

X – RAY DEPARTMENT

Lecture 4

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INTRAORAL RADIOGRAPHIC TECHNIQUES

THE PARALLELING TECHNIQUE

BASIC PRINCIPLES

The paralleling technique requires (1) that the film be placed parallel to the long axes of the teeth being radiographed and (2) that the x-ray beam be directed at right angles to both the film and long axes of the teeth. When placing a film in a patient's mouth, the radiographer must keep in mind that the long axes of the teeth do not parallel the midsagittal plane. Most maxillary teeth flare out slightly, tipping the root apices toward the center of the palate. The mandibular anterior teeth often have a similar inclination, with the root apices tipped toward the floor of the mouth. Mandibular premolars are more upright, and the mandibular molar crowns may be lingually inclined, placing the roots in a slightly buccal position. The relative positions of the teeth in the jaws must be kept in mind during film placement.

In order to achieve parallelism between the long axes of the teeth and the film, the film must be placed *away* from the teeth, toward the midline of the oral cavity. If the film is placed too close to the teeth, parallelism is very difficult to achieve. Additionally, films that are placed too close to the teeth may not record enough tissue in the area of the root apices. The alveolar process just lingual to the teeth prevent a film from reaching the depth of the palate or floor of the mouth. To ensure adequate coverage and parallel placement, films must be positioned away from the teeth, with the patient biting near the anterior edge of the biteblock.

An increased film-to-object distance results in some magnification and geometric unsharpness in an image; the proper placement of the film in the paralleling technique creates such a distance between the film and the objects being imaged. To compensate, a long (16-inch) x-ray source-to-film distance (SFD) is used to help minimize the magnification and unsharpness generated by the distance between the film and the teeth. The paralleling technique is sometimes referred to as the "long-cone" technique because of the length of the position-indicating device (PID) that is required.

In order for the film to remain parallel to the long axes of the teeth, a film holder must be used; the patient cannot hold the film and keep it in its proper position. There are many types of film holders available commercially. Several have some sort of an indicator in addition to the film holder to help with beam alignment. Proper infection control dictates that film holders should be autoclavable or disposable.

X-RAY BEAM ALIGNMENT

The x-ray beam must be aligned so that it is perpendicular to the film and long axes of the teeth in both the *vertical* and *horizontal* planes. The vertical angulation of the beam can be adjusted by pointing the PID up or down. Vertical angles are usually indicated on a scale along the sides of the tubehead. Positive angles are formed when the PID points down, and negative angles are formed when it points up.

The horizontal angulation of the x-ray beam is adjusted by directing the PID to the left or right in the horizontal plane. This angulation is not marked on the tubehead. The film should be placed so that the x-ray beam passes through the interproximal contacts of the teeth and is

perpendicular to the film and long axes of the teeth. If the beam is misdirected in the horizontal plane, the proximal aspect of one tooth will be projected over the proximal aspect of another, creating an overlapped contact. Correct horizontal angulation allows clear visualization of the interproximal areas; these contacts are said to be open.

The beam should be centered on the film packet so that the entire film is exposed to the radiation. A misaligned beam that covers only a portion of the film results in a partial image on the film. The portion of the film that is unexposed will have no image, and the unexposed area is often called a "cone cut".

As was previously mentioned, many commercial film-holding devices have beam-alignment indicators attached to them, making the task of beam alignment easier. However, these devices are not foolproof. Care must still be taken to ensure that the beam is perpendicular to the film and teeth. Some film holders collimate a circular beam to a rectangle only slightly larger than the film. Particular care must be taken so that the beam is aligned perpendicular to the film in both the vertical and horizontal planes, so that a partial image is avoided. Some x-ray units have rectangular PIDs to reduce patient exposure, and the use of a film holder with an alignment indicator makes proper imaging easier. Because the beam of radiation is only slightly larger than the film in a unit with a rectangular PID, the PID must be carefully aligned with the film to avoid partial images.

Seating the Patient. The patient should be comfortably seated, in an upright position if possible. The supine position may be used for a few films during an endodontic or surgical procedure. The patient's head and back should be supported. The patient's medical history should be briefly reviewed if it has not been previously addressed by the radiographer. The patient should be asked to take out all removable items from the mouth (including chewing gum), and eyeglasses should be removed. The patient must *always* be draped with a lead apron and thyroid collar, even if only one exposure is to be made. The oral cavity should be inspected for the presence of any anatomic variations or other abnormalities that might radiographs are positioned in the mouth.

