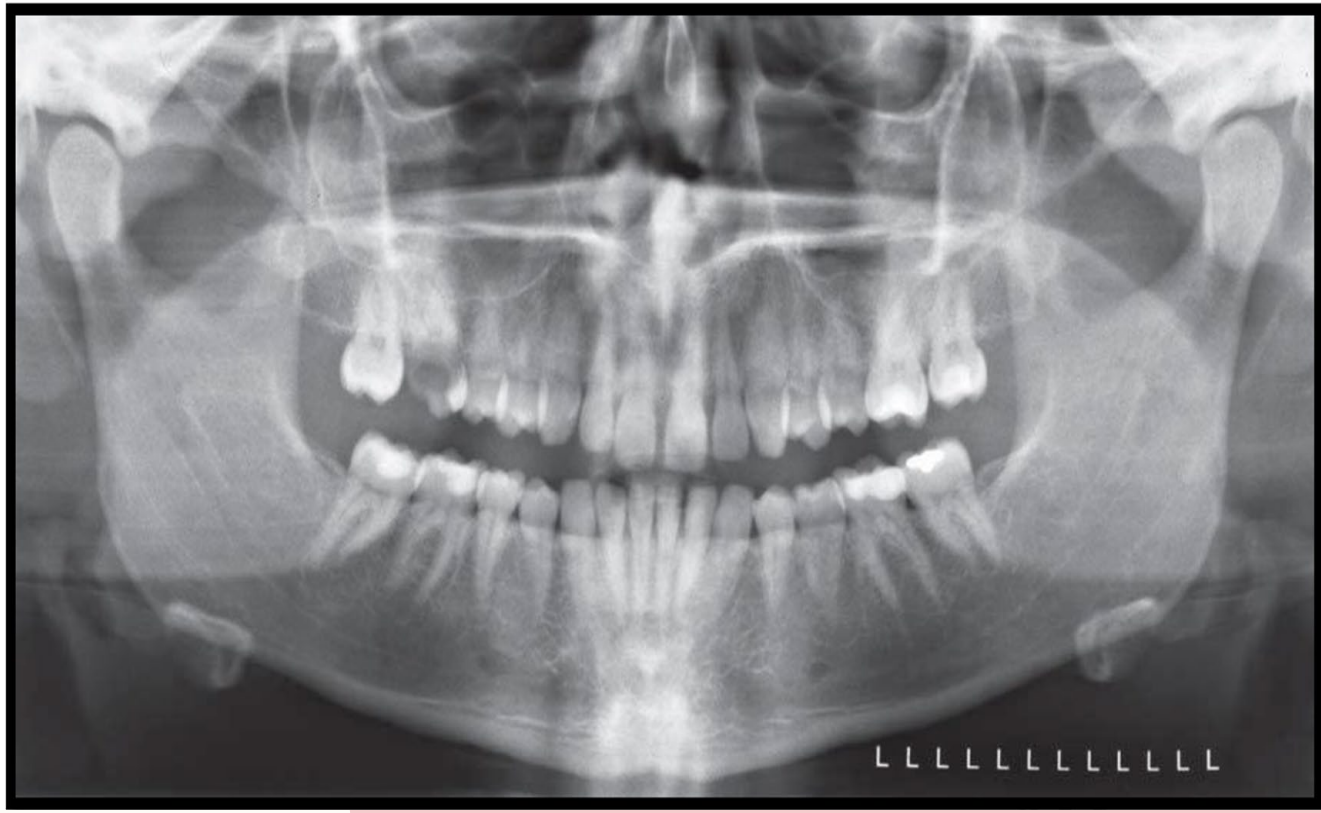
Interpretation of normal anatomical structures, ghost image and pathological conditions on a panoramic image can be complex.

An operator should always analyze a panoramic image for any possible technique or processing errors.

It is essential to know that in a good panoramic radiograph, the mandible is "U" shaped; the condyles are positioned about an inch inside the edge of the film and 1\3 of the way down from the top edge of the film. The occlusal plane exhibits a slight upward curve, or “smile line”. The roots of the maxillary & mandibular anterior teeth are readily visible.