Preparing the Unit. Exposure factors should be checked and set prior to placing the film in the patient's mouth. It is also advisable to place the tubehead near the area of interest, so that fewer alignment movements are made with the film in the patient's mouth.

General Procedures for Film Placement. Start by taking any *anterior* periapical films *first*. If #1 size films are used, they are smaller and easier for most patients to accommodate. This will enable the patient to grow accustomed to the procedure before the posterior films are placed. The relative ease of the procedure in the anterior will allow you and your patient to tackle the posterior placements with greater confidence.

Films for anterior teeth (cuspids and incisors) are always placed with the long portion of the film in a vertical direction; posterior films (for premolars and molars) are always placed in a horizontal orientation.

The all-white side of the film packet should face the lingual aspect of the teeth. Place the film packet firmly into the film holder so it will not be dislodged during placement.

In the maxilla, remember to keep the film packet away from the teeth, toward the midline of the oral cavity, into the highest portion of the palatal vault. Initially, place the film holder so that a V is formed over the teeth. Then bring the horizontal portion of the film holder into

contact with the teeth you are imaging. Then ask the patient to "*slowly* close." Try to say "slowly" first; avoid the word "bite." The command "bite down" may bring an unwanted response down on your fingers! If the film holder seems unstable because of the patient's occlusion, a cotton roll may be inserted under the holder, against the *lower* teeth if *upper* teeth are being imaged. Try not to allow the film to bend against the palate. Keeping the film in the highest portion of the vault and having the patient close gently will help to prevent film bending. Remember that a film that is placed parallel with the long axes of the teeth will *not* be parallel with the patient's midsagittal plane in the maxilla.

Mandibular films must be placed between the teeth and the patient's tongue. In order to capture the images of the apices of the teeth, the musculature in the floor of the mouth must be displaced by the film holder. This may be uncomfortable if the muscles are tense. In addition, the mucosa overlying the lingual aspect of the alveolar bone is thin, fragile, and easily abraded. Keeping your patient as comfortable as possible will make film placement easier.

Remember to keep the film *away* from the teeth and alveolar ridges. Place the film under the tongue at an angle, with the "elbow" of the film holder above the teeth. *Gently* depress the floor of the mouth while uprighting the film to a parallel position and ask the patient to "slowly close." As the patient starts to close his or her jaw, the floor of the mouth will drop slightly and the film holder should then contact the teeth to be imaged. As in the maxilla, a cotton roll may be used for stability, this time against the *upper* teeth.

SUPPLEMENTAL PERIAPICAL TECHNIQUES

BISECTING ANGLE TECHNIQUE.

The bisecting angle technique is based on the geometry of triangles. Two triangles will be equal if they share a common side and have two equal angles. This will make all corresponding sides equal. Therefore, a tooth and its image on the film will be equal in length if they share a common imaginary line between them.

To achieve the equal triangles, the film packet is placed close to the crowns of the teeth and extends at an angle into the palate or floor of the mouth. An angle is formed by the long axis of the teeth and the film. An imaginary line that bisects the angle creates two equal angles with a common side. If the x-ray beam is directed at 90° to the bisecting line, two equal triangles are formed.

The film packet should extend beyond the incisal or occlusal aspect of the teeth by about 1/8 to 1/4 inch. Film holders for bisection of the angle, including some with beam-alignment indicators, are available commercially. In a pinch, the film may be held in place by the patient's finger, but care must be taken to instruct the patient to use gentle pressure near the crowns to avoid bending the film.

Similar projections are used in the bisecting angle technique as in the paralleling technique. However, #2 size film is traditionally used in both the anterior (in a vertical orientation) and posterior (in a horizontal orientation) regions. All four maxillary incisors can be imaged on a #2 size film, so only three, as opposed to five, projections are needed in the maxillary anterior region.