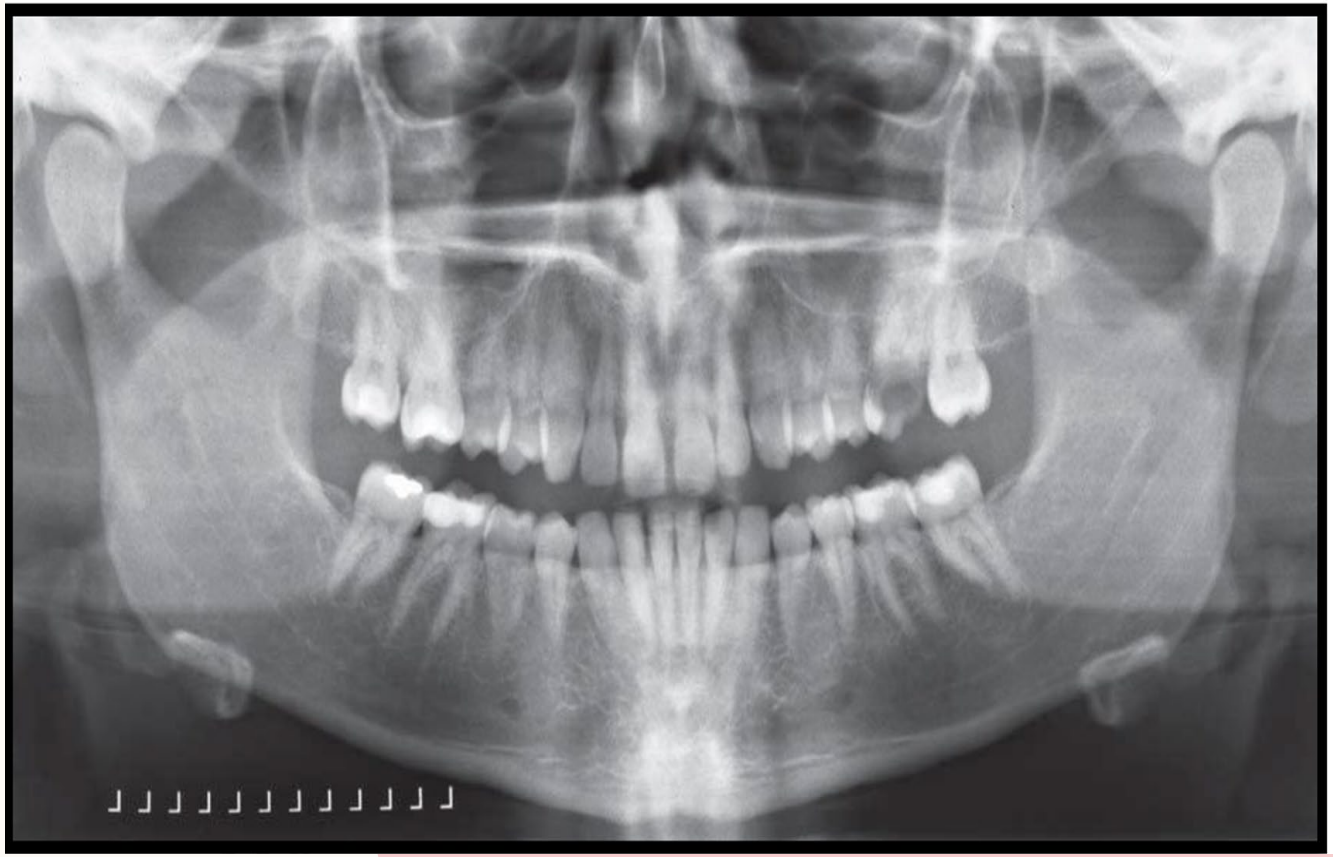
Dentition:

A panoramic image demonstrates the complete dentition; the interpretation must always include identification of all erupted, impacted, and developing teeth, permanent, deciduous, or mixed dentation, and abnormalities of number, position, and anatomy. Existing dentistry, including endodontic obturations, crowns, and other fixed restorations, should be noted, the numbers and configurations of the roots, and the relationships of the tooth components to critical anatomic structures.



Midfacial Region:

The midface is a complex mixture of bones, air cavities, and soft tissues, all of which appear on panoramic images. Individual bones that may appear on the panoramic image of the midface include temporal, zygoma, mandible, frontal, maxilla, sphenoid, ethmoid, vomer, nasal, nasal conchae, and palate.



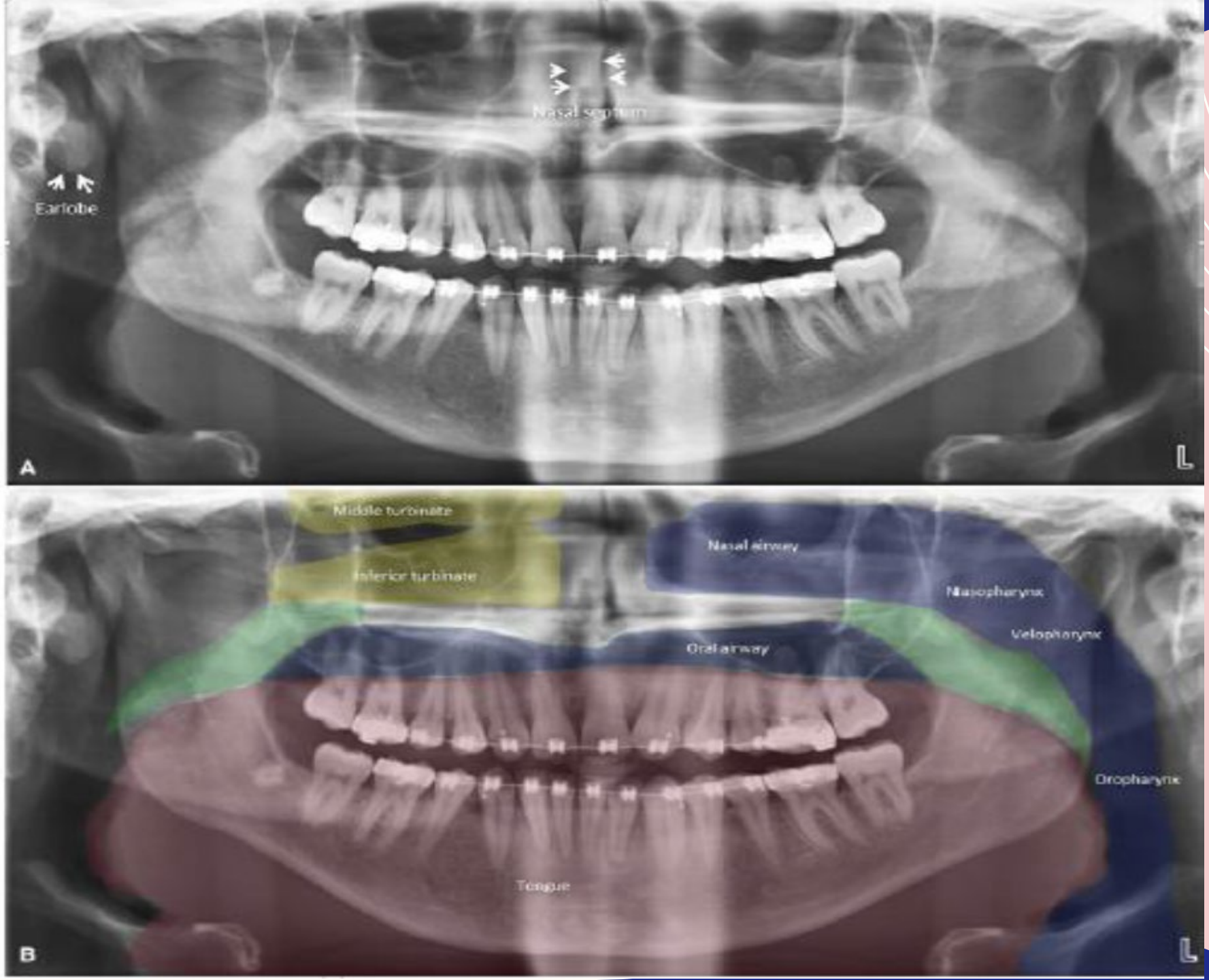
The maxillary sinuses are usually well visualized on panoramic images. The clinician should identify each of the borders (posterior, anterior, floor, roof) and note whether they are entirely outlined with cortical bone, approximately symmetric, and comparable in radiographic density.

Mandible:

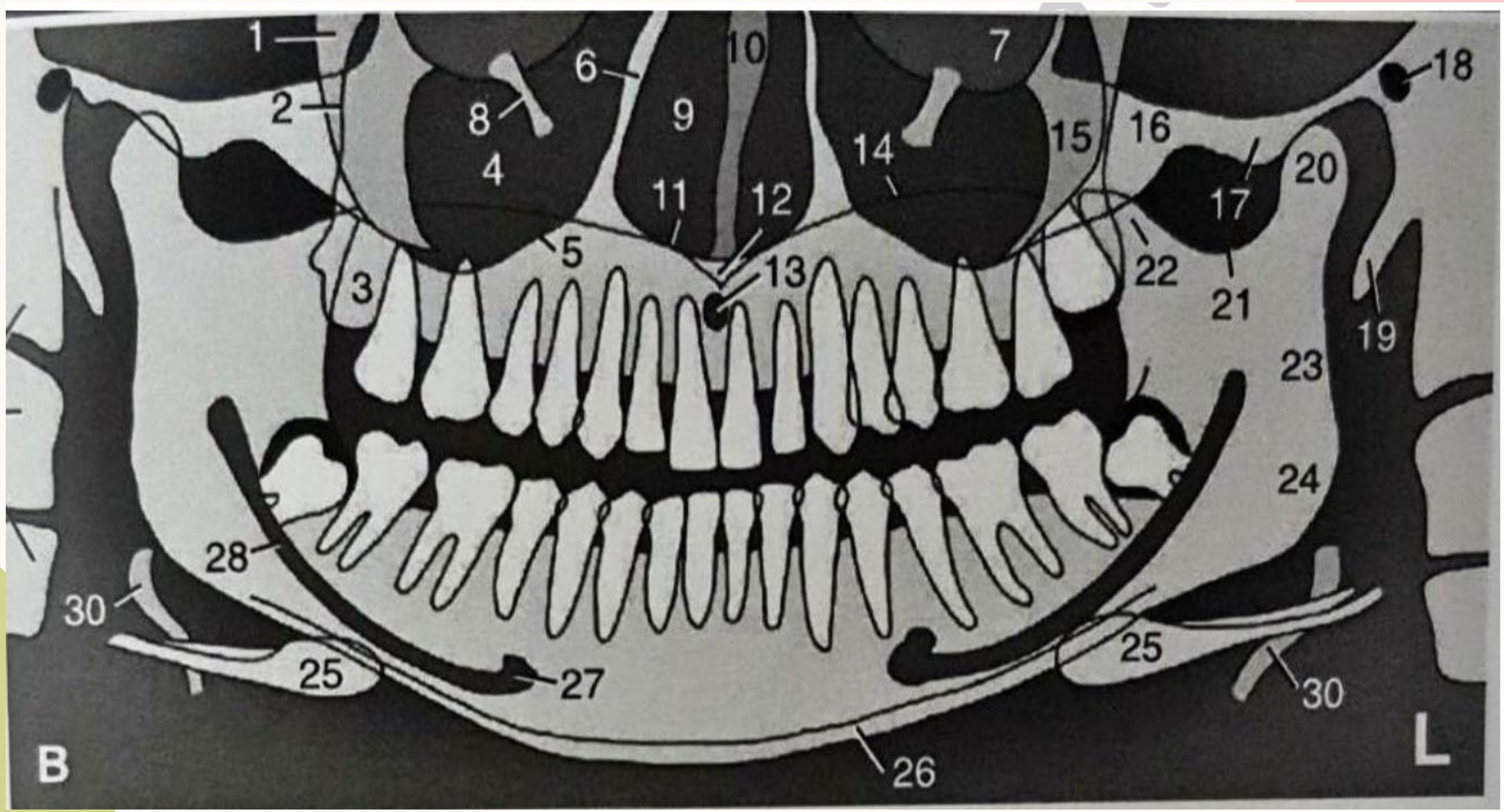
Assessment of the mandible on panoramic radiograph can be classified into the major anatomic areas (condylar and coronoid process and tmj, ramus, body and angle, anterior sextant, mandibular dentition and supporting alveolus).

Soft Tissues:

Soft tissue structures may be identified on panoramic radiographs, including the tongue arching across the image under the hard palate (approximately extending from the right to the left mandibular angle), lip markings (in the middle of the image), the soft palate extending posteriorly from the hard palate over each ramus, the posterior wall of the oral and nasal pharynx, the nasal septum, the earlobes, the nose, and the nasolabial folds.


Nasal septum
Earlobe
A
L
Middle turbinate
Inferior turbinate
Nasal airway
Nasopharynx
Velopharynx
Oral airway
Oropharynx
Tongue
B
L

ANATOMICAL LANDMARKS IN THE PANORAMIC RADIOGRAPH



1. Pterygomaxillary fissure
2. Posterior border of maxilla
3. Maxillary tuberosity
4. Maxillary sinus
5. Floor of the maxillary sinus
6. Medial border of maxillary sinus/ lateral border of the nasal cavity
7. Floor of the orbit
8. Infraorbital canal
9. Nasal cavity
10. Nasal septum
11. Floor of the nasal cavity
12. Anterior nasal spine
13. Incisive foramen
14. Hard palate/floor of the nasal cavity
15. Zygomatic process of the maxilla
16. Zygomatic arch
17. Articular eminence
18. External auditory meatus
19. Styloid process
20. Mandibular condyle
21. Sigmoid notch
22. Coronoid process
23. Posterior border of ramus
24. Angle of mandible
25. Hyoid bone
26. Inferior border of mandible
27. Mental foramen
28. Mandibular canal
29. Cervical vertebrae
30. Epiglottis

When you see that sunset or that panoramic view of God's finest expressed in nature, and the beauty just takes your breath away, remember it is just a glimpse of the real thing that awaits you in heaven.

Greg Laurie