Beam alignment can be a challenge with bisection of the angle if film holders with alignment indicators are not used. The beam should pass between the contacts of the teeth being imaged in the horizontal dimension, just as it does in the paralleling technique. The

vertical angle, however, must be directed at 90° to the imaginary bisecting line. Too much vertical inclination will produce images that are too short (foreshortened), and too little vertical inclination will result in images that are too long (elongated). The beam must be centered over the film to avoid cone cutting. A round PID is most often used when bisecting the angle; a rectangular PID greatly increases the chances of generating a partial image. Usually a shorter (8-inch) PID (therefore shorter exposure times) is used when employing the bisecting angle technique.

Radiographers may have difficulty imagining the bisecting line and then directing the beam perpendicular to that bisector. Although the best results will be produced if each film placement in every patient is analyzed individually, the following guidelines may be helpful in allowing the radiographer to determine if he or she is approximating the correct beam alignment.

The patient's midsagittal plane should be perpendicular to the floor, and the occlusal plane of the arch that is being imaged should be parallel to the floor. This means that the patient's head is upright for maxillary films and tipped back slightly for the mandibular arch. If these positioning requirements are met, the following vertical angulations will produce reasonable films for most patients:

Maxillary incisors	+40° to +50°
Maxillary cuspids	+45° to +55°
Maxillary premolars	+30° to +40°
Maxillary molars	+20° to +30°
Mandibular incisors	-15° to -25°
Mandibular cuspids	-20° to -30°
Mandibular premolars	-10° to -15°
Mandibular molars	-5° to 0°

Remember that a positive angulation occurs when the PID is tipped downward, and a negative angle occurs when the PID is tipped upward.

The advantage of the bisection of the angle technique is that it can be used when a patient's anatomy precludes the paralleling technique. For example, it is very difficult to place films in a position parallel to the teeth when the patient's palatal vault is very shallow. The same holds true in the mandibular incisor area in a patient with a very short lingual frenum. It may also be difficult to correctly position films in a parallel position when there is a palatal or mandibular torus present. The major disadvantage of the technique lies in the fact that the image produced is not as accurate as that obtained with the paralleling technique. In addition, if a short, round PID is used, the patient is exposed to more ionizing radiation than when a long, rectangular PID is used. *It is preferable to use the paralleling technique whenever possible*, but diagnostic films can be obtained with the bisecting technique when necessary.

TECHNIQUES FOR CHILDREN

Most children are eager to cooperate and respond very well to praise for a job well done. You may, however, need to be extra patient and imaginative in some instances.

Demonstrating the equipment and explaining the procedure in detail before attempting the real thing will increase your level of success. Keep in mind that children have a very

short attention span and have a hard time remaining still for any length of time, so work quickly yet accurately.

Young, growing tissues are particularly vulnerable to the effects of ionizing radiation. A *lead apron and thyroid shield must be used each and every time a film is taken on a child.* Because of a child's smaller size, the exposure factors should be reduced; the ideal choice for exposure reduction is a decrease in the exposure time, because a shorter time will decrease the chance of movement artifact (blurring).

The type of radiographic survey needed for children is variable. Selection of the types, sizes, and quantity of films depends on the child's dental health, age, and ability to cooperate with the procedures.

TECHNIQUES FOR EDENTULOUS PATIENTS

A completely edentulous patient may need radiographs for the detection of any pathologic lesion or the determination of the proximity of the maxillary sinuses or mandibular canals to the alveolar ridges. A panoramic radiograph is an easy means of imaging edentulous arches, but periapical films can be obtained in edentulous areas as well. Either the bisecting angle or paralleling technique may be used. If paralleling instruments are used, cotton rolls may be used on the biteblock for support and comfort. The "cotton roll" technique is also useful in partially edentulous patients. Edentulous areas may require less exposure because of the absence of the teeth.

GAGGING

Obtaining diagnostic films on a gagging patient is a real challenge, and it is a relatively common problem encountered in intraoral radiography. The gag reflex is a physiologic one, but it can be influenced by a number of psychologic factors. Some of the following management strategies may increase your chances of success.

Maintain an air of confidence in yourself. You may not always *feel* confident and in control, but it is important that the patient *believes* you have performed the procedure hundreds of times. Relax, and try to relax the patient with casual conversation. Explaining the procedure to the patient will eliminate surprises and reinforce the idea that you are familiar with the procedure to both the patient and yourself! Do not bring up the subject of gagging.

The power of suggestion is strong. The patient may say, "I'm a gagger," in which case you are forewarned and should bring out your best bag of tricks to control the situation.

Start with the anterior periapical films; these are easily tolerated by most people, gaggers included. The fact that you can obtain these films will give you and the patient more confidence to try the posterior areas. Prepare the unit exposure factors and approximate placement of the tubehead *before* placing the film in the patient's mouth.

Be as gentle as possible, but place films accurately and quickly. There will be times when you will not be satisfied with the film placement, and it is perfectly acceptable to begin again. Placing the film *exactly* where you want it the first time eliminates small adjusting movements that may tickle the palate or tongue and elicit a gag reflex. Rubbing your finger in the area where the film will rest provides two functions: it lets the patient know where to expect the film, and it desensitizes the area somewhat.

If the patient gags, remove the film and reassure the patient. Some people are very embarrassed by the fact that they gag, and you need to assure them that it is not unusual. Having the patient place some salt on his or her tongue or briefly dipping the film in some mouthwash may alleviate some gagging. Having the patient raise one foot may also work; the concentration of the patient on another activity decreases the attention paid to gagging. It may be helpful to have the patient breathe through his or her mouth while you place your finger for a few seconds in the area where the film will rest.

Because the patient must hold his or her breath in order to gag, sustained breathing with an object in the mouth usually will not elicit a gag reflex. Such a demonstration will convince patients that they are able to tolerate film placement. If you use breathing distractions, be sure the patient does not hyperventilate.

Topical anesthetic sprays may be used in severe cases. Caution must be used to ensure that the patient does not inhale the spray or that it is not placed too far down the throat to impair swallowing. There are some people whose gag reflex is so strong that diagnostic-quality intraoral films are impossible to obtain. Extraoral films are indicated for these individuals.

BITEWING RADIOGRAPHS.

Bitewing radiographs are probably the most common types of films ordered by the dentist for patients because of the nature of the information available on them. One can see the crowns of both the maxillary and mandibular teeth, the interproximal areas, and the crest of the alveolar bone, all on one film. Although producing a bitewing of diagnostic quality seems to be a relatively easy task, the technique is quite error-sensitive and can be challenging in some patients.

In general, two #2 size bitewings are taken per side of the patient: a *premolar* film and a *molar* film. Some practitioners may prefer one #3 size film per side, although the molars and premolars sometimes require different horizontal angulations in order to open the proximal contact areas.

Children often need only one #2 size bitewing per side, and small children with primary dentitions may require a #1 or #0 size film.

FILM PLACEMENT

The premolar bitewing radiograph should include the distal half of the crowns of the cuspids, both premolars, and often the first molars in both the maxilla and mandible.

The molar film should be centered over the second molars. The films are held in place either with cardboard tabs or paralleling instruments. Paralleling instruments decrease the amount of beam misalignment often seen on bitewings; however, the patient's teeth remain farther apart owing to the thickness of the biteblock, and therefore less alveolar bone is seen with this method. When tabs are used, the film should be placed so that the tab protrudes over the occlusal aspect of the mandibular teeth. The radiographer should hold the tab as the patient *slowly closes*.

Placing a downward fold in the tab before placing the film may help in keeping the film in place. Take care not to let the patient catch the finger tip of your glove as he or she closes. Additionally, do not pull the film too tightly against the lower teeth as the patient closes his or her mouth. The upper edge of the film may catch on the lingual aspect of the maxillary alveolar ridge or even the maxillary teeth, and the film will be forced down into the floor of

the mouth. The upper half of the film should slide into the palatal vault so that both arches are equally covered by the film. When using a paralleling instrument, the film should be placed away from the ridges so that the film and the holder will settle equally into the floor of the mouth and palatal vault. Placing the holder toward the midline of the oral cavity will also allow placement of the film forward enough to include the distal half of the cuspids in the premolar view. If the film and holder are too close to the teeth, the holder will bump into the alveolar ridge where the arch curves in the vicinity of the cuspid, making capture of the cuspid image difficult. The film should be placed so that it parallels the alignment of the teeth in the arch.

BEAM ALIGNMENT

Beam alignment is fairly simple for bitewings taken with paralleling instruments. The beam should be aligned with the indicator ring and be parallel with the indicator bar, so that the beam is perpendicular to the film and passes through the contacts of the teeth. Beam alignment is more challenging when tabs are used. The patient's midsagittal plane must be perpendicular to the floor, and the occlusal plane should be parallel to the floor. The vertical angulation should be set so that $+10^\circ$ is indicated on the tubehead. (Remember that a positive angulation means that the PID points downward.) This small vertical angle compensates for the fact that the upper half of the film tends to be lingually inclined against the palate. A vertical angulation of $+10^\circ$ places the beam so that it is *nearly* perpendicular to both the upper and lower halves of the film.

Correct horizontal angulation ensures that the contacts between the teeth being radiographed are open (not overlapped) on the film. The beam should be perpendicular to the film and pass directly between the contact points. The horizontal angles will be similar for the molar and premolar bitewings, although some adjustment may be necessary in moving from one to the other, because of the curvature of the dental arches.

The beam must be centered over the film to avoid cone-cutting.

OCCLUSAL RADIOGRAPHS

Occlusal films are often supplemental to periapical and bitewing films, they are useful when larger areas are to be visualized, for pediatric or edentulous patients, and to aid in the localization of a foreign object or impacted tooth. A #4 size film is used for adults; a #2 size film is often sufficient for children.

TOPOGRAPHIC MAXILLARY OCCLUSAL FILM

The topographic occlusal film is taken with a technique similar to bisecting the angle. For the maxillary radiograph, the patient's maxillary arch should be parallel to the floor and the midsagittal plane perpendicular to the floor. The film is placed in the mouth, white side against the maxillary teeth, and the patient should gently close on the film.

The beam should be directed so that the vertical angle is perpendicular to the imaginary line bisecting the angle formed by the maxillary incisors and the film. This angle will be approximately $+65^\circ$ to $+75^\circ$. The horizontal angle should be such that the beam passes between the central incisors. The PID should be centered over the film. A round PID will allow greater coverage of the film and anatomic structures than a rectangular PID. Exposure factors will be similar to those for a maxillary incisor periapical film.

TOPOGRAPHIC MANDIBULAR OCCLUSAL FILM

The mandibular dental arch should be parallel to the floor, and the midsagittal plane should be perpendicular to the floor.

The occlusal film is placed with the white side against the mandibular teeth, and the patient gently closes on the film packet.

The vertical angulation of the beam should correspond to the bisecting angle principle and will approximate -30° – 40° . The beam should be centered over the film and pass through the prominent chin point (mentum). Exposure factors are similar to those for a mandibular incisor periapical film.

MAXILLARY LATERAL OCCLUSAL VIEW

The lateral occlusal view allows a topographic view of the more posterior aspect of the maxillary arch. This view is generally not employed in the mandible. A lateral oblique jaw projection provides similar coverage in the mandible.

In the maxillary lateral occlusal view, the patient's occlusal plane is parallel to the floor and the midsagittal plane is perpendicular to the floor. The film is placed with the white side against the teeth and positions so that the longest dimension of the film extends toward the molars. The edge of the film should extend about 1/4 to 1/2 inch beyond the cusp tips of the molars.

The beam is directed at a vertical angle of about $+60^{\circ}$ to $+65^{\circ}$ and centered over the film so that the center of the beam passes between the proximal contacts, similar to a periapical film. The exposure factors are similar to those for a molar periapical film

CROSS-SECTIONAL MANDIBULAR OCCLUSAL VIEW

Cross-sectional or true occlusal views are of value for examining the buccal-lingual dimension of the mandible or to evaluate the presence of objects in the floor of the mouth. Cross-sectional views in the maxilla are difficult to obtain, because a beam that is perpendicular to the maxilla would have to pass through the top of the cranium.

In a cross-sectional view, the patient's midsagittal plane should be perpendicular to the floor. The position of the occlusal plane is less critical, because the beam is directed 90° to the *film*. In fact, it is often easier to have the patient tip the head backward somewhat.

The film is placed with the white side against the mandibular teeth. It may be positioned with the long axis in a buccal-lingual direction for imaging the more anterior portions, or it may be directed with the long axis toward the molar region, often over only the left or right side of the jaw.

The beam should be centered over the film with a vertical angle of 90° to the film. Exposure factors should be similar to a mandibular periapical film. Slightly less exposure is required for a soft-tissue examination of the floor of the mouth.